

THE WORLD ENERGY SITUATION AND PROSPECTS FOR THE 1980s

Colin Robinson

ECONOMICS
DEPARTMENT

SURREY ENERGY ECONOMICS
DISCUSSION PAPER NUMBER 4

APRIL 1981

THE WORLD ENERGY SITUATION AND
PROSPECTS FOR THE 1980s*

Colin Robinson

* Amended version of a paper given to a Conference on World Transport of Energy on 26-27 February 1981, organised by European Study Conferences in conjunction with Staniland Hall Associates Ltd..

THE WORLD ENERGY SITUATION AND
PROSPECTS FOR THE 1980s

Colin Robinson

1. INTRODUCTION :

The three objectives of this paper are

- to set the present world energy situation in historical perspective;
- to sketch out some of the energy trends we may anticipate in the 1980s;
- to make some very brief introductory remarks about world transport of energy in the 1980s.

As much of the paper concerns the future I should preface my remarks by acknowledging that many people are, with good reason, extremely sceptical about the value of energy market forecasts. The 1970s are littered with discredited energy forecasts many of them made by people whose idea of "forecasting" is to project a past trend or to use a naive correlation between energy consumption and real GNP. In comparatively settled conditions such methods may give the appearance of working but they are merely misleading when there are substantial variations in the price of energy relative to other goods and in the price of one fuel relative to another. Obviously one wants to avoid such gross methodological errors. But it is also prudent to adopt a reasonable humility in saying anything at all about the energy future. We see it only through a very dark glass. One day we shall be face to face with what is now the future, but for the time being we cannot hope to do more than select some important determinants of the energy future, assess how they may change and try to understand the effects of the changes.

2. POSTWAR TRENDS IN ENERGY CONSUMPTION :

2.1 Pre-1973 :

A simple table will help to bring into perspective the energy "crisis" of recent years. Table 1 shows estimates (based on United Nations

statistics) of world consumption of commercial sources of energy from 1950 to 1979. For the purpose of analysis, I have divided the period into two parts - 1950 to 1973 and 1973 to 1979. Unfortunately, we do not yet have complete statistics for 1980 but I shall say something about that year as we consider the table. We can see the following three important features of the pre "crisis" period 1950 to 1973.

- (i) a rapid growth in world energy consumption at over 5 per cent per annum compound on average. That is about the same rate at which world real GNP was increasing during the period. The growth of energy consumption was fairly steady throughout the 1950s, 1960s and early 1970s - it was 5½ per cent per annum between 1950 to 1960 and about 5 per cent per annum between 1960 and 1973 - which is what one would expect in the relatively settled economic conditions which we can now see persisted up to the early 1970s. A growth rate of 5 per cent per annum implies a doubling of world energy consumption about every 14 years.
- (ii) a drastic decline in the share of solid fuel in world energy, even though the tonnage of solid fuel consumed was increasing. In 1950 solid fuel accounted for over 60 per cent of world energy consumption; by 1973 its share had virtually halved to just over 30 per cent. The principal reason for this sharp decline was, of course, the increasing competitiveness of oil and gas. Particularly in the old-established deep mining areas where coal production remained highly labour-intensive, coal prices rose relative to oil and gas prices and in regions such as Western Europe coal consumption fell in absolute as well as relative terms despite considerable protection from governments.
- (iii) fast increasing consumption of oil and gas because of the same market forces which brought relative decline to coal. Oil in particular carved out a large share of the market - 45 per cent in 1973 compared with only 27 per cent in 1950 - as its falling relative price stimulated improvements in consumption and transport technology which brought it into widespread use as a fuel for industry and power generation. During these years international

transport of natural gas, by pipeline or in liquefied form by tanker, was still in its early stages. Nevertheless, world gas consumption increased rapidly and in 1973 was over 6 times what it had been in 1950.

In very broad terms, Table 1 demonstrates that in the postwar period up to 1973 we lived in a world which relied for its energy almost entirely on fossil fuels. Hydro and nuclear electricity remained minor sources of energy on a world scale although they were, of course, important in some countries. The period began with coal supplying nearly two thirds and oil and gas just over one third of world energy. It ended with the positions more or less reversed: coal's share was about one third whereas oil and gas had roughly two thirds of the market.

