World energy markets in 1988-89 were marked by sustained growth in demand for all types of energy. The petroleum industry participated in this general growth — oil demand was the main beneficiary in Japan and the developing Asian countries. This favourable market situation has limited the downward pressure on prices which would otherwise have arisen from over-production in some Gulf countries, relative to their OPEC quotas, since Spring 1989. Energy industries have been subject to a reawakening: oil exploration has been revived, reorganization of the coal industry is well under way, the electricity industry is pursuing the potential of gas turbines. Despite continued obstacles in the nuclear industry, pressure from public opinion to limit CO_2 emissions has been seen as a favourable sign by proponents of nuclear power. Energy markets show signs of new flexibility, but they also face new sources of rigidity due to environmental constraints and the energy needs of developing countries.

La conjoncture énergétique mondiale en 1988-89, c'est avant tout une croissance soutenue de la demande qui a profité à toutes les sources d'énergie. Au Japon et dans les pays d'Asie en développement, c'est même le pétrole qui en est le principal bénéficiaire. Cette conjoncture favorable a limité les effets à la baisse des dépassements de quotas par certains pays du Golfe à partir du printemps 1989. Du coup, les industries de l'énergie sortent de la morosité: l'exploration pétrolière repart; les restructurations charbonnières vont bon train; l'industrie électrique joue surtout la carte de la turbine à gaz. En outre, les pressions de l'opinion publique en vue de limiter les émissions de CO_2 sont interprétées comme un indice favorable par les tenants de l'énergie nucléaire. De nouvelles flexibilités apparaissent, notamment dans les possibilités de substitutions interénergétiques, mais le retour en force des préoccupations environnementales et les contraintes de financement des investissements énergétiques dans les pays en développement sont aussi de nouvelles contraintes pour les industries de l'énergie.

Demand Upturn Confirmed Amid New Constraints for Energy Industries: 1988-89 in Review

JEAN-MARIE MARTIN

Are energy markets once again definitively in an expansion phase? Was 1988 a turnaround year? Numerous commentators believe this to be the case — observing that petroleum products, natural gas, coal and electricity have all returned to sustained growth.[1] In this view, a clear upward trend in prices will lead to healthier markets as excess productive capacity comes back into service.

The combination of profound industrial reorganization (especially in the oil industry) and a return to economic growth (stimulated by the 1986 fall in oil prices) will thus eliminate the more serious doubts that have surrounded energy industries since the second oil shock. In such a climate, investment could again take off.

Is such an optimistic vision borne out by the changes that have occurred during 1988 and 1989?

1. The Recovery of Oil Prices

After a year of slow recovery from July 1986, through July 1987, crude oil prices were eroded over a 15-month period (July 1987-October 1988). This trend was reversed after December 1988: the spot price of Dubai crude began to rise

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1/ See, for instance, Meo (1988).

again, reaching $18 (US) in April 1989. The price of Brent and West Texas Intermediate (WTI) crude rose even faster, creating a $5 gap in June. After easing slightly between July and August, prices remained firm until the end of 1989. In current dollars, the increase was thus of the order of 60% (see Figure 1).

This turnaround was the result of a price increase imposed by OPEC with a view to increasing its control over oil supply. It can only be understood, however, in the context of an attempt to maintain stronger discipline among OPEC member countries.

1.1 The Jump in OPEC Prices

The price increase occurred at the end of November, 1988 in the new situation created by the termination of the war between Iran and Iraq. The price weakness that preceded it resulted from a lack of discipline within OPEC itself, the majority of whose members did not respect the production quotas aimed at limiting supply to 15.06 million barrels per day (excluding Iraqi production). Production reached 21.2 Mb/d (again excluding that of Iraq), if not more, in October[2] — 5-6 Mb/d over the figure decided in December 1987 and reconfirmed in Vienna in June 1988.

Not all OPEC members were equally responsible. It is difficult to evaluate Iraq's role because it has refused to accept quota levels since the start of its conflict with Iran (the latter being the only OPEC country unable to fulfil its authorized quota).[3] The greatest degree of discipline was shown by Venezuela (with an increase of 8.2%), Algeria (+3.9%), Indonesia (+0.8%), Libya (+0.4%) and Qatar (+0.03%). Equador (with an increase of 36%) and Gabon (+26%) showed little respect for the quotas, though the actual volume of their production is low. Apart from Nigeria (+15%), the countries responsible for destabilizing the market were all located in the Gulf region: Saudi Arabia (+30%), Kuwait (+65%) and the United Arab Emirates (+110%). Taken together, their over-production accounted for 80% of the total OPEC over-production (see Figure 2).

Why was there such a lack of discipline on the part of the richest countries, those which were neither caught in the stranglehold of debt nor threatened by popular revolt?

One reason is probably to be found in the traditional rivalry between Abu Dhabi and Dubai. Abu Dhabi produced three times as much as its rival, with the result that the latter was unwilling to let its output fall below its production capacity. As a consequence, the United Arab Emirates produced 1.5 Mb/d instead of 0.948 Mb/d. A second reason was clearly the ending of the Iraq-Iran conflict in mid-July. In addition to its recently re-evaluated reserves, Iraq now has sufficient pipeline capacity for it to double exports in 1989 and to triple them in 1990-91. If Iran follows suit once its installations are repaired, the market will be quickly swamped (*Le Pétrole et le Gaz Arabes*, 1988; *Pétrostratégies*, 1988). The conditions under which Iraq will be reintegrated into the quota system are thus a crucial factor in OPEC's future. In the event of failure, it would mean the end of OPEC and of the leadership role which Saudi Arabia exercises through the organization.

Within this perspective, over-production by Saudi Arabia, Kuwait, Qatar and the United Arab Emirates in the summer of 1988 would appear to have been a deliberate strategy, intended to force the two warring countries to reach agreement on their respective quotas and so to re-establish production discipline within OPEC. Numerous attempts failed: those of the Price Control Committee in early August and in late September in Madrid; and attempts by this same Committee in conjunction with the Long Term Strategy Committee on October 20th and 22nd, again in Madrid. Intransigence by Iran and Iraq continues to prevent the reintegration of the latter within the quota system. Iraq wants to

2/ The estimate of 21.2 Mb/d is from the International Energy Agency. The publication *Le Pétrole et le Gaz Arabes* (1988) still considers this estimate to be too low. According to it, actual OPEC production reached 21.98 Mb/d in October 1988.

