CONFIDENTIAL

ENERGY

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SECRETARY OF STATE FOR ENERGY
THAMES HOUSE SOUTH
MILLBANK LONDON SW1P 4QJ
01-211 6402

The Rt Hon Francis Pym MC MP
Secretary of State for Foreign
& Commonwealth Affairs
FCO
King Charles Street
London SW1

11 October 1982

Dear Secretary of State,

ENERGY SUPPLY PROJECTIONS

Thank you for your minute of 27 September.

My reasons for not making new Government supply projections for coal, gas and oil are that they are unnecessary, unreliable, and would give the Government nothing but trouble domestically.

However, I recognise the sensitivity of the US to the IEA's gas study and agree that we must find a way to participate in it as constructively as possible. What I propose is that in explaining our attitude towards making supply projections, my officials should stress to the IEA that we are nevertheless anxious that this study should proceed in a way that commands confidence. We should offer to discuss what data we have with the IEA, on a confidential basis, so as to enable the IEA Secretariat to produce their own estimate of UK gas supply on as informed a basis as possible. We should suggest that the IEA also spoke to BGC and to other gas producers with licences on the UK Continental Shelf. This Department's 1979 projections may also be of some help.

I am copying this to members of E Committee and Sir Robert Armstrong.

Yours sincerely

J. L. Cumming

pp NIGEL LAWSON

(Approved by the Secretary of State and signed in his absence.)

Energy, Policy, Pt 7

Energy Projection at Sizewell

FCS/82/143

SECRETARY OF STATE FOR ENERGY

1. Thank you for sending me a copy of your letter of 23 September to the Chancellor, with the set of energy projections.

2. Others are better placed than I am to comment on the wisdom in domestic terms of not publishing projections which could be made if we chose and which might leak. On the foreign policy side I am concerned about the repercussions that will follow from our resulting inability to give to the IEA and the European Commission individual fuel supply projections, particularly for gas. Both bodies have been accustomed to receiving supply projections from us in the past, and we have referred at both to the preparation of these latest projections, so our failure to provide relevant figures will not be readily understood.

3. My particular concern is with the IEA gas study. As you are aware, George Shultz has proposed alternative energy sources as an item for discussion among the Foreign Ministers of the Five and this is likely to concentrate on alternative gas supplies. We will be taking the line that the IEA gas study, perhaps under some sort of NATO umbrella, will meet this requirement. The study was commissioned as a result of an American initiative, and has always been closely and directly linked with the Siberian pipeline debate. The Americans and our European partners can both be expected to be upset if we fail to cooperate fully with the study, and fail to provide figures which they know we are likely to have available.

/4.

4. In these circumstances I hope you will be able to agree to your officials passing at least the gas supply projections to the IEA Secretariat and to the European Commission on a confidential basis, and not for publication.

5. On the Community side I accept that their gas study will be less affected and that we have already provided many of the figures on gas supply that they need. Nevertheless, our partners there may be less helpful over our planned Community coal initiative if they think we are being uncooperative over the provision of information to them. I hope, therefore, that we can pass on a similar confidential basis our individual supply projection to them.

6. I am copying this to the members of E Committee and to Sir R Armstrong.

(FRANCIS PYM)

Foreign and Commonwealth Office
27 September 1982

Prime Minister (2)

MCS 27/9

01 211 6402

The Rt Hon Sir Geoffrey Howe QC MP
Chancellor of the Exchequer
HM Treasury
Parliament Street
London
SW1

23rd September 1982

Dear Chancellor

My Department has prepared the attached set of energy projections as part of the Department of Energy's evidence for the public inquiry into the construction of a Pressurised Water Reactor at Sizewell.

I have made my views on energy projections clear publicly on a number of occasions. No-one can predict with any confidence what UK energy production will be in twenty or thirty years time. But, for the most part, we do not need to. Oil, and increasingly coal and gas are internationally traded. Because we have access to international supplies, UK energy supply investment need not be constrained by a need to match UK energy production to energy demand, and investment decisions can be made on the basis of whether the project offers a worthwhile return.

There are therefore no figures given in the projections for future UK energy production, except for electricity where opportunities for trade are more constrained than for other energy sources.

The projections examine the possible development of energy demand in the UK up to 2010, covering a wide range of assumptions about future economic growth and world fossil fuel prices, with alternative cases on how the structure of the UK economy might develop. Earlier drafts were discussed with the nationalised energy industries, and circulated at official level in the first half of August.

One or two last minute changes are still outstanding. The most important of these relate to the power station build projected in the paper. I have asked officials to incorporate two improvements. The first is to change the basis of the power station build figures in Table 7 so that they refer to stations not yet ordered and exclude both the refurbishment of existing stations and plant already under construction. The second is to give a less monolithic look to the nuclear figures in the four "central" cases; at the moment each of these assumes a 15GW build in the 1990s; there is however a case which shows a 10GW build in this period, and I have asked that this be substituted for the case at present shown as BL. Your officials might also note that the overall range of the projections has been increased by reducing the oil price profile for the lowest case, Case C.