2.2 Post 1973 :

Since the early 1970s, the price signals which energy producers, transporters and consumers receive have of course changed dramatically and market behaviour has, as a consequence, begun to alter. We need to look at why the market changed because it should have something to tell us about what may happen in the future. In the brief discussion which follows of the determinants of energy market changes in the early 1970s I am not concerned to assign blame or praise to anyone, but simply to try to explain what happened. I begin with the oil market because that was the source of the principal changes.

In a market such as crude oil there is a natural tendency for producers to try to form groupings. There are relatively few producers so that in principle, agreements are fairly easy to reach. The demand for individual crudes is fairly elastic but the market demand for crude oil is inelastic, except in the long run, because of the absence of close substitute products. Producers will therefore try to suppress competition among themselves so as to take advantage of the inelasticity of market demand; in that way, they can increase the profits of the group as a whole. When the producers concerned are private companies their natural desire to form groups can be countered by government action (such as anti trust laws) but it is more difficult when the producers are governments.

During the 1960s the crude oil market was not dominated by any producer grouping even though OPEC had been formed in 1960. Indeed, in many countries oil prices fell in real terms. By the early 1970s, however, a significant change came over the market in that expectations were formed of future oil scarcity and therefore future oil price increases. In such circumstances oil will tend to be held back for the higher-priced future (assuming that the rate at which prices net of costs are expected to rise exceeds producers' discount rates). Even in a competitive market, output would probably have been reduced and prices would have risen providing increased revenues to the producers because of the inelasticity of market demand. How much difference OPEC made is not entirely clear but its presence in the market may well have accentuated the price rise in 1973-74.

The behaviour of the oil producing countries in the early 1970s is thus explicable in terms of the economist's standard resource depletion theory.¹ I have no doubt that other factors were also important - for instance, OPEC's growing confidence after it had existed for over 10 years, and a desire to lead a Third World crusade against "exploitation". The 1973 Arab-Israeli war also provided the proximate reason for the 1973 oil price increases. Nevertheless, without the economic forces we have mentioned, it is doubtful whether such increases could have been made.

We should note, as an important aside, that OPEC is not and never has been a true cartel. If it were, it would have an explicit output - sharing scheme - something on which its members have never been able to agree. For a while after 1973 it had a dominant producer (Saudi Arabia) willing to vary output to maintain the price level. More recently, OPEC as such seems to have had little influence on oil prices. Prices have increased in the last two years primarily because of shortages and uncertainty resulting first from the Iranian revolution and its after-effects and then from the Iran-Iraq war. OPEC seems to have done little more than meet, ex post, to try to reach some measure of agreement on what the price actually is in a rather confused market.

The process of rising oil prices which began in the early 1970s contains the seeds of its own eventual destruction. As oil prices go higher, the

desire to shift away from oil increases and the ability to shift should also increase as technological change is stimulated. It is not entirely clear what the market price of crude oil is at the moment. Table 2 shows the changes since 1970 in the f.o.b. price of Light Arabian crude oil, which used to be the "marker" crude. The official price is at present \$32 per barrel. However, pricing is in some disarray because there is a "deemed" marker crude price of \$36 per barrel, Saudi Arabia itself is reported to be selling some crude to countries affected by the Iran-Iraq war at \$36, spot prices in early March 1981 are slightly above the official prices and there are all manner of premia being charged by different countries. As an approximation we can say that the weighted average price of Light Arabian type crude oil is probably around \$36 per barrel now. That is about twenty four times the market price of a similar crude in 1970, when market prices were a little below posted prices. In real terms, of course, the increase has been much less. If we deflate the increase in nominal terms by the U.S. dollar index of the unit value of world exports of manufactures which approximately tripled between 1970 and late 1980 we find that the real increase in the crude price has been about 8 times in the last ten years. There was a big upward step in real terms in 1973-74 followed by relative stability until 1978 when real prices drifted downwards, to be followed by further large real increases from mid 1979 onwards.

Such real increases should, on the face of it, set in motion powerful forces to shift consumers away from oil. Let us examine, with the aid of Table 1, the record since 1973 to see if there are signs of such adjustment.