3/ In the percentages which follow, production of the Neutral Zone (300 Mb/d) is divided equally between Kuwait and Saudi Arabia.

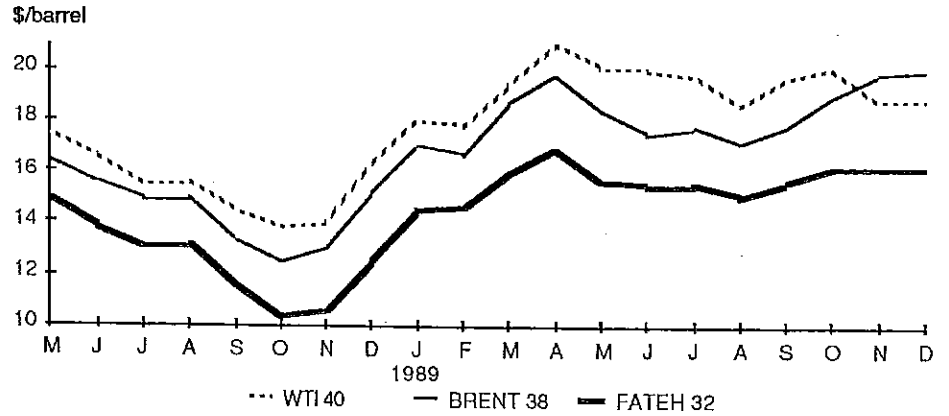

Figure 1: The Spot Price of Crude Oil (monthly averages in current dollars)
Sources: *Energie Internationale 1989-1990, 'Complément Statistique,'* Part A; *Petroleum Intelligence Weekly* (various issues).

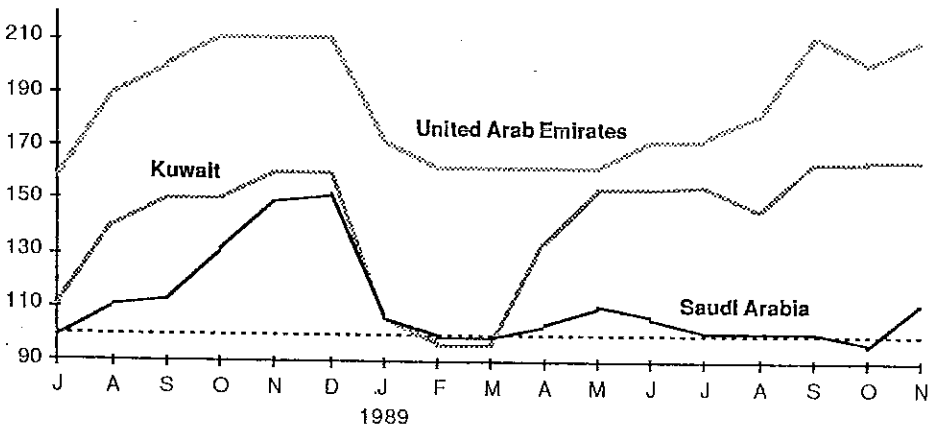

Figure 2: Oil Production Levels Relative to Quotas in the Gulf Countries
Source: *Pétrole et Gaz Arabes* (various issues).
Note: production quota = 100.

keep its production ceiling at 2.7 Mb/d, whereas Iran insists that Iraq's quota be limited to the same level as its own at 2.4 Mb/d. It would appear that OPEC is "truly at the end of its rope" (Maurus, 1988).

However, signs of an increase in prices are beginning to appear. The riots in Algeria at the beginning of October were perhaps the alarm signal. Doctor Subroto, the new Secretary General of OPEC has been actively trying to convince the Organization's members of the need to respect production ceilings — an essential need if prices are to begin to rise again — and the Madrid meeting at the end of October helped to move things in this direction. Iran and Iraq, though still opposed, began to talk, and those countries wanting an immediate rise in prices (Iran, Algeria, Libya, etc.) moved closer to those in favour of a gradual adjustment of prices, limited within a range that would increase OPEC's market share (Saudi Arabia and the Gulf countries).

This movement was given official form in the agreement reached by the 13 OPEC member-countries in Vienna on November 28, 1988. Despite Saudi Arabia's demand *in extremis* that the $18 target price be replaced by a reference price of $15, a consensus finally seemed to have been

reached. Iran accepted the reintegration of Iraq with a quota identical to its own. All the members of OPEC seemed to agree on a strategy that combined two aspects:

- a gradual return to a price of $18 per barrel during the first half of 1989, and
- a lifting of the production ceiling from 16.6 Mb/d (including Iraq) to 18.5 Mb/d (i.e., a rise of 11%) from 1 January 1989.

New quotas were defined within this framework (see Table 1), with each country being allowed a 4.1% increase, though this figure was higher for three countries: Iran (+11.4%), Qatar (+36%) and Iraq (+71% relative to the quota that it should have had but that had never been accepted). In addition, all the countries agreed on a more precise definition of the quotas and on the need for tighter controls on production discipline. A control committee consisting of eight members (Algeria, Indonesia, Iran, Iraq, Kuwait, Nigeria, Saudi Arabia and Venezuela) was given responsibility for monitoring price movements and for checking that quotas were respected. This committee would be convened on the request of at least four members in the event of a prolonged fall in prices over two consecutive months, or if no progress was made in moving towards the $18 target price.

