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POLICIES AFFECTING ENERGY CONSUMPTION IN THE FEDERAL REPUBLIC OF GERMANY

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INTRODUCTION: THE FULL SCOPE OF ENERGY CONSUMPTION POLICIES

Energy policy can be used to influence energy consumption in many ways: directly, by expanding or confining consumers' choices; or more indirectly, through incentives or disincentives for certain choices, creation or removal of barriers or misdirections to market allocation, administration or control of sales prices, regulation of price structures, and other policy instruments. Even the reduction or increase of energy supply by means of price guarantees, subsidies, etc affects the level and structure of consumption as it changes price levels and relative prices. Such measures and regulations, often taken for reasons other than energy policy, are regarded as energy conservation policy measures only when they are intended to reduce energy consumption.

This review covers the whole range of energy consumption policies in the Federal Republic of Germany, focusing on conservation policy. Supply-side policies are considered to some extent, not only because of their influence on energy consumption but also in order to compare the different policy approaches to energy demand and supply. The fairly broad scope of the review reflects the author's view that conservation policy is an important element of energy policy, but that it is embedded in the more general task of optimally allocating all resources.

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ENERGY POLICIES IN RETROSPECT

Separate Energy Policy Fields until 1973

The energy policies of the several conservative or conservative-liberal governments during the 1950s and 1960s were partial policies, barely coordinated with one another. There was an interventionist coal policy, imposed in reaction to a loss of sales and jobs by the domestic hard coal industry. There was a deliberate policy of little action toward oil flowing in. There was a consistent nuclear policy. For electricity and gas utilities, the pre-war control system was prolonged in an adapted form, and the structures of regional monopolies were preserved by a specific exemption in the law enacted in 1957 against restriction of competition. Almost nothing was done with respect to energy consumption. The Social Democratic party's (SPD) participation as a junior partner in government from 1966 [in a grand coalition with the conservative Christlich Demokratische Union/Christlich Soziale Union (CDU/CSU)] and its takeover of the leading part in the first social-liberal coalition in 1969 did not change the substance of energy policy or the weight of issues.

The year 1973 saw two important events in energy policy. The second, the oil crisis of that year, came from outside, although, as one of the big importers the Federal Republic of Germany was not completely free of responsibility for the crisis. The first event was largely endogenous: shortly before the first oil crisis became apparent, a comprehensive federal government paper on its energy policy was published, called the *Energy Program*. These events mark 1973 as the end of an era in federal energy policy. In that year came the first recognition that government policies can strengthen the rational use of energy. Extensive discussion of energy policies before and after 1973 are in (1), a well-informed critical view from abroad, and (2), a Marxist analysis.

PRIORITY FOR SUFFICIENT, LOW-COST, AND SECURE SUPPLIES The first decade of economic development after World War II was characterized by a lack of energy. Rational use (given the equipment available) and saving (even at the expense of feeling cold) were the prevalent experiences of those years. Indigenous coal production was encouraged, to supply fuel for reconstructing the economy. Consistent with West Germany's economic policy in the 1950s, which was to open the economy to foreign trade, the opportunity to import oil was welcomed and made use of extensively.

Coal. Initially, imported oil was regarded as complementary to indigenous coal. In 1958, however, when a recession slowed growth in energy demand, domestic hard coal consumption fell for the first time. In reaction, a defensive hard coal policy was introduced, and has more and more penetrated all fields

of West German energy policy. Domestic coal was protected from import competition in the beginning by duties and import quotas. The government promoted rationalization in a legalized cartel and later, during the transition period of the grand coalition, formed Ruhrkohle AG to optimize rationalization.

The mid-1960s saw the beginning of demand-side coal policy, which encouraged the use of indigenous hard coal in electricity generation and subsidized coking coal. Both measures have continued. The fuel choice for public electricity generation was more and more influenced, and later restricted, by "voluntary agreements" requiring utilities to consume given amounts of domestic coal.

Nuclear power In 1967, the first two fully commercial nuclear power light water reactors (LWRs) of about 600 MW each, were ordered by Nordwestdeutsch Kraftswerke AG (NWK) and PREUSSENELEKTRA; in 1969, the first 1300 MW LWR was built in Biblis for Rheinisch-Westfälische Elektrizitätswerke AG (RWE). These events mark the turning point for nuclear energy in West Germany, as the reluctance of the two leading electricity-producing groups turned into enthusiasm. For about 15 years, scientists, electricity-intensive industry, plant constructing industry, and political administrations had been struggling for "peaceful use" of nuclear energy, largely to secure low-cost energy in the long run. Eight nuclear research centers were founded and, temporarily, a specific department of atomic energy at the federal ministerial level (3).

The support of nuclear power increased energy supplies, in particular electricity supplies, without making consumers pay more. Thus, it increased energy consumption.

Oil Apart from taxation (see sections on *Transport sector* and *Residential sector* below), specific oil policy measures were not taken before the mid-1960s. Then, the government became worried about the diminishing role of West German oil companies, which had few low-cost resources. Increasingly, the nation's oil was being supplied by multinational oil companies, which were taking over West German oil companies and thus acquiring domestic oil reserves. To strengthen domestic companies, the federal government favored the formation of the exploration company DEMINEX by several West German oil companies and subsidized its operations abroad. These measures were intended to increase oil supply, which again illustrates the priority placed on cheap energy supply.

Around 1970, when the world oil market turned into a seller's market and signs of political influence on oil prices and a strengthening of the oil cartel became visible, the government became more concerned about security of oil supplies and began to develop contingency strategies for short- and medium-

term supply disruptions. In contrast to this contingency planning, measures to actively support a rational use of energy under normal circumstances and to prepare the economy for an ever-increasing scarcity of energy in the long run were not developed until the oil crisis arrived in 1973.

Electricity The electricity and gas supply structures, local and regional monopolies, which had been sanctioned and placed under investment and price controls in the 1935 Energy Industry Act (Energiewirtschaftsgesetz), were not challenged during the formation of the new post-war political and economic order. The Energiewirtschaftsgesetz was carried over to the Federal Republic. Authority for investment and price control was given to the state governments (Länder), i.e. utilities had to apply to their states for increases of tariffs and for permits to construct power plants and other supply investments. Price control was based on average costs. The 1974 Federal Electricity Tariff Regulation Order (BTOelt) codified the tariff structures with falling average prices, which had developed in practice, in most cases a choice of different two-part tariffs consisting either of a low standing charge and a higher commodity charge or vice versa. For tariff customers, the optimal tariff is determined by the utility. As generating costs fell almost monotonically owing to economies of scale and lower fuel prices, applications for price increases were infrequent until the 1970s.

The antitrust law enacted in 1957 (Gesetz gegen Wettbewerbsbeschränkungen, or GWB), did not apply to the license contracts between utilities and municipalities (Konzession) or the territorial contracts among utilities. The law thus sanctioned exclusion of direct competition in electricity and gas supply. A system to control misuse of the monopoly position imparted by this exemption was introduced, but it remained weak.

Gas Before the introduction of natural gas, a gas supply system was operated using manufactured gas from coal or oil. The gas industry during the 1960s took a great risk in bringing natural gas into the supply system without specific policy support. For some local municipally owned utilities, risks were too high; however, they were not too high for some multinational oil companies, which took advantage and seized a high participation in the equity of transmission companies.

Conservation: a nonissue Before 1973, energy demand in the Federal Republic of Germany was the object of a number of studies, analyses, and projections [the most prominent of which was the Energie-Enquête (4)], but the level of energy consumption was not an object of energy policy. Energy conservation was unknown as an issue in politics. The attitude toward energy consumption was one of laissez-faire; market imperfections that prevented

energy consumers from making rational use of energy and other resources were ignored. House construction standards regulated the buildup of humidity, but not heat loss.

Excise taxes were imposed on oil products. Starting in 1951, increasingly significant rates were applied to nonsubstitutable engine fuels, for fiscal purposes; beginning in 1960, low rates were applied to heating fuels in a half-hearted effort to support domestic coal. The impact on energy consumption was not an issue in introducing these taxes. The tax on gasoline and diesel fuel, however, did influence the efficiency of cars manufactured and used in West Germany.

The Discovery of Rational Energy Use as a Policy Issue

THE ENERGY PROGRAM OF 1973 The energy program of 1973 was not intended to be anything more than a synopsis of the then-current energy policy of the federal government. Thus, the program itself contained nothing new in substance. It did, however, change the policy approach, because it forced the administration to present a systematic view of its policy and the reasoning behind it. The publication of such a synopsis of the government's energy policies was a pragmatic way to comply with propositions that had been made by policy analysts for some time. The economist H. K. Schneider had discussed goals, priorities, and instruments of energy policy, suggested clarification of priorities, a consistent approach, and coordinated procedures in energy policy, and insisted that planning of energy policy procedures should not be confounded with planning of the economy and would, thus, not be foreign to a market economy (5).

Rational energy use becomes an issue In the energy program of 1973, energy conservation in the sense of rational energy use was taken up as a last minor point. It was regarded as a possible way to reduce rates of growth of consumption, to improve security of supply, and to reduce stress on the environment. The decision to dedicate a few sentences to rational energy use came from the evolving discussion of environmental problems, stimulated by Club of Rome ideas and reinforced by German ecologists. Nevertheless, since there was no conservation policy, there was little substance to explain. The administration obviously had to scrape together measures that had vague relationships with rational energy use (e.g. the promotion of mass transport systems and electric cars) in order to fill one program point (no. 78 of a total of 80). Thus, the consideration of energy conservation in the energy program was less than half-hearted. It gives the impression that an important part of the government was skeptical of rational energy use as a concern of energy policy. Nevertheless, the issue was established.

In contrast to the weak stand on conservation, it is interesting to see what happened to other fields of energy policy (for details, see Ref. 6).