The most significant market changes of the last few years are quite obvious from the final two columns of Table 1. They are what one would predict is a situation of rising real energy prices when the prices of oil and gas are increasing faster than those of other fuels. The rate of growth of total energy demand halved in 1973-1979 compared with 1950 to 1973 as energy prices increased relative to prices in general and world real GNP grew only slowly; oil consumption increased at less than 2 per cent per annum instead of $7\frac{1}{2}$ per cent; gas consumption grew at about 3 per cent per annum compared with $8\frac{1}{2}$ per cent in the earlier period; and there were signs of some revival in coal, consumption of which rose slightly faster than total energy demand so that its market share began to increase a little. If we had full 1980 figures we would doubtless find the contrast

between the pre 1973 and post 1973 periods accentuated. 1980 was a year in which world real GNP increased only, slightly - perhaps by 1 per cent or so and world energy consumption may well have fallen. We know, for example, that in the OECD countries preliminary estimates show that oil consumption fell by about 7½ per cent last year (from 38.6 million b/d in 1979 to 35.7 million b/d in 1980) and in the non-communist world oil consumption appears to have dropped by about 6 per cent in 1980.²

There has also been a reduction in OPEC's share of world oil output, as Table 3 shows. In 1973, the members of OPEC produced about 54 per cent of the world's oil but in 1980 the OPEC share was down to less than 44 per cent. Although both Iranian and Iraqi production were reduced in 1979 and 1980 by what are generally believed to be abnormal events, the downward trend in OPEC's share since 1973 is well-established: it is partly a consequence of a deliberate policy of "conservation", but it is also due partly to competition from newer producing countries. Non-OPEC producers such as Mexico, Britain and Norway, have been increasing production substantially and Soviet output has also risen somewhat. OPEC's share of world crude oil exports has also fallen from its peak of over 87 per cent in 1973 to probably just over 80 per cent last year.

Adjustment to the changed energy situation has clearly begun and to the extent it has occurred it seems to be attributable mainly to market forces. There is little sign that the policies of national governments or the EEC have helped: to some extent, indeed, government policies have been a hindrance to adjustment in that they have attempted to hold down energy prices, as U.S. administrations did until very recently and as the Canadian government is still doing.³ The one substantial government achievement seems to have been to establish the IEA emergency sharing plan. Otherwise the periodic international meetings of consumer governments seem to have produced no more than general expressions of concern and oil import targets that would almost certainly have been achieved anyway as a consequence of rising oil prices and economic recession. Like OPEC meetings they have been well-staged and apparently dramatic events which, in fact, are of rather minor consequence compared with what is happening in the energy market place.

Despite the incipient adjustments we can see in the energy market, most observers of that market would probably agree that the speed of the adjustment

process has so far been disappointing, particularly on the supply side. Energy demand and more especially oil demand have been depressed to some extent by relative price and income effects but there is little sign of any significant production from new non-oil sources of energy supply. For as long as one can remember we have heard that a relatively small rise in oil prices above some threshold would stimulate the production of substitutes - whether tar sands, shale oil or nuclear power - the prices of which would set an upper limit for conventionally-produced crude oil. Evidently it has not happened yet. It is worth enquiring what constraints there have been on energy market adjustment in the last few years because we should thereby learn something about that may happen in the 1980s.

3. CONSTRAINTS ON THE ADJUSTMENT PROCESS :

3.1 Relatively small consumer price increases

Before considering true constraints to adjustment, we should examine what have been the price signals received by consumers. One reason why the market has not adjusted as fast as one might expect given the large increase in the real f.o.b. price of crude oil is that, for a variety of reasons, real consumer prices of oil and other fuels have risen much less. For example, the c.i.f. price of crude has risen less than the f.o.b. price. Oil company other costs have also increased at a slower rate than the cost of their crude oil. More important, the specific duties which are levied on oil products in most consuming countries have fallen substantially in real terms, even though for some products such as gasoline taxes in Europe still constitute over half the consumer price. Furthermore, there has been rapid general inflation since 1973 which has limited the rise in energy prices relative to the general price level. If we take Britain as an example,⁴ we find that in the household market the real price of heating oil rose by just under 90 per cent between 1973 and mid 1980 and the real price of all household fuels increased only about 16 per cent. Over the same period, the real price of fuel oil rose about 190 per cent and the real price of all industrial fuels approximately doubled. The oil price increases are large but much less dramatic than the increases in the f.o.b. export price of crude, which over the same period was multiplied about five times in real terms.