Although higher than before, the new production ceiling was still very much lower than actual production in November 1988 (22.5 Mb/d). The objectives set by the agreement would not be reached unless all 13 OPEC members considerably reduced their production levels — which they undertook to do, starting on the first of January 1989. There was an immediate rise in prices even before this reduction took effect (see Figure 1): in the space of one week, the price of Brent went up by $1.60; West Texas Intermediate (WTI) by $1.50; Dubai by $1. In spite of a slight settling down in February, the trend has continued upward since. This has been maintained by a meeting in London at the end of January of the principal NOPEC members (i.e., oil exporting countries that do not belong to OPEC: Mexico, Oman, Malaysia, Egypt, Angola, Columbia, North Yemen, China, Brunei, etc.) and by the announcement, early in March, that they would reduce their production and exports by roughly 5%.

Several accidents also served to push events in this direction. Shortly after production started up again in the British sector of the North Sea after the explosion of the Piper Alpha platform (in July 1988), an oil tanker breaking loose from its moorings and a gas leak on the Brent Delta platform (January 1989) forced a further reduction in activity. The rupture, in March, of the oil tanker Exxon-Valdez paralyzed Alaskan oil output, while another accident (on the Cormorant platform in April) again affected North Sea production.

Will the rise in oil prices last? Changes in demand (see below) and the need to renew stocks, which fell considerably in the fourth quarter of 1989, are in line with such a hypothesis.[4] But the extent to which OPEC can maintain its internal discipline remains the key factor in the short-term. Figure 2 shows that the United Arab Emirates still feel free to ignore the agreement arrived at in late November. Having reduced their production in December, they continued to keep it at a level well above their quota. As a result, Kuwait considers itself released from its commitments, stepping up its production to the same level as that of the United Arab Emirates in May.

The consequences of this lack of discipline were limited by the Saudis' policy of strictly adhering to the Vienna agreements, varying its production according to the state of the market (reducing it at the beginning of April and increasing it early in May).

In opposition to those countries (Algeria in particular) that wanted a minimum price of $18 imposed at least until the end of 1989, Saudi Arabia reaffirmed its preference for a strategy of price freedom, based simply on a minimum price of $15, that would be gradually increased according to the state of the market. The June conference came down on the side of the Saudis: the idea of a "target price" was abandoned in favour of a "reference price," which OPEC un-

4/ The fall in stocks has been estimated at 0.9 Mb/d. Although governments have increased their stocks by 0.2, companies have diminished theirs by 1.1 (OECD, 1989).

Table 1: OPEC Production Quotas (Mb/d)

	To end of 1988	From 1 Jan 89	From 1 July 1989	From 1 Oct 89*	From 1 Jan 90
Algeria	667	695	733	771	827
Equador	221	230	242	254	273
Gabon	159	166	175	184	197
Indonesia	1190	1240	1307	1374	1374
Iran	2369	2640	2783	2926	3140
Iraq	(1540)	2640	2783	2926	3140
Kuwait	996	1037	1093	1149	1500
Libya	996	1037	1093	1149	1233
Nigeria	1301	1355	1428	1501	1611
Qatar	229	312	329	346	371
Saudi Arabia	4343	4524	4769	5014	5380
United Arab Emirates	948	988	1041	1094	1095
Venezuela	1571	1626	1724	1812	1945
Total	16600**	18500	19500	20500	22086

*The column for 1 Oct 89 has been calculated on the basis of a pro-rata distribution of the increase in permitted production of 1 Mb/d.
**15060 excluding Iraq

Source: *Pétrole et Gaz Arabes* (various issues).

dertook to maintain, and the production ceiling was raised from 18.5 Mb/d to 19.5 Mb/d without any change in the shares of the various member countries (see Table 1).

Kuwait, which was claiming a larger share (7.6% as opposed to 5.6%), immediately said it would not respect its quota, though it would limit its production to 1.3 Mb/d until September so as to avoid upsetting the market too much. As for the United Arab Emirates, they did not feel under any greater obligation to respect the new agreement than they had for the one of November.

Throughout the second half of 1989, Kuwait and the United Arab Emirates systematically overstepped their quotas. OPEC's October production exceeded 22.5 Mb/d — 2 Mb/d over the new quota of 20.5 Mb/d decided in September for the fourth quarter. Nevertheless, prices remained sufficiently firm for the annual OPEC conference (held in Vienna in the last week of December) to decide on a further increase in quotas, to take effect on 1 January 1990 (see Table 1).

Two factors were important in stabilizing prices during the second half of 1989: the fact that quotas were respected by the majority of OPEC member countries (Saudi Arabia in particular) and, as discussed in the next section, the continuing strong demand for OPEC oil.

1.2 Increased Demand for OPEC Oil

The new trends in oil demand can be clearly seen in Table 2. From the end of 1987 until the end of 1989, the volume of OPEC member countries' crude production increased (by 3.9 Mb/d), as did its market share (from 40% to 45%). It is reasonable to suggest that this growth helped to bring the different positions within OPEC closer together since the end of November 1988. Without growth, the new policy would never have withstood the overstepping of quotas by some of the Gulf countries. To explain this we have to look at non-OPEC supply, as well as at demand within the international oil market.

On the supply side, changes were minimal. NOPEC production fell slightly, between 1987 and 1989, as the net result of diverging adjustments:

(1) Production in OECD countries continued to

Table 2: World Oil Supply and Demand (excluding the planned economies) 1986-89 (Mb/d)

	1986	1987	1988	1989 [f]
Consumption	48.2	49.3	50.9	51.8
Comprised of:				
North America	18.0	18.5	19.1	19.1
Europe	12.2	12.3	12.4	12.4
Pacific	5.2	5.2	5.5	5.8
OECD	35.4	36.0	37.0	37.3
non-OECD	12.8	13.3	13.9	14.5
Availability	48.3	48.6	50.8	52.3
Comprised of:				
OECD	16.8	16.8	16.6	16.0
Developing countries	8.6	9.0	9.3	16.0
Socialist countries	2.0	2.1	2.2	2.1
Conversion gains	1.1	1.1	1.1	1.1
OPEC	19.8	19.6	21.6	23.5

[f]: forecast

Source: International Energy Agency (1989).