Contingency planning The menace of an oil crisis in the short run had been foreseen by the federal government. By the time of the crisis, a law prepared in 1972, authorizing the government to take decisive actions in defined fields in case of supply shortages, had passed the parliament and could be applied. Its provisions, consisting of flexible demand and supply side responses to be enacted at short notice, were ready when the emergency became reality in 1973.

Nuclear power declared a "necessity" Security of energy supply in the long run had been gaining priority as the finiteness of resources became more widely recognized. At that time, the only answer to presumed limits to growth seemed to be nuclear power. Therefore, the importance of state subsidies for the further development of high-temperature and breeder reactor technologies (based on the existing small pilot plants) and intensified nuclear fusion research were stressed and budgets increased.

With respect to light water reactor power plants, a capacity of at least 40,000 to 50,000 MW was announced as "necessary" by 1985. The semantics of necessity became typical for the debate. Its use in the 1973 program marked a new kind of involvement by the government. It was an obvious sin against this policy's own ideals, based on a chronic misunderstanding of the character of projections. A projection of 40,000 to 50,000 MW was not implausible in a framework of a total projected capacity of 140,000 MW under the circumstances of continuous economic growth and low electricity prices until 1985. But in the energy program this conditional number was turned into a goal, albeit ambiguously formulated. It was the decision for the unconditional support of nuclear power.

The hopeful position on nuclear power was somewhat softened after the Three Mile Island accident at Harrisburg in 1979. When lower consumption growth became apparent, the high capacity goal was abandoned. The government's positive position was shaken by the Chernobyl accident in 1986, but was not changed in principle even then.

Design of the new coal policy Nuclear power was not the only field where energy policy departed from a market-oriented policy. In the case of coal also the government never made a clear distinction between the conditional character and the goal character of numbers. Thus the quantities projected for German hard coal were understood as goals. In the energy program of 1973, important elements of the coal policy still prevailing today were already designed. The concept of raising the money for a part of the coal subsidies

through a percentage charge on the electricity bill was introduced as a plan. In 1977, the concept was enforced, accompanied by the erection of obstacles to the construction of oil and gas power plants and by the first contract with the electricity producers requiring the use of a certain amount of German hard coal. Conclusion of this contract was called "voluntary," but in fact the utilities agreed in order to avoid legislation. This policy was even fostered in 1980 (see below).

The Evolution of a Conservation Policy

Skepticism about conservation policy was demolished within less than two months of the publication of the energy program, when in November and December 1973 the avalanche of oil price increases and supply curtailments by OPEC rushed in.

THE FIRST REVISION OF THE ENERGY PROGRAM IN 1974 The turmoil of the winter of 1973–1974 forced the government to rethink its energy policy. The first revision appeared in 1974. The government understood the message of the crisis, that security of supply was a problem in the short as well as the long run and that energy prices would be higher in the future.

To reduce dependence on oil, which was regarded as the epitome of insecurity, the supply-side approach was stressed. The nuclear option was pursued ever more intensively. The use of lignite and increasing contributions from natural gas were not only welcomed but actively supported. Tax deductions were awarded for a large new lignite open-cast mine, and political and financial support was given to diversification of natural gas sources, with contracts with the Soviet Union and Norway, and plans for gas deliveries from Iran and Algeria. As with nuclear power and coal, a kind of quantified goal was introduced for natural gas, another puzzling feature of a policy that claims not to aim for quantitative goals. Voluntary hard coal use in electricity production already planned in 1973 was revised upward. Most of these and other measures focused on reducing oil consumption. Thus, a rather indirect strategy was chosen in supporting the energy sources competing with oil, i.e. nuclear energy, lignite, domestic hard coal, and natural gas.

In addition, substitution of electricity for oil in heat markets gained political backing. However, the strategy was inconsistent, as the funding for coal subsidies was drawn from an extra duty on electricity in addition to the higher cost accepted by the price control. Almost no additional burden was laid on the culprit, oil, at that time; only an increase to 90 days of obligatory storage and the introduction of information systems to allocate oil in times of scarcity. Support for DEMINEX was enforced, although the position of the multinational companies inside the country was not questioned, and their international role was seen as beneficial to the national market. In the years to

come, this open market attitude toward the development of the oil sector turned out to be very effective in the adaptation process. The national support of non-oil supply and conservation, combined with the restrictive oil policies of other countries, led to a period of relatively low oil product prices, an absence of acute supply shortages, and a dramatic adaptation and restructuring in the West German oil industry. A new feature was the participation of West Germany in international conferences leading to the formation of the International Energy Agency.

First concrete conservation measures and plans Energy conservation remained a secondary priority. Nevertheless, the issue was filled with substance as specific energy conservation measures were introduced or prepared. In the first revision of the energy program, the number of points devoted to energy conservation was increased from one to five (numbers 68 to 72). In looking back, the approach seems quite substantial. The revised program called for information programs; commissioning of a revision of building codes; preparation of a law to create a legal basis for mandatory measures; commissioning of research projects in the technical and economical potentials of conservation, waste heat recovery, and new technologies; and support of district heat. Above all, the belief was expressed that prices would force consumers to react properly.

ENERGY CONSERVATION PROGRAM AND SECOND REVISION OF ENERGY PROGRAM It was another three years before an energy conservation program worthy of its name was designed and enacted. It came into being in 1977, after a fierce battle between a group favoring more drastic measures and a group arguing for a more cautious approach, both represented in the social-liberal (SPD/FDP)[2] government of Chancellor Schmidt. The battle ended in a victory of the cautious approach over a strong group inside the Social Democratic majority. Although the conservation measures taken were rather modest, conservation was publicly presented as a high priority of energy policy; in the second revision of the energy program presented in the 1977, it was put in a still more prominent position. It did not seem suitable to stress the supply options, since they had not lived up to expectations. Real oil prices had fallen in German currency, and indigenous hard coal was in trouble again.

Philosophy of energy conservation policy and approach The philosophy of energy conservation policy was characterized [by then-State Secretary and later Minister for Economic Affairs, Graf Lambsdorff, (7)] as "aimed pre-

[2]FDP, Freie Demokratische Partie

dominantly at highlighting market signals, at dismantling any barriers that impede efficient reactions to these signals, and at helping the required adjustment process achieve the breakthrough." This means that conservation policy was directly related to energy market prices. This principle has been valid ever since. The conservative-liberal (CDU/CSU/FDP) government in power since 1982 had little objection to continuing along this line, in particular since the liberal partner has been in charge of energy policy in all cabinets since 1972.

On the basis of the suppositions, that sovereignty and responsibility for decisions are with the individual market participant, and, that a price mechanism freely reflecting world market price developments gives the signals to which all individuals may react, and thus leads to an optimal consumption, a classical market oriented philosophy was declared as relevant:

- The state acts only in the case of market failure.
- Government measures must be restricted to economically efficient choices, i.e. payback of conservation investments must be guaranteed.

The federal government of 1977 (the social-liberal coalition of Helmut Schmidt) adopted a rather narrow interpretation of this philosophy in formulating practical conservation policy, in particular with respect to the transport and industrial energy-consuming sectors, where some measures advocated by the SPD were not adopted. Energy policy measures were directed almost exclusively at the residential sector and to buildings in other sectors. In the two other end-use sectors, transport and industry, the impression of efficient energy use evoked by a comparatively low specific energy consumption may have softened the emphasis of government action. For example, in the transport sector, the high taxes on car fuels originally imposed for fiscal reasons in West Germany and other European countries had enhanced the fuel economy of West German cars and even more so that of French and Italian cars.

Industry and transformation sector Industry was assumed to be capable of more rational energy consumption decision-making, which would render government action superfluous. For small- and medium-scale industry, the federal government did finance some programs to disseminate information and provide consulting services. Specific loan programs for energy conservation investments by small- and medium-scale industry were offerred by the government-owned Bank for Reconstruction (Kreditanstalt für Wiederaufbau, KfW).

In 1974, a grant program had been launched under the Investment Grant Act, in which the government refunded 7.5% of investments in heat recovery, cogeneration, and other measures to save energy. This program, which runs

until 1989, was intended to spur economic growth, which had already become weak before the oil crisis. Since investment in district heating was included in the program in 1978, the subsidies were largely absorbed by the transformation sector, specifically the public cogeneration and district heat utilities. This sector also received the largest portion of a 35% grant program for coal-fired cogeneration and related heat distribution systems, in a program initiated in 1977 and funded by the federal and state (Länder) governments. Its total volume was 730 million deutsche marks (DM) for the first period (1977–1982) and 1200 million DM for the second period (1982–1985). This program, although announced as part of the energy conservation strategy, was meant to support the use of indigenous hard coal.

Transport sector Energy conservation policy for the transport sector consisted of a 1979 agreement between the federal government and the automobile industry, entered into by car importers the same year. It was agreed that the fuel consumption of cars should be measured and published consistently, and that average fuel consumption should be reduced 10–12% (later increased to 15%) by 1985.

Gasoline and diesel fuel taxes in 1977 were left at the level set in 1973 (0.44 and about 0.50 DM/liter, respectively) and increased only in 1981 (to 0.51 and 0.5325 DM/liter, respectively). However, an additional levy of about 0.005 DM/liter on oil products was introduced in 1978 to raise funds for oil stockpiling.

Residential sector Federal energy conservation policy for the residential sector and for nonresidential buildings has applied all kinds of conservation measures. Aside from moral suasion and the public information campaigns that started immediately after the 1974 crisis, there were other measures of varying degrees of intensity:

- Research: consumption (end-use), technology (rational use, nondepletable sources, renewables, etc), and organization (barriers, etc). Dating from 1974, these programs were stepped up in 1979.
- Information: improvement of consumers' knowledge; dissemination of know-how to architects, contractors, plumbers, etc; dissemination of research results in workshops and seminars; auditing (nonsystematic and noncompulsory); and labeling of appliances (voluntary). Budgets were increased in 1979.
- Pledges of appliance manufacturers to increase efficiencies of new appliances (1980).
- Removal of barriers: allowance of rent increases [14% per annum (p.a.) from 1974 and 11% p.a. after 1978], to accommodate sufficient returns on conservation investment in private and public housing; and introduction of a

heating cost settlement regulation in centrally heated multifamily houses with incentives for rational energy use.