3.2 Government action

A second factor we have already mentioned as an obstacle to adjustment is the attempt by some governments to shield their citizens from rising energy prices. The United States has until recently been the worst culprit but there has been an element of fuel price subsidisation in many countries. In Britain, for instance, household gas prices have been held down and Canada is still trying to keep its crude oil prices below the world level.

3.3 Time lags in demand response

A third factor which reduces the speed of adjustment to a change in energy prices is the complementarity between fuels and fuel-using equipment. When energy prices change relative to prices in general and relative to one another, there is inevitably a significant time lag before consumers bring their actual stocks of fuel-using equipment into line with the stocks they desire on the basis of the new prices and the prices they expect in the future. Although all manner of housekeeping measures can reduce fuel consumption considerably, as we have seen in the last few years, large savings require investments in energy-conservation and in fuel switching which seem to require big real price changes (actual and expected) before they become economic. Recession, too, blunts the willingness to invest.

3.4 Time lags in supply response

I have already mentioned that the supply side response to the changed energy market has been particularly disappointing. To some extent a slow supply response to price changes is inevitable because of the time taken over such major projects as bringing in new oilfields, opening new mines and constructing new power stations. The supply reaction has, however, been slowed by a phenomenon which has become increasingly important in the last ten to fifteen years - concern about the environment. I am not here to discuss whether such concern is right or wrong - it would indeed be difficult to generalise - but simply to point out that new energy supply facilities tend to be obtrusive and to represent potential pollution hazards. Thus we must expect objections to such facilities to delay their introduction. Whether we are talking about offshore oil fields in the United States, hydro-electric schemes in Norway or coal mines

in Britain such delays have occurred and must be expected in the future.

However, the biggest "environmental" problem - or, at least, the one which has probably caused most delays on the supply side - concerns not the fossil fuels but nuclear power. It is a curious paradox that the replacement energy source which was most advanced by the early 1970s happened to be the one which arouses most public concern and opposition. Governments of industrial countries forced nuclear along in the 1960s at a time when public protest was small or seemed unimportant, but now nuclear power programmes are in deep trouble almost everywhere in the world. To some extent the delays are attributable to technical difficulties in construction or operation and to the labour relations problems which often occur on large construction sites. Nevertheless, the main factor now seems to be a failure to convince the public - or at least a certain articulate section of the public - that large nuclear programmes are needed. To earlier concern about the various possible sources of danger from nuclear fission has been added the argument that the likely slow growth of electricity consumption has undermined the basis of most nuclear plans.

There is room for reasonable people to differ about how real are the alleged hazards of nuclear power, about whether "public opinion" really is for or against, and about what may happen to electricity demand. But whatever one's views on such matters, the relevant point so far as we are concerned is that there is a large question mark over the public acceptability of nuclear power and that, whether we like it or not, further delays to nuclear programmes must be anticipated. Despite the oil supply problems of the last two years, an articulate section of public opinion is unconvinced of the nuclear case, as has recently been demonstrated again by the Brokdorf protests. Only France, which by the mid or late 1980s should (barring accidents) provide about half its electricity from nuclear fission, has a big nuclear programme (over 35 GW) which is more or less on schedule. Belgium is aiming to be about 50 per cent nuclear before the end of the 1980s but its programme is of course comparatively small. The Japanese also have a fair-sized nuclear plan (30 GW by the mid 1980s) which

has not so far been greatly delayed and Britain has a modest target of a total of 20 to 25 GW of nuclear plant by the end of the century. In the United States, however, which has over 50 GW of nuclear plant in operation, no new nuclear order has been placed since 1978 partly because of the Harrisburg accident, and the German programme, as I have already mentioned, is in disarray. Although before the "crisis" of the 1970s many people believed nuclear programmes to be over-ambitious and unlikely to be fulfilled, I do not think anyone predicted that the delays would be as great as they have been.