Note: The difference between consumption and availability is accounted for by stock variations (-0.8 in 1987 and -0.11 in 1988). The data include consumption and production of liquified natural gas.

fall (in Australia and the US in particular), though it increased in the North Sea and stabilized in Canada (in this latter case it may simply have been the result of the Canadian government's encouragement program).
(2) In contrast, production by NOPEC developing countries grew by 4.4% in 1988 and by 3% in 1989 in Angola, the Congo, Syria, South Yemen, Malaysia and Pakistan. (Mexico was the exception, remaining stable at 2.9 Mb/d.)
(3) Exports from the Soviet Union, which had increased in 1988, fell in 1989.

In contrast, distinct upward trends were evident on the demand side, especially after the International Energy Agency again revised its estimates. Not all regions contributed to the same extent: Japan and other Pacific Rim countries came first with 6%, followed by North America (2.7%) and Western Europe (0.8%). These differences were the result of specific movements within each region:

- In all regions, but particularly in Europe and the Pacific countries, demand for jet fuel grew rapidly with the exceptionally fast development of air transport.
- Changes in demand for intermediate products (light fuel, diesel oil) was more varied. It continued to fall in Europe and rose very sharply in the Pacific region (9.9%) and North America (5.3%), probably as a result of diesel road transport. In North America even heavy fuel oil made a substantial comeback (3.8%), particularly for use in electricity production.
- Finally, strong growth in gasoline demand returned in all three regions — between 2.2% in North America and 3.2% in the Pacific countries.

Part of this change in the pattern of demand for oil was completely independent of the state of supplies of other energy sources, being a response to specific needs (transport and chemicals in particular).

Growth in oil demand was even stronger in developing countries (4.4%), lying somewhere between its pre-1973 level (9%) and that of the early 1980s. The movement was strongest in South and South-East Asia, though it was also to be seen in oil-producing countries in which population growth is rapid (Algeria, Nigeria, Egypt, Mexico, Venezuela, etc.).

Growth continued throughout 1989 in the developing countries and the Pacific region. In contrast, it flagged in Europe and the US. Although this was obviously influenced by the big fall in oil prices, it can only be properly understood against the background of overall growth in energy consumption, to which we now turn.

2. A Return to Sustained Growth in Overall Energy Demand

For the moment, available data can only provide a provisional picture of world energy consumption in 1988. Nevertheless, the main outlines — a return to sustained growth, but with considerable variations among regions — can already be discerned.

2.1 *OECD Member-Countries*

The rate of growth in primary consumption rose from 2.8% in 1987 to over 3% in 1988 — for both years, substantially higher than during the decade of stability from 1977 to 1986. The simplest explanation would seem to be overall economic growth: "1988 has been particularly brilliant in the industrialized world as a whole; there has been strong growth, inflation accelerated only marginally and balance of payments deficits fell" (Jeanneney and Charpin, 1989).

But there are also other factors to consider. A comparison of growth rates in the principal OECD countries (see Table 3) with those of primary energy consumption (Table 4) reveals a certain number of breaks. Western Europe, which has a GDP growth rate close to that of the US, increased its energy consumption by only 0.5%, whereas North America's primary energy consumption rose by over 4%, the same increase as in the Pacific Rim.

Climatic variations (particularly important in 1988) undoubtedly encouraged growth in the US, whereas they retarded it in Western Europe. But these climatic effects came on top of more general trends which reflect changes in energy intensities in the industrialized countries since 1985 (see Table 5). While the trend downward continued, rates of change were lower than in the early 1980s. In addition, they varied from country to country: in the UK, West Germany and Japan the average rate of decline was still close to 2% per year, whereas it was hardly greater than 1% in France and Italy and did not exceed 0.5% in the US.

Technological change, driven by, among other things, rises in oil prices, has not stopped. But, in relation to overall energy consumption, it has been partially counterbalanced by other trends, that have themselves been supported by improved energy efficiencies in household and industrial equipment and transport vehicles. Thus there is currently a renewed "explosion" in air and road transport, as well as a strong upturn in industries that are heavy energy consumers, most of which have modernized their equipment in ways that significantly reduce their spending on energy.

Table 3: Percentage Rates of Economic Growth in Large OECD Countries

	1988	1989 [f]
United States	3.9	2.6
Japan	5.7	4.7
West Germany	3.5	3.1
France	3.4	2.6
Italy	3.8	3.6
United Kingdom	4.2	2.5
EEC	3.6	2.9
OECD	4.1	3.0

[f]: forecast

Source: Annual average GDP growth rates supplied by the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII, 1989).

In addition, the effects of policy differences can be seen in changes in the structure of consumption: in Western Europe the use of fossil fuels has flattened out and is even falling, while primary electricity production is growing at over 7%; the opposite is the case in North America and Japan, where the dominant feature is the growth in the use of coal, natural gas and oil.

Naturally these developments are not entirely independent of movements in the price of energy products, which generally fell in 1988. In the absence of any substantial tax changes (for the most part, tax rates increased only in Italy and Spain), prices of petroleum products have followed international oil prices, but decreases were particularly significant on fuel markets. These were of the order of 10% for fuel oil, and as high as 25% for heavy fuel oil in the US. Since then, price gaps relative to other fuels have closed, particularly in the case of coal, the price of which has continued to rise on international markets (from $35/t to $41/t for spot coal from South Africa delivered to Rotterdam). But prices have not always been the determining factor. Price increases did not prevent growth in coal use in the Pacific countries — Japanese electricity producers accepted rises of roughly 20% in new contracts with their Australian suppliers. Neither did they hold back natural gas in North America, where the spot price rose significantly in 1988.

Table 4: Variations in Primary Energy Consumption in the OECD countries 1987-88 (%)

	Oil	Natural Gas	Coal	Hydro-electric	Nuclear	Total
North America	3.0	5.3	7.7	-6.3	14.7	4.8
Western Europe	0.9	-2.1	-4.0	6.8	7.0	0.5
Japan and Southern regions	5.8	4.6	7.7	5.1	-7.3	4.9
OECD	2.7	3.1	4.1	-0.1	8.1	3.4

Source: OECD (1989).