- Subsidies: large grants (1978 to 1982) and tax deductions (1978 to 1983) financed by federal and state governments for heating energy conservation investment (4.35 billion DM); prolongation of tax deductions for new technologies, including district heat connection, in 1984 (prolonged and extended to heating system refurbishment in 1986 with a cutoff in 1991).
- Prices and taxes: the 1974 Federal Electricity Tariff Order, with two two-part tariffs (low standing charge/high commodity charge or vice versa), and an off-peak and a small consumer's high-price single-part tariff. The 1980 amendment introduced a linear component (a high commodity charge as a minimum price) for very large electricity consumers. In 1989, another amendment is planned to abandon the steep (low commodity charge) tariff. In 1977, a 4.5% coal levy was added to the electricity bill, then raised to about 7.5% in 1987 and 8.5% in 1989.

  Light fuel oil (LFO) taxes introduced in 1960 were increased from 10 to 20 DM/t in 1978, while heavy fuel oil (HFO) tax was reduced from 20 to 15 DM/t; an oil storage levy was introduced in 1978 (about 5 DM/t); from 1989, the fuel tax is considerable (56 DM/t on LFO); to counteract free-ride in a netback natural gas pricing system, a natural gas tax of 0.025 DM/cbm is to be charged after 1989, as well.
- Standards: replacement of new building norms by legal standards for new buildings in 1977, adaptation of standards and inclusion of specified building retrofit in 1982, valid from 1984; heating system equipment efficiency codes enacted in 1978, increased in 1982; heating system operation codes effective after 1978.

Figure 1 summarizes the policy measures taken since 1973 that bear on residential energy consumption. Time of introduction of a measure, its period of validity, and its intensity are indicated. The figure shows that a tangible federal energy conservation policy began in 1977. Judging from the number of measures taken, the period from 1977 to 1983 seems to mark the blossoming of energy conservation policy. Thus, the introduction of a considerable energy conservation program coincided with the second oil price rise beginning in 1978.

Energy Consumption Policies in the 1980s

THIRD REVISION OF ENERGY PROGRAM Four years after the second revision of the energy program, when another oil price increase and a successful reelection of the social-liberal government had occurred, the federal government felt that the time had come to explain its energy policy in a third revision in 1981 (8). Taking into consideration the confrontation on economic policy and energy policy inside the government, the third revision documents the

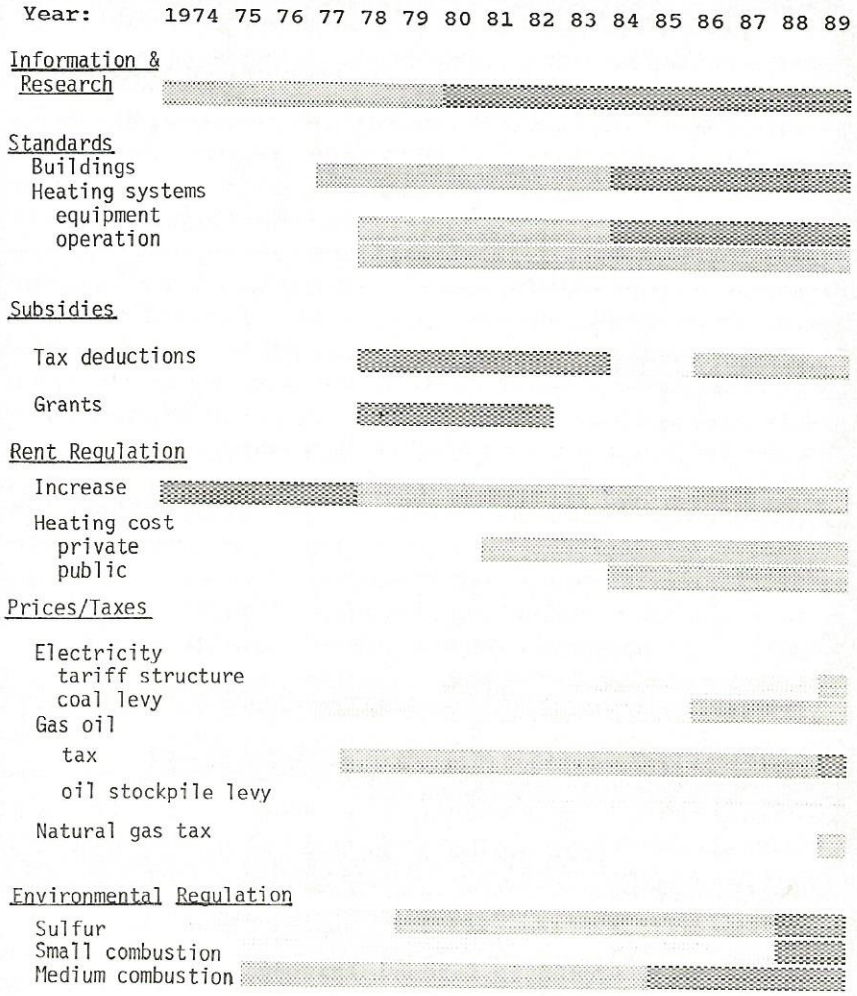

Figure 1 Major West German federal policy measures on residential and other building energy consumption, from 1974 to 1989. The spans of the bars indicate periods of validity of the measures; the shades of the bars indicate qualitative classifications of the intensities of the measures.

strong position of the junior partner, FDP, in charge of energy policy, since it almost completely disregards the suggestions on conservation policy made by the majority in the first Temporary House Committee (Enquête-Kommission of the 8th legislative period of the parliament) on Nuclear Energy Policy. In this committee, the Social Democratic and liberal (FDP) members and a majority of the experts had supported considering the introduction of a large catalogue of conservation measures. The liberal members in government,

however, in particular the minister in charge, Otto Graf Lambsdorff, succeeded in continuing the path taken. Nevertheless, the number of points devoted to conservation in the third revision was increased to 29 (of a total of 134 points). In substance, this revision called for the tightening of building and equipment standards already mentioned, some measures in public buildings, and a gasoline tax increase as well as a smaller diesel tax increase. In this program, however, a prolongation of the subsidies program was also declared, although for only a few energy-saving measures and only in the form of tax deductions.

RESHAPING CONSERVATION POLICY The end of the first large-scale subsidies program for saving heat in buildings, in 1982, coincided with a change in federal government. The new conservative-liberal coalition placed first priority on limiting the public debt, abandoned grants, and reduced sharply the tax deduction program. Because the program for saving heating energy had turned out to be largely a program for home modernization (in particular window-replacement), with little impact on energy consumption, the government found good reason for this cutback. Tax deductions were limited to the installation of new technologies and district heat connections, until in 1986 the replacement of old heating equipment was made eligible for special depreciation. Critics maintain that these tax deduction programs have uneven and unjust income distribution impacts, since their benefit rises with increasing marginal tax rates.

The inclusion of heating equipment in the tax deduction program in 1986 was accompanied by a considerable amendment to the small combustion plants regulation, which took some more time to be enacted. Both measures, however, are part of a strategy to reduce emissions from home heating, by replacing old heating equipment.

Following the philosophy that conservation policy supports the market, building and heating equipment standards were made more stringent in 1982, and set to go into effect in 1984. The fall of oil prices in 1985–1986, however, changed the basis for calculating the economics of the standards introduced. Nevertheless, the standards have not been revised.

As the low prices have withdrawn the economic justification for additional conservation measures, environmental concern (and environmental law) has become an important vehicle for conservation policy in the residential sector (Figure 1). After the introduction of sulfur content limitations for light fuel oil, emission standards were set for medium-size combustion equipment. Beginning in 1988, emission standards were also applicable to small combustion equipment. Much of the existing equipment will therefore have to be replaced.

The subsidies program for coal-fired combined heat and power (CHP), as well as the respective distribution investment, ran out in 1985 and was not renewed, as discussions found its benefit less than expected (9, 10).

Although the subsidies were cancelled or reduced, the period since 1984 is probably comparable in terms of conservation policy intensity to the earlier period, in terms of effectiveness and degrees of involvement in the market (see section on CONSUMPTION DEVELOPMENT).

DEMAND-SIDE CONSEQUENCES OF COAL POLICY The coal policy strategy enforcing the use of domestic coal was tightened in 1980, with a whole set of new arrangements, including a new reference base for subsidies (for part of the coal contracted, the utilities received a refund to reduce coal cost prices to the level of heavy fuel oil prices, for another part, the price of imported coal became the reference price), new coal import legislation, and a new "voluntary" contract requiring utilities to take larger quantities almost up to the end of the century (1995 for purchases and 1997 for use), therefore called the "Jahrhundertvertrag." The utilities accepted on the basis of an unwritten accord that the federal and state governments would back the use of nuclear power. Thus, the utilities saw themselves in a position to keep the electricity tariffs and cost at acceptable levels in spite of their use of expensive coal.

This coal policy has increasingly distorted market allocation in fuel choices for electricity production. Under the current conditions of reduced growth in electricity demand, the extent of market allocation has fallen almost to zero. Given the low variable cost of run-of-river hydroelectric, lignite-fired, and nuclear power stations, as well as the obligations to take West German hard coal, few utilities have room for fuel oil, natural gas, or imported coal. Even the limited import allowances of coal are not fully used.

The situation has been aggravated by environmental policy, which has forced coal-burning plants to install electrostatic precipitators, scrubbers, and nitrogen oxides control devices. Another unwritten accord has allowed electricity producers, which have high such investment, to earn high depreciations within a few years, since the electricity tariffs have not been reduced in step with reductions in fuel cost.