The Inspector at the Sizewell 'B' Inquiry, Sir Frank Layfield, has asked that the projections be made available to Inquiry participants in good time for the next preliminary Inquiry meeting on 18 October. In practice this means we must release the projections two weeks beforehand, on 4 October. If we do not adhere to this timetable, the Inspector has made clear that he may have to delay the start of the Inquiry main hearing. It is most important that this is avoided; I must therefore ask for any comments by Thursday, 30 September.

Copies go to Members of E Committee, and to Sir Robert Armstrong.

Yours sincerely

NIGEL LAWSON
(Approved by the Secretary of State and signed in his absence)

cc JS / Energy

DEPARTMENT OF INDUSTRY
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JU846

Secretary of State for Industry

7 October 1982

NBPM

MLS 8/10

The Rt Hon Nigel Lawson MP
Secretary of State for Energy
Thames House South
Millbank
London SW1

Dear Nigel,

SIZEWELL B

Thank you for sending me copies of your letter to the Chancellor, enclosing the energy projections and the Department of Energy Proof of Evidence. I am content that they should both go forward as inputs to the Sizewell enquiry.

I attach considerable importance to the argument that nuclear power can help to bring electricity prices down and improve industrial competitiveness. No doubt we will want to develop this during the course of the enquiry and also to cover the implications of a nuclear programme for UK equipment suppliers. Officials of our two Departments are considering how these issues can best be handled.

I am copying this to the recipients of your letter.

Yours ever

Patrick

Energy: Policy, Pt 7

NBPM ~~~ cc ~~~

DEPARTMENT OF ENERGY
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MRS 5/10

ENERGY

PARLIAMENTARY UNDER
SECRETARY OF STATE

The Rt Hon Tom King MP
Minister for Local Government
& Environmental Services
2 Marsham Street
London SW1

5 October 1982

Dear Minister

Thank you for your letter of 1 October to Nigel Lawson commenting on the Department's latest energy projections.

I understand that, following discussions between our officials, the final text is acceptable to you.

I am copying this letter and the final text of our proof of evidence and the projections, as submitted to the Sizewell Inquiry, to members of 'E' Committee and to Sir Robert Armstrong.

Yours sincerely

Andrew Tre...

(p) DAVID MELLOR

Approved by Mr Mellor and signed
in his absence

Energy, Policy, Pt 7

DEPARTMENT OF ENERGY

PROOF OF EVIDENCE
FOR THE
SIZEWELL 'B' PUBLIC INQUIRY

DEPARTMENT OF ENERGY
OCTOBER 1982

CONTENTS

DEPARTMENT OF ENERGY PROOF OF EVIDENCE
FOR THE SIZEWELL 'B' INQUIRY

This proof of evidence will be presented by Mr R J Priddle, an Under-Secretary in the Department of Energy and Head of the Energy Policy Division.

1 The Department of Energy's responsibilities derive from the duties placed on the Secretary of State by Parliament. These are generally described in the Ministry of Fuel and Power Act 1945 as extended by the Continental Shelf Act 1964. These make the Secretary of State for Energy responsible "for securing the effective and co-ordinated development of coal, petroleum and other minerals and sources of fuel and power in Great Britain and in the Continental Shelf and for promoting economy and efficiency in the supply, distribution, use and consumption of fuel and power". In the first section, this proof of evidence describes the general policy framed to discharge these responsibilities. In the second section, and against this background, it explains the Government's approach to electricity supply and the role of thermal nuclear power within the electricity supply system.

Energy Supply and Demand: the Government's approach

2 A major aim of the Government's overall economic policy is to set the right conditions to enable the supply side of the economy to operate more competitively and efficiently. A crucial element of that policy is to remove, where practicable, obstacles to the free operation of market forces throughout the economy. In the energy sector, where available resources and distribution networks are concentrated substantially in the hands of public sector monopolies, the market is far from free and competitive. The thrust of Government policy in this sector therefore is to remove market distortions where possible or otherwise to seek to ensure that the energy market operates as nearly as possible as a free market. Such an energy market will regulate energy supply and demand with greater success and efficiency than relying on central planning as the means of ensuring that UK supply meets demand.

/3 Steps which

3 Steps which the Government is taking to this end include transferring functions from the public to the private sector, reducing the monopoly powers of the nationalised industries and, where those industries are not and cannot by their nature be fully exposed to market forces, introducing alternative disciplines. Examples of this policy are the sale of Britoil, the weakening of the British Gas Corporation's monopoly and the investigations of efficiency conducted on behalf of the Government by the MMC and outside consultants.