Table 5: Changes in Energy Intensity Relative to GDP for Several OECD Countries (toe per million of 1980$)

1985	1986	1987	1988	
United States	576	561	566	568
Japan	326	318	309	308
Federal Germany	438	432	427	417
France	383	382	384	372
Italy	280	279	282	274
UK	407	404	396	384

Sources: *Enerdata* Data Bank (IEPE, Grenoble) for primary energy consumption data; CEPII (1989) for constant dollar GDP at purchasing power parity.

2.2 *The Major Developing Regions*

Variations are much greater here than in the main OECD regions. But they should be interpreted with care as long as the available data remain limited and unconfirmed.[5]

According to the Organizacion Latinoamericana de Energia (OLADE), the South American sub-continent's primary energy consumption rose in 1988 by 2.6%, with coal increasing at 8.5%, natural gas 4.7%, electricity 5.1% and oil 1.9%. This growth follows a net reduction observed in the 1980-85 period relative to the 1960s and 1970s. In light of the economic growth rates shown in Table 6, the sources of growth in energy consumption in 1988 are to be found in uses which do not add to measured production and in a deterioration of energy efficiency.

The Asian situation stands out in contrast with that of Latin America. In 1988 primary energy consumption grew by 4% in Southern Asia and by 10% in South-East Asia.[6] This involved primary energy growth of 3.6% in India, 6.1% in Indonesia, 10.5% in the Philippines, 8% in Pakistan, 11% in South Korea and 13% in Thailand. Oil has often played an important role, with growth rates as follows: 4.6% in Indonesia, 5.9% in India, 8% in the Philippines, 9% in Pakistan, 15.2% in Thailand and 19.5% in South Korea. Final electricity consumption also followed suit with growth rates of 7.2% in India, 10% in Taiwan, 12% in Pakistan, 13.5% in Thailand and 15.8% in South Korea.

The role of high rates of economic growth (Table 7) is indisputable in this case. But other random factors also play a part, such as the cold winter, poor hydraulic conditions and nuclear power station stoppages in South Korea. And particular structural changes contributed to energy consumption growth, such as the development of thermal electricity and, especially, the rapid increase in the number of automobiles. For example, the automobile stock rose by 33% in South Korea in 1988.

2.3 *The Centrally-Planned Economies*

As in the other categories considered above, changes in the Communist nations varied con-

5/ We are indebted to Hugo Altomonte (IDEE, Fundacion Bariloche, Argentina) and Bruno Lapillonne (Asian Institute of Technology (AIT), Bangkok) for the information that follows.

6/ The estimates in this paragraph, provided by AIT in Bangkok, are based on the earliest 1988 energy balance statistics available for the region and are therefore not definitive.

Table 6: Economic Growth in Latin America (%)

	1986	1987	1988
Argentina	5.8	1.9	-3.0
Brazil	5.1	5.6	-
Chile	5.4	5.4	7.1
Colombia	7.1	5.8	3.5
Peru	8.9	7.3	-8.6
Venezuela	6.8	1.7	-

Source: Information provided by Instituto de Economia Energética, Bariloche, Argentina *BID Informe* (1988) and the Economic Commission for Latin America.

siderably from country to country.[7]

Growth in energy consumption in China was again very strong in 1988: 6-7% for petroleum products, 10-11% for final electricity, and 6% for overall primary energy consumption. It was based on the very rapid rate of industrial development (21%), due especially to that in light industry (23%), and to some extent on growth in the most highly energy-consuming industries, such as steel (5.2%), cement (9.1%) and chemical insecticides (20.7%). It was difficult to keep energy production in line with demand, since oil production grew by only 2.2%, with the result that exports stopped rising and foreign coal sales contracts were revised downwards. Some commentators are already talking about an "energy crisis" (*Petroleum Intelligence Weekly*, 1989b).

In the Soviet Union, oil demand stagnated and natural gas demand grew moderately. The winter was not particularly hard and it appears that economic growth has not been strong; as well, the results of energy conservation efforts may be starting to take effect (*Pétrostratégies*, 1989b). In contrast, the delay in the nuclear program since the Chernobyl accident means that oil-fired power stations have to be kept in service. Given the stagnation in oil production (624 Mt in 1988), this demand trend has nevertheless allowed an increase in the volume of exports (4.4%) and re-exports (of about 5%).[8] This volume fell considerably in 1989.

...

If we attempt a provisional overall view of these trends in world primary energy consumption

Table 7: Economic Growth in Southern and South East Asia (%)

	1987	1988	1989	1990 [f]
India*	3.6	3.1	9.0	4.0
South Korea	12.0	12.0	7.5	6.5
Thailand	8.4	11.0	10.5	10.0
Indonesia	3.6	4.7	4.5	-
Malaysia	5.5	8.7	7.7	6.5
Taiwan	11.0	7.3	7.2	-
Philippines	5.9	6.5	5.8	-

[f]: forecast
*fiscal year

Source: Average annual growth rates in GDP according to *Far Eastern Economic Review* (1989).

during 1988 (excluding the traditional energy sector), we arrive at a rate of growth likely to be between 3.5% and 4%. This estimate is close to that provided by the *BP Statistical Review of World Energy* (see Table 8).

During 1989, growth in consumption remained strong in Asia but slowed down in the OECD countries and apparently in the Soviet Union and Central Europe as well. Based on the limited information available at the end of the year, developments in 1989 have not altered the general trend towards a return to growth in world energy consumption.

3. The Redeployment of Energy Investments

The confirmation of the upturn in energy demand in 1988 did not lead to generalized pressure on the supply side. Available production capacity remained high in the short-term for oil, natural gas and coal and, in industrialized countries, even for electricity.

In the longer term, if demand trends continue in their present direction, the situation will depend on how the various energy industries in-

7/ The following data come from work on centrally-planned economies by Catherine Locatelli at IEPE.

8/ Part of the crude oil imports linked to the export of materials is re-exported by the Soviet Union to countries which pay for their oil in hard currencies.