Thus coal policy has not only suspended the role of the market as allocation instrument in fuel choice for electricity production, but has also increased the price of electricity, imposing strong disincentives on its use. The distortions have spread. In markets where electricity can be replaced by fuel, electricity has difficulty competing. Since the fall in oil and gas prices, it has been losing shares in the heat markets. Self-generation using natural gas has become popular, although (under the coal legislation) it is restricted to plants smaller than 10 MW. Large industrial customers still cheaply supplied on the basis of long-term contracts have warned that they might close down or evade high

electricity costs by leaving the country, if they cannot purchase electricity from abroad or under similar conditions to those offered from abroad.

INFLUENCE OF POLICY AND PRICES ON CONSUMPTION

Shortcomings of Conservation Policy Analysis

Analyses aimed at determining the influence of energy conservation programs on energy consumption have found it extremely difficult to separate the influences of price from those of policy (11). In some studies, the impact of prices has been ignored completely, with all the changes recorded being attributed to the policy pursued. Other studies were ill conceived in comparing the trends recorded or anticipated in conjunction with the implementation of such programs with the status quo ante and in attributing all changes to the programs involved. It is not, however, the status quo ante that is the reference case, but rather the trend that would have been recorded if the program in question had not been adopted. Thus, most major studies have overestimated the impact of such programs on energy consumption.

Final Energy Consumption Analysis

The following review of consumption developments since 1970 deals with the final heat market in some detail. Other final demand sectors are reflected briefly. The main data base is Ref. 12 updated in Ref. 13.

The energy use pattern of the industrial sector is the diametric opposite to that of private households. In the household sector, about 85% of the total energy input is for space heating, with the rest accounted for by process heat and hot water production. The opposite is true in industry. The heat utilization pattern in the small-scale consumer[3] sector lies somewhere in the middle. Since there is a predominance of subsectors that have practically no need for process heat (services, trade, public and private administrations, schools, etc), space heating is of greater importance than process heat and hot water production; it accounts for about two thirds of total consumption in this sector.

Not only the utilization patterns, but also the form and criteria of the decision-making process in both industry and households, are of importance for explaining the trend in consumption. With regard to these decision-making structures, the small-scale consumer sector cannot be viewed as a mix of the two other sectors.

The main question in analyzing the trend in energy consumption between

[3]Throughout this paper, the term "small-scale consumer" refers to "commercial and public sector consumer"

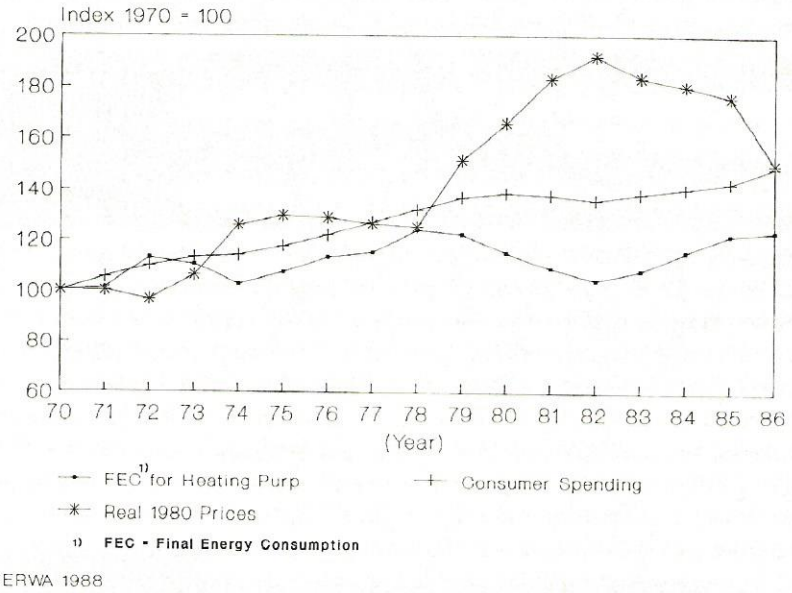

Figure 2 Energy input for heat purposes, consumer spending, and household energy prices

1970 and 1986 is the question of how energy prices, on the one hand, and energy policy decisions, on the other, have contributed to the fact that the energy input in all the sectors and end-uses involved has grown noticeably more slowly than the output produced there.

RESIDENTIAL Since 1970, residential energy consumption (input for heat) and energy prices (weighted average of respective fuel and electricity real prices) have developed along what economists would view as textbook lines. The trend in consumption is practically a mirror image of that in prices (Figure 2). The more the price moves away from or closer to an imaginary axis, the more the energy input will move away from or closer to this axis in the opposite direction. However, the level of activity (measured here in terms of real consumer spending) rises more than proportionately to the axis.

As will be shown when the energy input is viewed in terms of the uses to which it is put, real consumer spending has in the past been a useful indicator of the heat output achieved in household energy use. It rises slightly more markedly than the floor space available per residential unit, reflecting not only the increase in space available, but also the fact that heating comfort has improved. From 1970 (= 100), the index of real consumer spending rose to around 150 in 1986, while energy input for heating rose only to about 123. The improvements in efficiency reflected in this fact were recorded mainly in space heating.

The figures for 1987 only seem to indicate an increase in consumption. In fact, taking into account housing stock and temperature changes, households (and small-scale consumers) have used energy for heating purposes at least as efficiently as in 1986.

Space heating Temperature-adjusted specific energy input for space heating purposes (per square meter of floor space available) rose until 1973, then fell or stagnated until 1978. After 1979 there was a marked downward movement that came to an end in 1982. Since then, specific consumption has remained unchanged. From around 32 kilograms of coal equivalent per square meter (kgce/m^2) to 1973, specific consumption values fell to about 30 kgce/m^2 in 1978 and then to about 26 kgce/m^2, thus by almost 20% as a whole.[4] This 20% does not, however, reflect the full range of the increases in efficiency achieved because the floor space available is an inadequate yardstick for measuring households' space heating output, as it cannot capture the improvements of the heat services rendered.

The conclusion drawn on the basis of a critical evaluation of empirical studies is that the changes in consumption patterns noted in 1973–1975 and 1978–1982 were (initially) caused mainly by changes in consumers' behavior (14). After 1982, the conservation contribution of behavior was increasingly replaced by that of investment in improved equipment, a development not reflected in the trend of specific consumption, which has remained more or less steady. This shift nevertheless plays a vital role with regard to the future trend in consumption, because it reduces the danger of a renewed increase in specific consumption in the wake of low energy prices. The rising proportion of new residential buildings with considerably better thermal insulation properties, the gradual expansion of thermal insulation in older buildings, the increased use of more efficient heating equipment in existing buildings, and improved heating controls are replacing the effects of purely behavioral measures, which are not supported by material investment. If this were not the case, a renewed increase in specific consumption would be expected.

Hot water and cooking Energy input for hot water production and cooking in households depends on hot water consumption and on the number of hot meals prepared. Both, in turn, depend on a great number of factors that cannot be discussed in depth here.

If the number of households and their individual sizes are used as indicators, for instance, it comes to light that per capita energy input for hot water production has risen from about 80 to 130 kgce per capita even though the efficiency has improved considerably, while the energy input for cooking

[4]29.3 MJ = 1 kgce

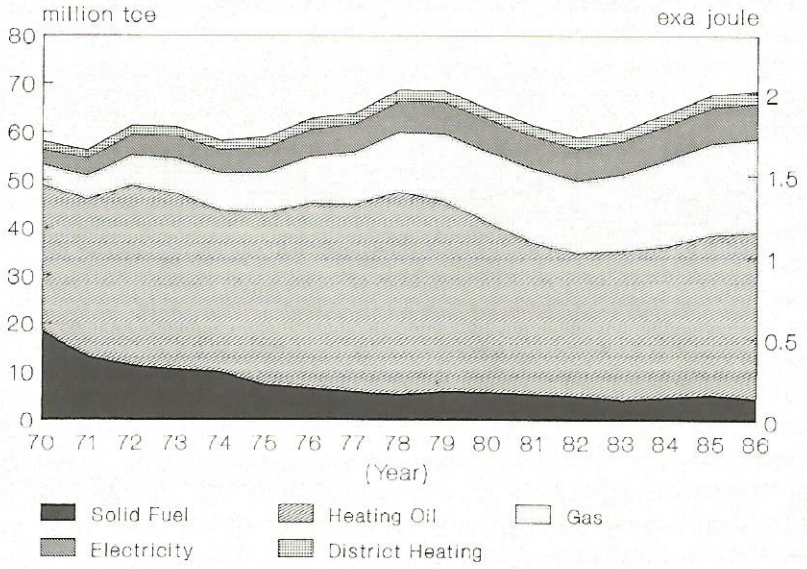

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Figure 3 Energy input for heat purposes in households, by energy source

purposes has dropped from around 30 to about 27 kgce per capita; the energy input for other process heat purposes has increased from around 2 to about 7 kgce per capita. The number and sizes of households are therefore by no means sufficient indicators of the heat output produced, especially where hot water production and process heat (for cooking and drying) are concerned.

Fuel choice The beginning of the period observed (1970) is still characterized by the substitution for solid fuels by light fuel oil, a process that began in the mid-1960s (Figure 3). The two increases in oil and gas prices have not led to a renaissance of coal. And not even the two other sources of energy, electricity and district heating, were able to raise their shares to any extraordinary extent in the periods of high prices.

The phenomenon marking the 1980s is the replacement of light fuel oil by natural gas. But this process did not start in 1978, as might be expected. Although the share of oil-fired central heating equipment in existing buildings has been declining since around 1979, the absolute number of residential units with oil-fired central heating equipment has to date fallen little, because the number of residential units has continued to rise (15).