4. EXPECTATIONS FOR THE 1980s :

Since analysis of the past is a necessary (but not sufficient) condition for successful forecasting, I hope that our brief analysis of the energy market in recent times may help to identify in broad outline some of the trends we may expect in the 1980s. Nevertheless, I should repeat my earlier warning about the extreme difficulty of foreseeing events in a market as uncertain as energy. To give us a focus I shall concentrate my remarks around the switch away from oil. Virtually everyone would agree that in the long run energy consumers will have to use relatively little oil (and probably gas too), substituting other fuels whether fossil or nuclear, renewable or depleting. We may well disagree about the process by which the low-oil-use society will be reached - for example, whether the market will accomplish the transition largely unaided or whether heavy government involvement is required - but I do not want to discuss the means to the end.

I want to ask the question - how far can we expect the switch away from oil to proceed in the 1980s? Since we are looking a relatively short period ahead, we can ignore renewable energy sources such as solar, wind, tidal and wave power which may well be important next century.

4.1 The oil market

Since recent changes in the energy market have their roots primarily in oil, we should first consider the oil market in the 1980s.

It is tempting to believe that recent conflicts and changes of régime in the Middle East are a lapse from normality so that somehow soon all will settle down. I doubt it. Most probably the Gulf war will come to some kind of conclusion in the foreseeable future, but the uncomfortable fact is that there are sufficient sources of tension and potential conflict in the Middle East to generate throughout the 1980s periodic bouts of supply uncertainty. Even if open conflicts are avoided, there is likely to be continued uncertainty in the oil market about the production plans of Saudi Arabia and other major producers. Although OPEC's share of world oil production will probably keep on falling, its members will still supply the great bulk of internationally traded oil. In any case, the Organisation itself, as in the recent past, may well do little to increase prices. Instead we can perhaps anticipate a repetition of the pattern of recent years - though one hopes on a smaller scale - with actual or expected supply shortfalls driving up prices fast, only for them subsequently to fall moderately in real terms as they are eroded by inflation. About the least likely oil price scenario for the 1980s is a smooth upward progression, despite OPEC's attempt to find a formula linked to real GNP in the OECD countries, inflation and exchange rates. Rather than OPEC control of the market in the 1980s, which would imply an output allocation scheme in the Organisation, I suspect we are more likely to have a disorderly market with periodic step increases in real oil prices followed by slight downward drift.

If we are correct in assuming continued uncertainty in the oil market during the 1980s there are implications both for the growth of total energy demand and for the switch from oil. Let us consider energy demand first.

4.2 Total energy demand

The 1980s are off to an unpropitious start in terms of economic growth and the chances are that we should expect relatively slow economic expansion to continue in the rest of the decade. Our view of the oil market suggests that there will continue to be real income transfers from oil consumers to oil producers and associated balance of payments deficits in the consuming countries which will make governments cautious in their macroeconomic policies and place a constraint on world economic growth.

Thus world energy consumption will probably rise only gradually with what increase there is occurring mainly in fuels other than oil. A declining energy growth rate is, of course, an essential part of the adjustment to a world where existing energy producers will no longer supply at the prices they obtained in the early 1970s. The slow economic growth rate which lies behind gradually rising energy demand may cause all manner of problems associated with disappointed expectations in the developing world, but that is not a matter we can pursue here.

No one can hope to foresee accurately how fast world energy consumption will increase in the 1980s. The old days of 5 per cent per annum growth have obviously gone for now, though I would not be surprised if they return in the more distant future. Whether energy consumption in the 1980s will even increase at the rate of $2\frac{1}{2}$ per cent per annum or so which was achieved between 1973 and 1979 seems to me doubtful, given rather slow economic growth and the potential for more efficient energy use, gradually though the latter may be realised. For the whole decade of the 1980s the average annual rate of increase in world commercial energy consumption may be around 2 per cent or even less, assuming that governments allow energy price rises to feed through to consumers.