Table 8: Changes in World Primary Energy Consumption 1987-88 (%)

	Oil	Natural Gas	Coal	Primary Electricity	Total
OECD	3.3	3.3	3.6	3.7	3.4
North America	3.5	5.9	4.4	11.8	4.5
Europe & the West	1.5	-3.7	0.5	4.4	1.0
Japan & southern regions	7.5	6.5	7.3	-4.3	5.4
Latin America	1.8	6.6	0.9	3.2	2.9
Africa & Middle East	2.9	6.2	7.9	7.4	4.4
Southeast Asia	13.9	13.4	9.5	2.7	11.4
Southern Asia	8.7	6.8	8.9	2.3	8.0
China & other socialist countries of Asia	5.8	4.7	5.0	5.0	5.1
USSR & Central Europe	-0.7	5.7	1.0	5.1	2.2
Total	3.1	4.7	3.7	3.8	3.7

Source: *BP Statistical Review of World Energy* (1989).

vest. What conclusions can be drawn in this respect for 1988? How did the various energy industries react to movements in prices and demand? Which technologies and which regions attracted investment decisions?

In addition to the diversity which we have already underlined, several main trends can be discerned:

- The favourable results in 1988 and the stronger medium-term outlook for oil and natural gas industries have stopped the decrease in exploration-production investment, a part of which appears to be returning to OPEC countries.
- The restructuring of the coal industry is accelerating, with mine closures in Western Europe and the opening up of new production capacity (mainly around the Pacific basin).
- Handicapped by the nuclear impasse and renewed attacks on coal-based electricity production (the most important source of CO_2), the electricity industries are looking for new directions in which to develop their production capacity (though the financial constraints on this are particularly tight in the developing countries). Natural gas is the principal energy form to benefit from this situation.

3.1 Oil and Gas: Renewed Interest in the OPEC Countries

The combination of sustained demand and low crude prices has lead to strong growth in downstream profits (refining and, especially, chemicals) and good consolidated results for most companies (see Table 9).

Oil company investments are all rising significantly: 42% in the case of the majors; 50% in the case of the large North American independents; and between 40% and 100% for the various companies based in Europe or belonging to oil-producing states. The share of these investments directed towards exploration-production is obviously subject to large variations, but growth in spending on upstream activities (exploration, development, acquisitions) was in some cases

Table 9: Profits and Investment for Several Large Oil Companies — 1987-88 Percentage Change

	Net Profits	Investments	
		Total	Upstream
Majors	69.6	41.9	54.8
Chevron	41.4	106.0	155.1
Exxon	8.7	5.2	-4.4
Mobil	54.8	39.9	19.8
Texaco	-132.7	27.1	24.8
Independents	33.2	50.4	88.9
Amerada Hess	-45.9	109.8	n.a.
Amoco	51.7	58.5	n.a.
Arco	29.3	125.8	263.2
Maxus	-234.7	24.0	n.a.
Kerr MacGee	35.8	103.5	102.3
Murphy	0.0	17.9	n.a.
Occidental	25.8	62.8	n.a.
Phillips	1757.1	8.1	-3.6
Sun Oil	-98.0	13.3	11.0
Unocal	165.2	25.4	23.2
USX	7.0	-5.5	n.a.
Others			
Petroleos de Venezuela	-33.0	43.0	47.0
Petrofina	17.0	100.0	n.a.
Statoil	-122.8	-12.7	-8.2
Petrobras	181.9	-28.9	n.a.
SNEA	72.3	46.0	18.0
Total CFP	13.2	69.3	95.9

Source: Company reports and MIDOIL Data Base (IEPE, Grenoble).

considerable in 1988.[9] The 12 largest British and North American companies were able to replace 145% of extracted oil and gas — a distinctly higher level than in recent years.

However, half of this replacement comes from the purchase of existing reserves from other companies, some of which have been totally absorbed (Britoil, Dome, Tenneco). The other half comes from re-evaluations, improved recovery techniques and 1.7 Mb/d of extensions of reserves or discoveries (*Petroleum Intelligence Weekly*, 1989a). Thus the increase in upstream investment expenditure in 1988 was relative to a level which had remained low since the sharp fall that began in 1982. Two unfavourable trends came together, one of which now seems to be in the process of changing.

The first was the persistent lack of interest in exploration in the United States. Despite the appearance of a trough and the beginning of an upturn in 1988 (due to a substantial increase in bonuses for permits on the continental plateau), investment had fallen very rapidly. It was estimated at less than $11 billion in 1989 — one-fifth of the 1982 figure (*Oil and Gas Journal*, 1989).

The second trend was the reduction in exploration in the member countries of OPEC and OAPEC (Organization of Arab Petroleum Exporting Countries). All the indicators concerning this latter group have been falling since 1983-84: the number of months in which seismic teams operated, the number of exploration-development drilling operations, the number of metres drilled. This trend was reversed in 1988. Although it continued to fall in all other regions of the world, in the OAPEC countries the number of drilling teams rose from 163 to 176; the number of metres drilled (in thousands) rose from 1553 to 1828, and the number of exploration-development drilling operations from 710 to 726 (this figure is expected to reach 859 in 1989) (*World Oil*, 1989).

This movement is certainly not independent of the increase in the number of exploration licences issued by the OAPEC member countries since 1985. This jumped from 20 to 28 in 1988 (*Pétrostratégies*, 1989a). Indeed, numerous oil companies — especially those North American companies seeking to shift their upstream investments away from North America — are awaiting an opportunity to return to the developing OPEC and NOPEC countries. Some companies (Conoco, Marathon, Occidental, Amerada Hess, W.R. Grace) have even obtained permission from the Bush administration to remain in Libya (*La lettre Afrique énergies*, 1989).

European countries have not been left behind: AGIP, Veba Oil Libye and Denimex are active in Libya; AGIP and CEPSA have had their exploration contracts confirmed in Algeria, where Total

9/ The information concerning oil company results come from the MIDOIL data base set up by B. Bourgeois of IEPE, whose help has been indispensable.

CFP was given two exploration and production contracts at the end of March 1989.

The trend towards greater openness on the part of producing countries is quite clear. It requires, however, numerous regulatory and political changes — which explains a certain slowness at times.