From the 1960s until 1973, more than 60% of new dwellings used oil heat. This share declined to about 55% by 1974. In 1980 the share of oil fell to

40%, and by 1984, to 30%. In 1987 the oil share was about 34%. Because oil and gas together have held a rather constant market share since the 1970s, natural gas's share is the reverse of the coin. Its share in new dwellings rose from about 35% in 1978 to 55% since 1983.

Since 1980, central oil heating has been a net loser in the conversion of residental heating. Natural gas had become the main replacement already in 1974. Since 1978, in more than 60% of the conversion cases natural gas has been chosen. However, the annual rate of conversion has slowed from 3–4% of all dwellings to 1.5–2%. Obviously, the image of natural gas in the household is extremely favorable. Otherwise it is hard to explain why gas has taken over the prime role from light fuel oil in spite of the fact that its prices have generally been somewhat higher than gas oil prices in terms of heat equivalence. Certainly the time lag of the price adaptation, which has made gas look cheaper for half a year or so during a period of rising oil prices, has bestowed on natural gas an air of economic efficiency.

PUBLIC AND COMMERCIAL Between 1970 and 1986, small-scale consumers' aggregate energy input for heat purposes (Figure 4) developed along what economists would regard as textbook lines, as did that of households. The changes recorded in real energy prices since 1970 seem to have led to several

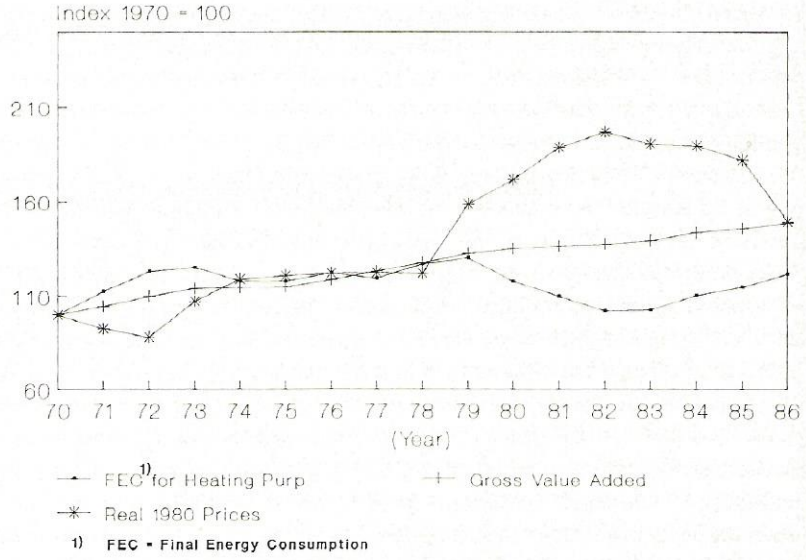

Figure 4 Energy input for heat purposes, gross value added, and small-scale consumer sector energy prices

energy-input adjustments, namely a short-term (1973–1974) and a longer-term (1978–1982) reduction of the energy input even though output (gross value added) rose in this sector. These reductions then seemed to flow into developments along parallel lines. The price increases have consequently given rise to marked increases in energy productivity in each case.

These developments become even clearer if the specific energy input for heat purposes is measured in terms of economic activity. In the first phase of adjustment, the intensity of energy input for heat purposes dropped rapidly from around 56 to about 52 kgce/DM 1000, then, after 1979, to below 40 kgce/DM 1000. Since 1983, the intensity seems to have increased further, reaching about 42 kgce/DM 1000 in 1986. This upward trend has not continued in 1987.

A more detailed analysis (on the basis of subsectors and individual heat uses) shows that the 25% drop in the energy-intensity of production was due to a number of different factors that are only partly the results of energy conservation.

Space heating Small-scale consumers' energy input for space heating must be regarded together with the trend in the useful space available, especially the space available to those economic sectors that account for the majority of such consumption. These sectors are the government (administration and public institutions); nonprofit organizations; and the services, trading, banking, and insurance sector.

Growth of the useful floor space in these subsectors has been uneven; a sectoral shift in the structure of the floor space has taken place, and the market shares of district heating and electricity have expanded. Therefore, the reduction of specific heating energy consumption can only partly be taken as an increase in efficiency.

Individual studies of parts of the small-scale consumer sector show that the improvement in energy productivity recorded between 1978 and 1983 is quite disparate in sectoral terms (16). The observations give rise to the hypothesis that private small-scale consumers generally react more rapidly and more markedly to price increases than public small-scale consumers, but that the reactions in the private sector differ considerably. The slower overall reaction of the public sector is due, however, not only to a less marked orientation to operational efficiency, but also to technical conditions. The division of governmental budgets and responsibilities, in which investment and operations belong to different units, obviously impedes energy-saving investment in space heating. For some years, organizations have been restructured to permit optimization of energy investment.

Process heat and hot water Energy input for process heat and hot water accounts for a small proportion of the small-scale consumer heating market,

namely about 18% and 13% respectively (as against the 69% share of space heating). Between 1970 and 1986, the trend in small-scale consumers' energy input for process heat developed along lines similar to those in their energy input for space heat. Since process heat is far less dependent on the space available than space heating and is linked more closely to output, the fact that the gross value added has risen by around 50% since 1970, while energy input for process heat production has increased by only about 13%, could allow the conclusion that real savings of more than 25% were achieved here. But here, too, there are some doubts as to such a conclusion because the reduction of the process heat energy-intensity was due also to other factors.

Fuel choice Where small-scale consumers are concerned, solid fuels (mainly coal) already played only a minor role in 1970. The oil price crisis did not lead to a lasting renaissance in the periods after 1974 and 1979 (Figure 5).

Changes were recorded mainly in a decline of the share of heating oil, mostly light fuel oil, and rises in those of natural gas, electricity, and district heating. The process involved was only partly a process of substitution in which consumers converted their systems. Most of the changes in shares were accounted for by a reduction of the specific consumption of existing oil-fired heating equipment and an increase in the share of natural gas and district

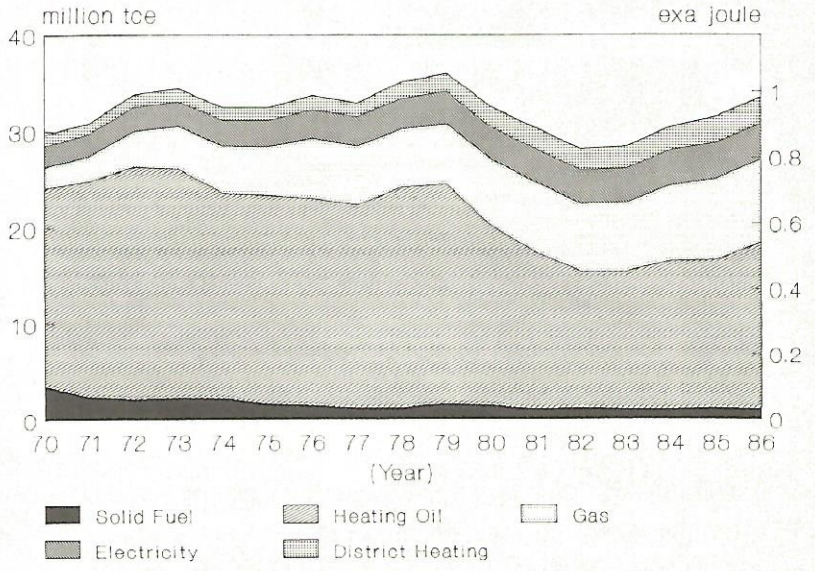

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Figure 5 Energy input for heat purposes of small-scale consumers, by energy source

heating in new plants. The expansion of the share of electricity in space heating was minor. It was primarily noted in the field of process heat.

To a marked degree, the changes in the shares of the various sources of energy were induced by prices, although the manner in which these changes were effected varied. The expansion of the share of natural gas, at the expense of heating oil, is always particularly marked whenever the delayed adjustment of prices due to the linkage of gas pricing to oil prices caused the level of natural gas prices to be lower, in terms of heat equivalence, than that of heating oil (1975–1976 and 1978–1981).

Where district heating is concerned, a marked expansion was recorded only after the second oil crisis (1978 to 1980); this expansion may have been due to the more rapid growth of the useful space available in buildings, above all in the public sector, in the mid-1970s, but it may also have been supported by government measures to promote district heating.

INDUSTRY As had been the case since the 1950s, the trend in the energy input for heat purposes in industry has not paralleled industry output since 1970 (Figure 6). The specific energy input for heat purposes per DM of real gross value added was already declining prior to 1973, the year in which the first increase in oil prices was recorded. It represented a continuation of a steady trend that was also reflected in a reduction of specific fuel consumption in industry by more than a quarter between 1960 and 1970 alone.

The energy price increases in 1973–1975 and 1978–1982 each seem to have

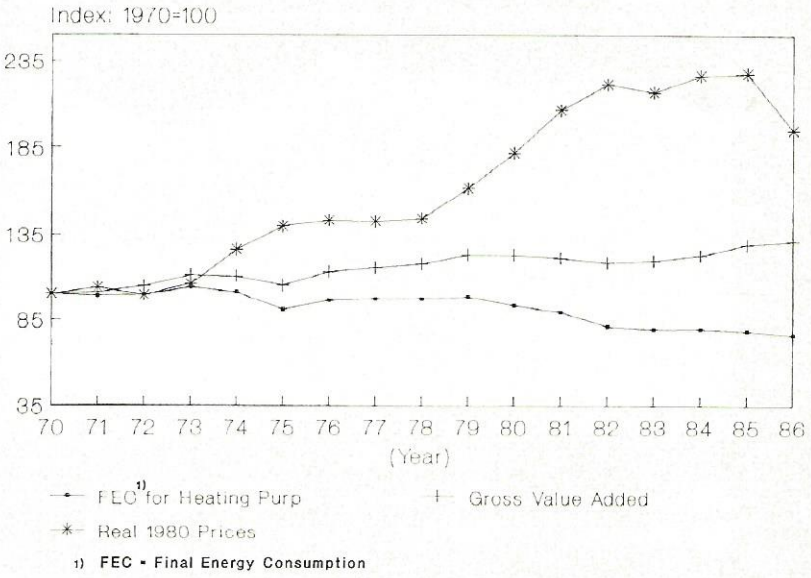

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Figure 6 Energy input for heat purposes, gross value added, and industrial energy prices

had a twofold effect on energy input; on the one hand via cuts in real production, and on the other via reductions of specific energy input. The latter, however, could also have been due to the level of business activity. In the case of lower capacity utilization, there is a tendency to use modern low-cost and generally more efficient plants and to shut down less efficient production plants. In industrial sectors where process-related heat energy consumption far outweighs space heating consumption, this can lead to a drop in the specific energy input for heating purposes.