4.3 Substitutes for oil

It seems inevitable that the supply response to increasing energy prices will continue to be muted. During the 1980s we can expect little from "synthetic" fuels - whether from coal, tar sands or shale. Even the modest quantities of oil being produced from oilsands in Canada now seem to be in jeopardy because of the effects of the National Energy Programme and the dispute between Federal and provincial authorities. Nor can one reasonably expect a sudden acceleration of nuclear plans. My personal view is that actual nuclear capacity will probably lag behind even the much reduced programmes which are now being suggested, partly because electricity consumption will be increasing rather slowly so that electric utilities will be happy to delay their plans and partly because of continued public opposition. At present the non-communist world's

nuclear capacity is approximately 125 GW and the plans appear to be to raise that capacity to some 310 GW by 1990.⁵ Although plant which could be in service by 1990 is presumably all on order, it is probably optimistic to assume that it will all actually be in service by then. One certainly cannot preclude a really serious setback to nuclear programmes because of an accident somewhere in the world. The price we shall pay for the relatively slow expansion of nuclear capacity is that fossil fuel prices will be higher and economic growth will be lower than they would have been if earlier ambitious nuclear targets had been achieved. Whether you regard the price as a real one or not depends on how realistic you believe the earlier nuclear targets to have been.

The conclusion I would draw is that in 1990 the world energy balance will not look so very different from what it was in 1980. World energy supplies will probably be provided overwhelmingly by conventionally-produced oil, coal and natural gas. No doubt oil's share of the market will have declined but there might be some increase in the tonnage of oil consumed. There still appear to be large potential sources of oil outside the present OPEC countries which oil companies will seek to develop if they can do so profitably. The main question I have over relatively high-cost areas such as the northern North Sea and the Arctic is whether governments, which seem to regard the oil industry as a virtually inexhaustible source of revenues, can be persuaded to desist from taxing what they believe to be "windfall" gains. There is, I believe, a good case to be made that the prospect of comparatively high profits is a necessary condition if such areas are to be developed.⁶

Although oil seems destined to remain our most important fuel source in the 1980s and by far the largest fuel in international trade - at present nearly 90 per cent of world energy trade (expressed in oil equivalent tonnage) is oil - we can already see the new trends in fuel use which are likely to become more important as the 1980s progress and which have significant implications for world transport of energy.⁷

It seems clear, for example, that coal is due for a revival given the likely trend of oil prices and given the natural desire of many countries

to diversify sources of fuel supply. International trade in coal, especially steam coal, should, therefore, expand very considerably. Although many countries have coal deposits, those with relatively large reserves which lie near the surface and can be mined cheaply are comparatively few. The United States, Australia and South Africa will probably become substantial exporters of steam coal, though, as all the reports on world trade in coal have told us,⁸ the rate of growth of steam coal trade depends on the speed at which the necessary transport and handling infrastructure is developed: a particular bottleneck in the near future seems likely to be the lack of port facilities. However, internationally-traded coal is at present much cheaper than fuel oil and, given the competitive structure of the world coal market, there seems a good chance that coal export prices will in the long run rise much less than crude oil export prices. I am less confident that the deep-mining areas of Western Europe will be able to provide coal at competitive prices⁹ so that, even in countries with indigenous coal industries, there should be a market for imported coal if governments will allow it to appear. It seems a reasonable expectation that in the 1980s coal's share of the world energy market will start to rise after its long period of decline and that the speed of the revival in coal generally will depend primarily on the speed at which constraints on the world steam coal trade are lifted. At present, coal's share of world trade in energy is about 6 per cent (of oil equivalent tonnage) and that share might be expected to increase somewhat in the 1980s.

As well as a growing international trade in steam coal the prospects also appear reasonably good for trade in natural gas and LPG.¹⁰ A number of new gas export pipelines should be operating in the 1980s - for instance, the Norwegian gas-gathering line, the Trans-Mediterranean pipeline and perhaps some new pipelines from the Soviet Union into Europe. The LNG trade which has grown fast in the last few years and is dominated by Japan and the USA as importers and Algeria, Indonesia, Brunei and Libya as exporters will probably find its expansion restricted somewhat by higher prices. Nevertheless, the small share of LNG in world trade in energy (2 to 3 per cent of oil equivalent tonnage) may well increase, as may the even smaller trade in LPG.

I want to leave with you a simple message about world energy trends in the 1980s. Slowly and hesitantly, the world's gradual move away from oil has begun. Since oil is by far the largest fuel in international trade, the implications of that move for the pattern of world energy trade are very considerable. Even in the next ten years we are likely to see significant change emerging in the form of relative decline in the very large oil trade and relative increase in the much smaller coal and gas trades. Ten years, however, is a comparatively short time for adjustment in the energy market. The trends we think we can foresee for the 1980s will most likely presage much more substantial changes in the 1990s and beyond.