3.2 *The Coal Industry*

The coal industry's growth has, until now, not suffered the same constraints as the hydrocarbon industry.

In the US, production, mainly directed to the domestic market, reached 860 million tonnes in 1988 and could rise by a further 20 Mt in 1989. The opening up of Pacific markets is manifested in the 1990 start-up of the Montana deposit by Meridian Minerals: from 1995, 70% of the annual 5 Mt production will go to Sumitomo (Japan).

China and the Soviet Union still hope to satisfy their domestic needs, at the same time producing a surplus available for export, though these plans are obviously subject to fast-changing economic and political developments in these countries.

Trade continues to grow between the major coal-importing countries (Japan and Western Europe) and those which depend on exports. Restructuring is well under way on both sides.[10]

Under the twin pressures of the fall in the price of oil and the desire to withdraw from coal production for other reasons, the one-time coal-producing countries in Western Europe accelerated their mine closures in 1988. The last two mines still in production in Belgium (Beringen et Zolder) will close at the end of 1992. In Western Germany, the Rheinische-Braunkohlen Werke and the Bergwerksverein Saarbergwerke reduced their production capacity by 1.7 Mt/yr. And in the UK, British Coal closed 4.1 Mt of production capacity in Yorkshire, Kent and the Midlands.

In the face of these closures, major new production capacity has been opened in Australia, Canada, Columbia, Egypt, Indonesia, Malaysia and Tanzania (see Table 10). New coal industries are developing, usually on the basis of open cast deposits with low direct costs and sheltered from strong environmental constraints. Who is investing? The principal oil companies would appear to be at the top of the list: Shell Australia, having acquired CSR's shares in three big steam coal mines, has become one of the largest coal operators in Australia, with annual production capacity of roughly 10 Mt (*Revue de Presse Etrangère de CDF*, 1988). But Esso (a subsidiary of Exxon) has also acquired part of CSR's capital, and ARCO Coal (an Atlantic Richfield subsidiary) has acquired part of ACI's assets and is now selling 5 Mt of coal per year. Adding the 5 Mt sold by BP, the extent to which the big oil companies have gained control over Australian coal production and sales is evident.[11]

3.3 *The Electricity Industries*

Although it varies from region to region, an upturn in final demand for electricity is in evidence. While the growth rates for India (7.2%), China (11%), Thailand (13.5%) and South Korea (15.8%) remain exceptions among developing countries, relatively high rates reappeared in the industrialized countries in 1988: 7% in Japan, 5% in the US, 2.8% on average in the European Community.

This upturn increases the risk of tension in relation to the obstacles that electricity industries continue to encounter in several regions. Existing overcapacity is likely to disappear faster than expected, especially as fewer nuclear power stations are brought into service. Installed nuclear power in the world grew 4.1% in 1988, as opposed to 6.5% in 1987 (see Table 11).

Opposition to the development of nuclear power has not diminished. In Western countries it has manifested itself in the refusal of authorities in Schleswig-Holstein (West Germany) to bring the Brokdork power station back into ser-

10/ The following data were put together by Olivier Quivy and confirmed by Mme Kohiyama of Charbonnages de France, to whom I would like to express my thanks. See also Doyle, Johnson and McCloskey (1989).

11/ For a more detailed view see *International Coal Report* (1988) October 7.

Table 10: Principal Coal Mines Under Construction or Planned in 1988

Location	Capacity (thousand tonnes per year)	Companies
Australia		
Hill River	4.0	CRA Ltd
Hunter Valley	4.0	Coal & Allied
Claremont (P)	6.6	QLD
Ensham (P)	2.0 - 5.0	QLD
German Creek (P)	1.2	QLD
N. Goonyella (P)	2.0 - 3.0	QLD
Ulan (E)	2.0	NSW
Canada		
Quinsam	1.3	Brinco
Stellarton (C, 1991)	1.0	Westray
Colombia		
Cerrejon Central (C)	1.6 - 5.0	Carbocol
Cerrejon Norte (P)	10.0 - 15.0	Carbocol
La Loma (C)	10.0	Drummond
La Jagua (C, 1994)	0.6 - 2.6	Prodeco
El Descanso (C, 1994)	10.0	Carbocol
Egypt		
El Arish	0.6	Sinai Coal
Maghara (C, 1994)	0.8	Babcok
Indonesia		
Kaltim Prima (C, 1995)	7.0	
Arutmin (C, 1992)	2.0 - 4.0	
Isideco (C, 1992)	2.0	
Malaysia	0.5	Global Mineral
Venezuela		
Paso Diablo (C, 1995)	6.5	
File Maestra (C, 1991)	1.0	
Tanzania		
Kiwira (C, 1995)	0.3	S. Minière Nationale

Source: See footnote 10 in text.
Note: Status and date production to begin: (P), planned; (E), extension planned; (C, date), under construction & date production to begin.

vice and by the inability of American power authorities to use completed stations (Shoreham and Seabrook). In other places, opposition has been still more radical, the restarting of nuclear programs having been totally abandoned in Switzerland, the Netherlands and Italy, where 13 GWe of existing capacity have just been voluntarily taken out of service.

Outside the EEC countries, only South Korea and Mexico (at Laguna Verde) have commissioned new reactors. The stoppage of several power stations, particularly in Armenia, and the interruption of several construction projects (including 12 nuclear projects) in the Soviet Union and Poland in 1988, are particularly noteworthy, since these countries were hitherto not subject to anti-nuclear lobbies.

For the moment, coal-based electricity production remains the principal alternative. In 1988, electricity companies in the US invested $4.9 billion in this sector (7.3% more than in 1987), as opposed to $8.6 billion in nuclear power (down 3.5%) (*Electrical World*, 1989). In Japan, where coal accounts for 10% of current electricity production, the latest forecast issued by the Ministry of International Trade and Industry (MITI) allows for a 15% share by the end of the century (*International Coal Report*, 1988).