Existing studies on the reasons for the decline in specific energy consumption in industry all come to the conclusion that the marked drops in specific fuel consumption are to a minor degree due to intersectoral structural change, which has, however, gained increasing importance between 1970 and 1984 (17–19).

Intrasectoral developments must therefore be the major determinants. Within the sectors, the change in the structure of product groups has hardly any effect, so that the drop can be regarded mainly as energy savings. Whether solely investment-related technology effects, narrowly defined (new processes), are involved here is doubtful. Changes in behavior patterns, above all those resulting from organizational measures, presumably had an effect as well.

The fact that the increases in energy-efficiency are in line with the long-term trend indicates that neither the trends in energy prices nor the few conservation policy measures have had major impacts on the energy input for heating purposes in industry as a whole.

Even in periods of high energy prices, obviously by far the majority of industrial investment is for reasons other than those relating to energy conservation (20). The capital stock is changed constantly by replacement, extension, restructuring, and rationalization investments, with a tendency toward the use of energy-efficient equipment and processes. In phases of rising energy prices, energy is given greater attention without becoming the dominant consideration in industry's planning. Greater importance seems to be attached to alignment to future markets, new products, and cost-reduction as well as, above all, labor-saving technologies. Where energy-intensive products are concerned, industry attempts to pass on higher costs to its consumers in the form of higher product prices.

Energy price increases are more likely to act as incentives in the field of engineering. On account of the long lead times involved (research, planning, construction), however, these effects may only become visible after around five years and are then even more difficult to identify as long-run price effects.

Fuel choice The extent to which energy sources are substituted for each other differs in the various fields of heat utilization. In the field of process

heat above 900°C, blast furnace operations are the most important sector. Here mainly coking coal is used but, depending on the oil price, heavy fuel oil is also used extensively. Apart from in-furnace operations, high-temperature processes are to be found mainly in the building materials industry, where predominantly fuel oil and coal (cement industry) and, for special requirements, also natural gas are used. In the rolling mill sector, heavy fuel oil and gases (blast furnace gas, coke-oven gas, and natural gas—sometimes combined) as well as electricity compete with one another. In all three of the major high-temperature fields, consumption of fuel oil has declined markedly since 1974, partly because of the resubstitution of coal (furnace operations, cement industry) and partly because of changes in the processes used (rolling mills). Electricity has constantly gained greater importance, but at a fairly low level of consumption (Figure 7).

Applications for process heat below 900°C are to be found, above all, in the chemical industry, the paper and pulp industry, the glass and ceramics industry, and the food industry, with both the chemical and the paper and pulp industries obtaining part of the heat required from their own combined heat and power production plants (here, consumption is not regarded as district heating, but rather listed as fuel used for steam raising). Wherever steam is used (the boiler market), there are broad options for substitution. In this subsector, fuel oil has been able to maintain its position alongside natural gas right up to the 1980s. Hard coal was able to hold its position only in

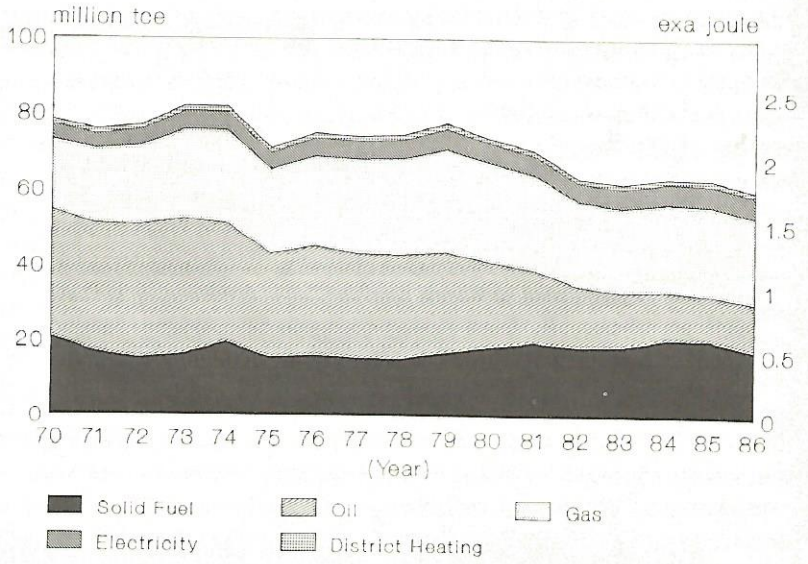

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Figure 7 Energy input for heating purposes in industry, by energy source

larger-scale boiler plants in the chemical industry. In direct heating applications in this temperature range (the glass and ceramics industry), the preference is largely for natural gas.

For space heating and hot water production, competition takes place mainly between light fuel oil and natural gas. Again, a specific feature here is the use of heat from industry-owned combined heat and power production plants; heavy fuel oil consequently contributes considerably (in the form of hot water and steam) to the space heating provided, but its share has been declining since 1978.

TRANSPORT SECTOR In the transport sector, a considerable increase in efficiency has taken place, which is hardly observable in the aggregate number, because it is eaten up by the increased quality of the transport service rendered (21).

Road transport accounts for about 90% of the energy consumption in the transport sector, of which about 70% is used for passenger transport. Both shares have increased since 1970 relative to rail, air, and inland waterway transport and goods transport (trucks).

In terms of fuel consumption per transport service unit, the average efficiencies seem rather constant since 1978. Specific fuel consumption of passenger cars has been stable at about 0.77 kgce per passenger-km (about 11 liters per 100 km). When broken down by engine capacity categories, average gasoline consumption has dropped by up to 4% since 1978 as a result of improvements in engine technology and aerodynamics. The effect of these improvements on average consumption was offset by the increase in average engine capacity. Improvement in the average takes time, because cars' average service life is about 10 years. Other factors influencing average consumption are the kind of use, and with that the average load factor in car use.

Specific fuel consumption of public passenger transport has increased to more than 0.20 kgce per passenger-km, presumably because of a decreasing load factor, while that of goods transport has been reduced by about 8% since 1978.

Evaluation

The goal of this review cannot be an evaluation of the energy consumption or conservation policy pursued to date; such evaluation is still missing in West Germany. Carrying out the evaluation would require including on the benefit side the current and future net improvement in energy-efficiency, and on the cost side more than just the government's program costs. Attempts are made in Ref. 22. Rather than evaluating, this review is meant to explain West German energy policy.

PROCESSES, ISSUES, AND DEBATES IN ENERGY CONSUMPTION POLICY

The Continuity of Energy Policy, Participants, and Positions

Comparing West German energy policy and particularly energy consumption policy with that of other countries, the continuity of this policy, despite several changes of governments and dramatic changes in the energy world, is striking. The policy is apparently imperturbably hanging on to its strategies, philosophies, and faults.

POLITICAL CULTURE AND PROCESSES IN THE FEDERAL REPUBLIC For a better understanding, it might be useful to highlight some important features of policy in West Germany, describe the organization and processes of energy policy, and characterize important institutions and views.

In the Federal Republic of Germany, two large and one or two small parties compete successfully for seats in the parliament, in which no party has reached an absolute majority since Adenauer in the 1950s. Thus, coalitions are necessary to form a government.

In the post-war political tradition, citizens have never voted down an acting government. Therefore, government changes came about only through changes in coalitions during the legislative period. In consequence, one party from the old coalition is always represented in the new coalition, making drastic change unlikely.

Federal government policy is the result of bargaining between coalition partners and their respective parliamentary groups. Voting along party lines is usual in West German policy. The position of the party and of the parliamentary party group to any policy issue is normally backed by every single member of the group, sometimes after a long internal struggle. This process of opinion and policy formation again reduces the likelihood of drastic changes. It, however, may also create frustration. Typically, a strong internal confrontation develops in the parties over economic and energy policy, in particular in the party of the coalition majority the longer a coalition lasts.

FEDERAL ENERGY POLICY ADMINISTRATION Departments or ministerial responsibilities are distributed among the coalition partners in a bargaining process. The coalition partner remaining in government tends to keep control of the departments it has presided over before. Thus, the department of economic affairs, which is in charge of energy policy, has had a liberal minister ever since 1972. Since 1973, the same person has headed the energy division.

In the different administrative departments relevant to energy policy, certain traditions of political ideas and forms prevail, since conditions are

favorable for ideas to survive changes in government. As these traditions differ among departments, they add to rivalry between departments competing in the formation of energy policy.

- In the department of economic affairs, which is in charge of energy policy, the ideal of an economic policy that restricts itself to setting an economic order and the rules of competition (ordoliberal) is held in high esteem. The case of coal policy shows that these principles may be sacrificed if the interest of a considerable group, endowed with influence and voting power, has to be taken into account.
- The staff of the department of research and technology is formed largely of scientists with a tendency to technocratic solutions. Under Social Democratic leadership, it attempted to take over some responsibilities of the economics department, in particular the long-term economic strategy, but did not succeed.
- Also technocratic in part, but rather more bureaucratic in spirit, is the department of buildings, regional, and urban planning.
- The fourth important partner in energy policy administration, the department for the environment, is an offspring of the department of the interior. Possibly because of the bureaucratic traditions, environmental policy tends to prefer mandatory instruments rather than market forces.