TABLE 1

WORLD CONSUMPTION OF COMMERCIAL ENERGY, 1950 TO 1979

	1950		1960		1970		1973		1979		Average Annual Compound Rates of Increase (%)	
	m.t.c.e.*	% of Total	m.t.c.e.	% of Total	m.t.c.e.	% of Total	m.t.c.e.	% of Total	m.t.c.e.	% of Total	1950-73	1973-79
Solid Fuels	1534	61	2206	52	2418	35	2503	32	2965	32	2.2	2.9
Liquid Fuels	672	27	1358	32	2936	43	3598	45	4020	44	7.6	1.9
Natural Gas	244	10	594	14	1368	20	1623	21	1945	21	8.6	3.1
Hydro and Nuclear electricity	42	2	85	2	154	2	186	2	280	3	6.7	7.1
TOTAL	2492	100	4243	100	6876	100	7910	100	9210	100	5.2	2.6

* m.t.c.e. = Million tonnes coal equivalent

SOURCES: 1950-73 Statistics are from World Energy Supplies 1950-74. United Nations, 1976.

1979 Statistics are estimated from BP Statistical Review of the World Oil Industry, 1979.

TABLE 2

CRUDE OIL PRICES, 1970-1980

Light Arabian crude oil, \$ per barrel,
f.o.b., Persian Gulf

	<u>Posted price</u>	<u>State sales price</u>
October 1970	1.80	
September 1973	3.00	
October 1973	5.12	
January 1974	11.65	
November 1974	11.25	10.46
October 1975	12.38	11.51
January 1977	-	12.09
July 1977	-	12.70
January 1979	-	13.34
April 1979	-	14.55
June 1979	-	18.00
November 1979	-	24.00
January 1980	-	26.00
April 1980	-	28.00
August 1980	-	30.00
November 1980	-	32.00

SOURCES: Colin Robinson and Jon Morgan: North Sea Oil in the Future, Macmillan, 1978 and The Petroleum Economist, various issues.

TABLE 3

WORLD AND OPEC OIL PRODUCTION
1973-1980

	<u>WORLD OUTPUT</u>	<u>OPEC OUTPUT</u>	<u>SHARE OF OPEC</u>
	Million tonnes		%
1973	2851	1542	54.1
1974	2876	1523	53.0
1975	2707	1348	49.8
1976	2937	1519	51.7
1977	3049	1524	50.0
1978	3097	1501	48.5
1979	3189	1524	47.8
1980	3066	1341	43.7

SOURCE: The Petroleum Economist, various issues

REFERENCES

- 1 See R.M. Solow, The Economics of Resources or the Resources of Economics, American Economic Review, May 1974, and Colin Robinson and Jon Morgan, North Sea Oil in the Future: Economic Analysis and Government Policy, Macmillan 1978.
- 2 The Financial Times, West's oil consumption expected to fall again, 4th February 1981.
- 3 The Petroleum Economist, Canada's policy in disarray, December 1980.
- 4 Department of Energy, Energy Trends, November 1980, Table 2.
- 5 The Financial Times, Regenerating the Nuclear Option, 4th February 1981.
- 6 Chris Rowland, Changing North Sea Profits Taxation and the Gains from Offshore Oil, Surrey Energy Economics Discussion Paper No.3, November 1980, and Colin Robinson, North Sea Policy Revisited, Lloyds Bank Review, July 1981 (forthcoming).
- 7 A detailed review of likely trends is in David Hawdon, Energy Transportation Requirements, 1980-1990, Surrey Discussion Papers in Energy Economics No.5 (forthcoming).
- 8 For example, World Coal Study, Coal - Bridge to the Future, Ballinger, 1980, and OECD, Steam Coal - Prospects to 2000, 1978.
- 9 See Colin Robinson and Eileen Marshall, What Future for British Coal? Institute of Economic Affairs, 1981 (forthcoming).
- 10 David Hawdon, Energy Transportation Requirements, 1980-1990, op cit