Natural gas is benefiting from obstacles to nuclear power, as well as from the dangers linked to the burning of coal. Thanks to rapid technical advances in recent years, combined cycle gas turbines are increasingly sought after. In the US, investment in electricity production of this type rose from $51 million in 1987 to $180 million in 1988 and could reach $259 million in 1989 (*Electrical World*, 1989). According to the 1988 edition of the *Annual Outlook for US Electric Power*, 22 of the 53 GWe of new capacity which the electricity industry will have to provide in order to meet demand in the year 2000 will come from gas-fed combined cycle plants and 14 from gas turbines for peak demand.

In the UK, the companies that have taken over from the Central Electricity Generating Board have postponed the construction of new coal-fired power stations, which they have been able to replace by smaller gas-fired plants (*Enerpresse*, 1989). Recently, the Department of Energy authorized the construction of two plants of this type. Gas-fired power stations are also envisaged in Sweden to replace the nuclear plants which the authorities have undertaken to dis-

Table 11: World Nuclear Power Production Capacity (1 January 1989)

	Share of electricity production in 1988 (%)	Installed capacity (GW)	Brought into service in 1988 (GW)
OECD member countries			
US	19.5	98.0	1.4
France	69.9	52.9	2.8
Japan	23.4	28.2	1.3
Federal Germany	34.0	22.7	3.8
UK	19.3	14.1	2.3
Canada	16.0	12.2	-
Sweden	46.9	9.7	-
Spain	36.1	7.6	1.1
Belgium	65.5	5.5	-
Switzerland	37.4	2.9	-
Finland	36.0	2.3	-
Italy	0.0	0.0	-1.3
Netherlands	5.3	0.5	-
Developing countries			
South Korea	46.9	6.3	0.9
Taiwan	41.0	4.9	-
South Africa	7.3	1.8	-
India	3.0	1.3	-
Argentina	11.2	0.9	-
Brazil	0.3	0.6	-
Pakistan	0.6	0.1	-
Mexico		0.7	0.7
Socialist countries			
USSR	12.6	33.5	-0.4
Bulgaria	35.6	2.6	-
East Germany	34.0	1.7	-
Hungary	48.9	1.6	-
Yugoslavia	5.2	0.6	-
Czechoslovakia	26.7	3.1	-
Total		316.5	12.6

Sources: International Atomic Energy Agency, Vienna, for shares of electricity production; ELECNUC (1989) for installed capacity and 1988 service dates.

Notes: Installed capacity refers to the net capacity of units that have had their initial start-ups. Installed capacity for the USSR and East Germany are estimates.

mantle. In Japan, Tokyo Electric Power has opted to install a large eight-unit, combined-cycle plant with a capacity of 2600 MWe.

4. Conclusions: New Sources of Flexibility and Rigidity

Energy markets appear to have turned around during 1988 and 1989. Growth in demand has reduced excess supply. Higher rates of economic growth, especially in Pacific Rim countries, have obviously played an important role. But OPEC's strategy has also had a part in the turnaround: despite an apparent confusion, OPEC was able to implement a strategy that has come close to protecting both prices and market shares. Movements in demand and supply mutually supported each other.

Is this turnaround a sign of market pressures in the near term? Or even of future energy crises? Any attempt to make such forecasts must account for new sources of both flexibility and rigidity in energy markets.

In the oil industry these new elements of flexibility have encouraged renewed growth and have limited the risks involved in overall energy supply.

In the upstream sector, numerous countries which, several years ago began to look for ways to reduce their reliance on foreign operators, are now going into exploration and production. Although their contribution to world supplies remains fairly limited, the new NOPEC countries are undergoing rapid expansion. Moreover, the OPEC countries are once again welcoming foreign oil companies, very often through joint ventures. The effect of this change will become greater as the companies involved increase their productivity by adopting rapidly developing exploration-production techniques. The centrally-planned economies could also benefit from this and put a stop to the rapid run-down of their reserves.

Downstream, the internationalization of several companies based in producer-exporter countries also benefits the oil industry. This movement will continue, even though opportunities will, for a time, be limited to the most dynamic companies and those with the strongest financial resources. Through their shares in refining and distribution, these companies are contributing to a reorganization of the oil industry

that should limit the risks of confrontation and renewed tension.

On the energy users' side, there are further sources of flexibility that could avoid a return of tensions related to oil supply. Outside the gasoline and chemical feedstock sectors, substitution possibilities have increased among petroleum products, natural gas, coal and even electricity. They have actually become instantaneous for certain uses and even in the chemical industry there is a substitution role for natural gas. From now on, any significant upward pressure on oil prices will come up against a limit that is all the more effective because of the speed with which natural gas and steam coal production capacities are being renewed.

We should, however, be wary of adopting an overly optimistic attitude. As well as this newfound flexibility, new sources of rigidity have become evident in the past two years. Some rigidities involve the industrialized countries in both the West and the East; others are observed in certain groups of developing countries.

The key factor in the industrialized countries has been the return of environmental issues to the front line of debate. Concerns about the environment have been expressed with sufficient vigour and substance to lead public authorities to respond to them without delay (as illustrated, for example, in measures taken in the US by President Bush soon after he was elected). The series of accidents linked to offshore production and hydrocarbon transport, and the excesses of road transport (increasingly seen as a major hazard), have supported the positions of some opposition movements. The Chernobyl accident created other sources of opposition, including those, in a new turn of events, in the Soviet Union and Eastern European countries. In addition to these national concerns have come signs of an awakening to ecological issues on a planetary level, fed by fears of an excessive accumulation of CO_2 in the atmosphere. The impact of these worries has already been felt in terms of the evolution of electricity capacity which, in some countries, no longer has any room for manoeuvre. It could at some future time be felt in the road transport sector.

In the developing countries (particularly the poorer ones such as those in Africa) sources of rigidity are quite different. Faced with very strong population growth in the next century, the African continent cannot meet its requirements if it continues to depend on energy sources which are increasingly difficult to produce and renew (wood), and if it continues to export (oil and coal) to others in the absence of outlets within its domestic markets. In this case insufficient investment is the main cause of rigidity — efforts to develop new techniques oriented towards the developing world are stagnating or have even been abandoned.

Environment and development. In both cases the limits of the market system can be clearly seen.

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