In all government departments, lawyers have strong influence.

Besides the federal government, the state (Länder) governments have important responsibilities in energy policy, such as regulation of electricity tariffs, gas and electricity investment control, and licensing and royalties for extractable resources. They can award subsidies and can combine the instruments they command for a powerful energy conservation policy. In energy conservation policy, the federal government has during the social-liberal era successfully initiated coordinated, or even common, federal/state programs.

ROLE OF PARLIAMENT AND ADMINISTRATION In spite of being the legislative sovereign, the federal parliament has never been able to take a leading part in energy policy. Again and again, parliamentary groups have—in most cases in vain—tried to take initiatives, in particular the parties in opposition. The most promising effort to take the lead was the establishment of a Temporary Committee on Future Nuclear Energy Policy in 1978 and its reestablishment in 1981, after the 1980 elections (23). But, what seemed to be a bridge to a new accord in nuclear policy and a catalyst for a new conservation policy during the social-liberal administration fell into insignificance, when Chancellor Schmidt had to concede the government to a conservative-

and research institutes. Some research centers, e.g. the centers of aerospace research (DFVLR) found new fields for employment and became engaged in energy systems analysis and the development of new energy technologies in fields related to air and space. Foundations and societies with private and public funding, such as the Fraunhofer-Gesellschaft, also became deeply engaged in energy technology systems analysis, and policy analysis, since the adaptation to another energy world has opened up new opportunities for innovation. Kübler (30) gives an overview.

In particular, the nuclear debate created a number of additional actors and institutions in policy analysis and consulting. As traditional nuclear energy policy was defended as scientifically founded, in an attempt to endow nuclear power with immunity from critics, the critical groups reacted by establishing their own research institutions, in part supported by churches and other groups in society, and by publishing studies, which were as scientific as the established ones (31, 32).

The cooptation of scientists (including economists) by pressure groups (and also by administrations) in the energy policy debate has discredited the public standing of scientists and experts to a large extent. Scientists, engineers, and economists, teachers, and researchers from universities and other institutions have contributed to this process, whenever they did not distinguish clearly in their statements between results of scientific research, informed estimates, and opinion.

Consumption and Conservation Analyses and Projections

The ever-increasing energy consumption in the 1950s and 1960s had a detrimental effect on energy consumption analysis. Engineering approaches, "bottom-up" econometric substitution analysis, and even input-output analysis had been applied in the investigation of energy consumption, but were discredited by the consumers of analyses, managers and politicians, since they chronically produced forecasts that were too low (33). Thus, time series analysis and even simple extrapolation seemed superior planning tools to the complex procedures.

The observation that energy consumption increased at about the same rate as economic growth, and electricity consumption at an even higher rate, had led to simplistic theories of natural growth laws. Even leading economists discarded the possibility of appreciable substitutability between energy and other production factors (5). Such belief was common among experts, when the world changed in 1974.

The projections made before 1973 on the basis of low oil prices had become waste paper. But many projections of future energy consumption made after 1973 were also misleading. First of all, they were based on experience (and incorrect theory) made in a period not comparable to the then-current situa-

tion. Second, they were based on the belief (and more often hope) that economic growth would recover. The consulting institutions (27, 28) accepted (grudgingly) the suggestion of the administration that energy forecasts, being the quantitative framework for energy policy, should be based on optimistic economic growth assumptions. The reasoning was that if future economic growth and energy demand were low, the damage caused by a high projection would be small, whereas if growth were high, the damage caused by rising energy scarcity would be extremely high. In fact, the forecasters were later trapped, when the government misused the explicitly conditional forecasts as unconditional prophecies to support certain supply options. Thus Diefenbacher & Johnson's explanation for high forecasts (34) that the forecasting institutions were too close to government and industry, is less than half of the full story.

Issues, Positions, and Debates in Energy Conservation Policy

When conservation policy became an issue in the mid-1970s, an intense discussion began about whether and to what extent various consumers should be influenced or limited in their choices. Typically, economists prefer a strategy of little interference with market prices and consumer sovereignty, whereas engineers and scientists use technical potentials to argue for the rational use of energy. In West Germany, the economists relevant in energy policy consulting in 1975 rather pleaded for the more cautious approach (35, 36), which came into practice. This approach was ideologically impure, since it accepted standards and subsidies as options, assuming market failures in the residential and other building sectors.

After the cautious approach had succeeded against a more active policy suggested by the then Social Democratic departments of research and technology and buildings, it was once again contested inside and outside the government. Intragovernmental suggestions of 1974, which were not enacted, included a speed limit on the Autobahn, an apportionment of the car tax to engine fuel taxes, and linear electricity tariffs (37). In addition, the economic assumptions used to determine building and equipment standards were criticized, in particular the interest rate (38).

After the oil price rise of 1978–1979, the discussion livened up again. The minister for research and technology suggested an energy use regulation for industry and other decisive measures. The debate on energy conservation became increasingly entangled with the discussion of economic policy. An intensified conservation policy became identified with more dirigisme, in some cases unjustly, in other cases (e.g. energy use regulation) not.

During about the same period, ecology groups were preparing a study, which was supposed to show the feasibility of a future without nuclear power (31, 32). Conservation was regarded as the major strategic policy field to

render nuclear power redundant. Differing from the Social Democratic party, ecology groups nationally and abroad (39) argued that the "soft path" is possible without dirigisme. A central proposal is the introduction of a linear electricity tariff, later modified to "linear time-of-use" [in substance, a normal time-of-use tariff, the expression "linear" is only to keep the semantic relation to the former proposal (same price per kWh)].

This pattern of arguments was adopted by several members of the Temporary House Committee on Nuclear Energy. The immediate combination of conservation and nuclear policy discussion may, in fact, have reduced acceptance and realization of some useful suggestions. It is otherwise difficult to understand why some of the conservation policy measures proposed by a large majority of that committee were never seriously considered for introduction (40).

Electricity tariff structures have remained an issue of energy policy ever since. The discussion of tariff structures was focused almost exclusively on the impact on electricity consumption. Economists have brought to attention the marginal cost pricing principle for optimal allocation only recently (41). An amendment of the Federal Tariff Order is expected in 1989 and will presumably allow a flat two-part tariff as well as time-of-use tariffs and abandon parameters like rooms and acres, which cannot be influenced by consumption or load demand, for measurement of the standing charge.

Regional and local energy planning concepts were introduced into the discussion in the mid-1970s, initially to bring forward district heating. Then it was realized by many interested parties that this concept could be used to establish a new allocation procedure for local heat supply. A fierce debate began even before the content of this concept was defined. Since there were potential losers and winners, political groups recognized the issue as an instrument for reaching their respective goals. Economists feared a balkanisation of policy and more diversions from efficient allocations in the market.

After several waves of local and regional energy supply concept studies, financed by the federal and some state governments, the level of excitement and fear has been reduced and room has been made for evaluation (42). It has become clear that most participants have not suffered a loss. Municipalities and local suppliers have benefited from improved information and cooperation as well as from the development of planning tools. Against expectations, gas suppliers have profited most, and district heat next most, both at the expense of the fuel trade (fuel oil and coal). Political groups hoping for more savings and new technologies are disappointed by the results. It has anyway become apparent that an economic agent—a utility—is necessary to carry out the strategies decided upon, and that neither the municipality nor other

institutions are able to finance costly strategies that will never produce an economic return.

Some Social Democratic state governments continue to finance the work to develop local energy supply concepts. These state governments try to complement federal energy conservation policy by giving additional subsidies. One state (the Sarre) has managed to set up a state agency to support energy conservation investment in the commercial and small industry sector, providing consulting and also financing. Similar agencies have been planned in Hessia and Northrine-Westfalia. An overview of nongovernmental programs is given in Ref. 43.

The increase of oil product taxes, as well as the introduction of a gas tax beginning in January 1989, has given new life to the discussion of a general energy tax on nonrenewable energy sources. This tax was suggested by the Council of Economic Advisors in 1977 (44, 45). For some time it has been part of the party program of the SPD.

A temporary house committee on the CO_2 problem is working to develop strategies to reduce CO_2 emissions. At this early stage, little can be projected as to the outcome. Since the conservative party has appointed members favoring nuclear power, which the SPD members and greens oppose, a unanimous proposal is unlikely. It is possible, however, that an intensified conservation policy will find common support at this time.

GENERAL OBSERVATIONS AND PRESENT PROSPECTS

In reviewing the energy policy of the Federal Republic, one observes strange discrepancies between public declarations of market orientation (46, 47) and actual policies. The official credo has always been that the market would be the superior mechanism for optimal allocation and for adaptation to changing external conditions in energy as in other sectors—once imperfections were corrected, obstacles set aside, and external effects (social costs) internalized. Competition should be secured by law and the federal trade agency (Bundeskartellamt). Where direct competition was (reluctantly) regarded as unsuitable (e.g. electricity and gas markets), it should be replaced by regulation and control. These guidelines were not questioned in principle even by the left-liberal governments during 1969–1982. It was merely disputed whether one should stick to a strict noninterventionist position or resort to temporary interventions in the market process.

Actual energy policies have violated these principles in many instances, before 1973 and after. On the one hand, much of the interventionist coal and nuclear policies and some aspects of oil and natural gas policies represent violations of the market preference. On the other hand, the laissez-faire agony until 1976 on the demand side was a violation, too, as imperfections and

obstacles to proper functioning were overlooked. Since a conservation policy was established in 1977, the approach has been rather consistent. Nevertheless, there was much more interventionism (in the form of subsidies) than one would expect from a policy of market orientation, partly because interventionism was easy to accomplish, partly because during the 1970s a Keynesian policy approach was preferred. It seems to be much more difficult to reduce market imperfection and internalize social cost.

Since oil prices have fallen, federal government conservation policy, which was using current oil prices as a reference point, seems somewhat forlorn. At the same time it is relieved by the fact that final energy consumption is not increasing. Whereas conservation policy seems paralyzed, in fact policy measures that have conservation effects are being taken for other reasons, in particular environmental (small combustion plants regulation) and fiscal (oil and gas taxes). In the present situation and with the current consumption trend, the government can buy time for a reevaluation and possibly a reorientation of conservation policy taking into account some obvious external effects of energy transformation and use.

An open question is what influence the increasing degree of European integration will have on energy policy. It will at least call for harmonization (of taxes, duties, subsidies, standards, etc) in the future, although it remains uncertain at what values agreement will be reached.

Literature Cited

1. Lucas, N. 1985. *Western European Energy Policies. A comparative study,* p. 171. Oxford
2. Meyer-Renschhausen, M. 1977. *Energiepolitik in der Bundesrepublik Deutschland von 1950 bis heute.* Köln
3. Radkau, J. 1983. *Aufstieg und Krise der deutschen Atomwirtschaft 1945–1975.* Reinbeck bei Hamburg
4. Arbeitsgemeinschaft deutscher wirtschaftswissenschaftlicher Forschungsinstitute. 1961. *Untersuchung über Entwicklung der gegenwärtigen und zukünftigen Struktur von Angebot und Nachfrage in der Energiewirtschaft der Bundesrepublik unter besonderer Berücksichtigung des Steinkohlenbergbaus.* Bonn
5. Schneider, K. H. 1967. *Zur Konzeption einer Energiewirtschaftspolitik.* In *Ordnungsprobleme und Entwicklungstendenzen in der deutschen Energiewirtschaft,* ed. F. Burgbacher, p. 25. Festschrift für Theodor Wessels, Essen
6. Meyer-Renschhausen, M. 1981. *Das Energieprogramm der Bundesregierung.* Frankfurt/Main, New York
7. Graf Lambsdorff, O. 1982. *Rationelle Energieverwendung.* In Jahrbuch 81/82 für Bergbau u.a., p. 8
8. Schmitt, D. 1982. After the second oil crisis. *West German Energy Policy,* ed W. Kohl, p. 137. Lexington, Mass.
9. Suding, P. H. 1982. Fernwärmesubventionen—Problematisierung ihres gesamtwirtschaftlichen Nutzens. In *Zeitschrift für Energiewirtschaft,* Heft 4, p. 197
10. Diekman, J., Horn, M., Ziesing, H.-J. 1985. *Beurteilung der Förderung des Fernwärmeausbaus unter gesamtwirtschaftlichen Gesichtspunkten,* DIW, Berlin
11. Karl, H. D., Rammner, P., Scholz, L. 1982. *Quantitative Wirkungen der Energieeinsparpolitik in der Bundesrepublik Deutschland.* In ifo-Studien zur Energiewirtschaft 3
12. DIW, EWI, RWI. 1986. *Der Energieverbrauch in der Bundesrepublik Deutschland* 1982, Köln
13. Suding, P. H., Forsbach, H. H. Juni 1988. *Entwicklung der Nachfrage im Wärmemarkt* 1970–1986, unveröf-

fentlichte Studie der ENERWA im Auftrag des BMWi, abridged English version prepared for the 1989 UN-ECE conference at Prague, CSSR
14. Meyer-Renschhausen, M., Pfaffenberger, W. 1983. Energie-einsparung im Haushaltssektor—zur Bedeutung der staatlichen Einsparpolitik. In *Zeitschrift für Energiewirtschaft,* Heft 2, p. 158; English version presented to *Consumer Behaviour and Energy Policy Conf., 1982, Noordwijkerhout, Netherlands*
15. Suding, P. H. 1985. Erdgas und Fernwärme. *Der Energiemarkt im Wandel—Zehn Jahre nach der Ölkrise,* ed. D. Schmitt, p. 105. München
16. Suding, P. H., Gommersbach, M., Forsbach, H. H., Seifert, B., Schmitz, A. 1986. *Energie für Wärmezwecke im Kleinverbrauchermarkt.* München
17. Garnreiter, F., Jochem, E., Schön, M. 1986. Produktstrukturwandel und technischer Fortschritt als Bestimmungsfaktor des spezifischen Energieverbrauchs in vier energieintensiven Industriezweigen. In *Zeitschrift für Energiewirtschaft,* Heft 4, p. 271
18. Mansfeld, L. 1987. Intersektoraler Strukturwandel und Energieeinsatz im verarbeitenden Gewerbe. In *Zeitschrift für Energiewirtschaft,* Heft 4, p. 271
19. Stoy, E. W., Kretschmer, W. 1988. *Electricity and Fuel Consumption in Industry,* RWE-AT
20. Neumann, F., Rammner, P., Scholz, L. 1987. *Die Bedeutung der Energieeinsparung als Motiv für Investitionen.* In ifo-Studien zur Energiewirtschaft 8, München, p. 4
21. Goy, G. C. 1988. Final Energy Consumption in the transport sector of the Federal Republic of Germany. In *IEA, Energy Demand Analysis Symp., Paris*
22. IEA. 1987. *Energy Conservation in IEA-Countries.* Paris
23. Meyer-Abich, K.-M., Dickler, R. 1982. Energy issues and policies in the Federal Republic of Germany. *Annu. Rev. Energy* 7:221–59
24. Meyer-Abich, K.-M., Schefold, B. 1986. *Die Grenzen der Atomwirtschaft.* München
25. Michaelis, H., Pelz, W. 1987. *Grenzen der Kernenergie—Eine kritische Auseinandersetzung mit Meyer-Abich und Schefold,* Düsseldorf
26. Renn, O., Albrecht, G., Kotte, U., Peters, P., Stegelmann, U. 1985. *Sozialverträgliche Energiepolitik.* München
27. DIW, EWI, RWI. 1978. *Die künftige Entwicklung der Energienachfrage in der Bundesrepublik Deutschland und deren Deckung—Perspektiven bis zum Jahre 2000.* Essen
28. DIW, EWI, RWI. 1981. *Der Energieverbrauch in der Bundes-republik Deutschland und seine Deckung bis zum Jahre 1995.* Essen
29. PROGNOS. 1984. *Die Entwicklung des Energieverbrauchs in der Bundesrepublik Deutschland.* Stuttgart
30. Kübler, K. 1986. Zehn Jahre Energieökonomie in der Bundesrepublik Deutschland: Bilanz und Ausblick. In Kappel, R. (Hrsg.): *Im Spannungsfeld von Wirtschaft, Technik und Politik.* Festschrift für Bruno Fritsch. München, p. 227
31. Krause, F., Bossel, H., Müller-Reißmann, K.-F. 1980. *Energie-Wende.* Frankfurt am Main
32. Suding, P. H. 1980. Zur Notwendigkeit der Kernenergie. In *Zeitschrift für Energiewirtschaft,* Heft 2, p. 75
33. Kraus, M. 1988. Energieprognosen im Rückblick. *Energieprognostik auf dem Prüfstand,* ed. M. Härter, p. 89. Schriftenreihe der Gesellschaft und Energiepolitik, Köln
34. Diefenbacher, H., Johnson, J. 1987. Energy forecasting in West Germany: confrontation and convergence. *The Politics of Energy Forecasting,* ed. T. Baumgartner, A. Midttun, p. 61. Oxford
35. Schmitt, D., Schürmann, H. J., Pluge, W. 1976. *Zur Notwendigkeit einer staatlichen Energieeinsparungspolitik—Ein kritischer Ansatz*—München
36. Pluge, W., Schmitt, D., Schürmann, H.-J. 1978. Steuerungsstrategien und alternative Energieeinsparungspolitiken. In AUGE/EWI, *Technologien zur Einsparung von Energie,* Studie im Auftrag des BMFT, Teil III, Wirtschaftspolitische Steuerungsmöglichkeiten, Essen
37. Eppler, E. 1975. *Ende oder Wende.* Stuttgart
38. Luhmann, H.-J. 1981. *Energieeinsparung durch Verstärkung dezentraler Kapitalallokation.* In Europäische Hochschulschriften: Reihe 5, Volks- und Betriebswirtschaft; Bd. 304, Frankfurt am Main
39. Lovins, A. B. 1977. *Soft Energy Paths.* Harmondswarth
40. Meixner, H. 1981. Energieeinsparungspolitik und Marktwirtschaft. In *Wirtschaftsdienst,* Heft 4, p. 178
41. Hoven, I., Schulz, W. 1988. Kostenorientierte Stromtarife. *In Zeitschrift für Energiewirtschaft,* Heft 4, 1988, p. 221
42. DIW, PROGNOS. 1987. *Energieversorgungskonzepte: Von der Planung zur Praxis.* München

43. Hildebrandt, L., Joerges, B. 1983. *Consumers Energy Conservation Policies and Programs in the Federal Republic of Germany*. Wissenschaftszentrum Berlin, IIUG reports
44. Schmitt, D., Schneider, H. K. 1983. Energiepolitik und Besteuerung. In *Staatsfinanzierung im Wandel,* Verhandlungen auf der Jahrestagung des Vereins für Socialpolitik in Köln 1982, Berlin p. 745
45. Sievert, O. 1977. Besteuerung von engpaβverdächtigen Energieträgern. In *Wirtschaftsdienst,* p. 595
46. Röhling, E., Mohnfeld, J. 1985. Energy policy and the energy economy in FRGermany. In *Energy Policy,* p. 535
47. BMWI. 1986. *Energy Report of the Government of the Federal Republic of Germany*. In BMWI-Dokumentation Nr. 279