4 The facts that we operate in a world market not only for oil but increasingly for coal and gas, and that that market is unstable and not greatly susceptible to Government influence underline the Government view that the UK cannot work to a set blue print of energy development. For example, a sharp escalation in the price of oil enhances demand for other fuels and requires a flexible response. Access to international markets means that energy supply investment options need not be constrained by a requirement exactly to match UK energy production to energy demand.

5 The public sector energy industries in the UK have their own responsibility for drawing up plans designed to sustain their supply obligations. The Government, in discharge of its responsibilities for public expenditure, evaluates these plans in the light of its own knowledge, but without attempting to match the detailed expertise of the industries. Energy projections have a role in testing energy supply investment proposals; and the latest set of the Department of Energy's projections is attached at Annex 1. But there are many uncertainties in such projections. They are not forecasts and they need to be continually reviewed and revised to take account of changing circumstances.

6 It is central to this market-oriented approach that energy should be priced realistically since interaction between supply and demand is mainly determined by price. If prices are artificially low, energy is used wastefully and consumers lack the

/incentive

incentive to invest in efficiency. If they are too high, consumers suffer needlessly, while producers are encouraged to invest in unnecessary new capacity. To minimise these distortions, energy pricing is discussed with the nationalised industries in formulating their financial targets, on the basis that prices should reflect market pressures where reasonably open markets exist, or the costs of supply in other cases. The Government considers it is then up to the consumer to rank his own investment priorities in the light of prevailing prices. Energy efficiency and supply investments are both necessary, but the Government does not seek to take to itself the decisions of millions of consumers. When the Government has to assess investment in supply, full account is taken of possible future price movements and technical change, and the consequential effects on demand.

<u>Electricity</u>

7 As with other fuels, the Government's objectives for electricity are that there should be secure supplies, provided to the consumer at the lowest possible cost. The Government's approach to achieving these objectives differs in some respects from its approach to the other energy industries. With electricity, it is more difficult - and will continue to be so - to sell surpluses, or make good shortfalls in supply, since the scope for international trade is limited to sales through interconnectors between adjacent national grids; and there are a number of uses where electricity is not interchangeable with other fuels.

8 The Central Electricity Generating Board, who have a statutory duty '... to develop and maintain an efficient, co-ordinated and economical system of supply of electricity in bulk for all parts of England and Wales, ...' have to take account of these limitations in their planning. So too does the Government in considering the industry's capital programme.

/9 Against this

9 Against this background, the Government seeks to ensure that the electricity supply industry makes as thorough and realistic an appraisal of future demand as possible; that its plans offer the prospect of meeting that demand as economically as possible while assuring security of supply and making an adequate return on investment; and that public expenditure considerations are properly taken into account. The Department does not duplicate the CEGB's calculations. But it must satisfy itself about the validity of the Board's methodology and in the case of major investments subject to the Department's approval to test the robustness of the proposals to different assumptions.

10 The energy crises of the last 10 years have shown the danger of over-dependence on one fuel, and the wisdom of a sensible degree of diversity of supply. Despite considerable research work in the UK and internationally on alternative and/or renewable sources of energy, on fast reactors, and on nuclear fusion, and the Government's encouragement of increased private generation and economic combined heat and power schemes, the Government considers that the only available and economic options for new secure base-load generating capacity at present are coal-fired or thermal nuclear power stations.

11 In 1981/82, 83% of the CEGB's generation was from coal - which also dominated base-load generation. By comparison nuclear accounted for some 12%. The nuclear output will increase, probably to around 20%, when those nuclear stations now under construction are fully commissioned. However unless new stations are ordered in the 1980s the nuclear power component will progressively decline as older nuclear stations are retired.

12 As was made clear in last year's White Paper on Nuclear Power (Cmnd 8317, published in July 1981) the Government considers it prudent for the country to have a range of supply options. In this context it sees an important and necessary role for nuclear power which will develop in the years ahead as older electricity generating plant is retired. The Government accordingly expects the electricity supply industry to pay due regard in its planning

/to the need

to the need for diversity and security in supply, including an appropriate nuclear component.

13 Nuclear power has the potential to produce electricity more cheaply than fossil fuels provided that new power stations can be built to time and cost. This is of importance, not only to individual electricity consumers but - through its influence on industrial competitiveness - to the economy as a whole.

14 Safety is paramount. The operational responsibility rests with the CEGB. It is the responsibility of the Nuclear Installations Inspectorate as part of the Health and Safety Executive to decide whether or not a new power station has been designed and built to the necessary standards and can be operated safely.

15 Government policy is to encourage the electricity industry to ensure that there is a reliable, safe and cost-effective reactor system available for ordering as necessary. In 1977, the CEGB declared its intention of establishing the PWR as a valid option; this intention was endorsed by the previous administration; and the present Government, in confirming its agreement to this in 1979, took the view that subject to the necessary consents and safety clearances, a PWR should be the next nuclear power station order.

16 This general statement of policy in no way pre-empts the particular decision on the proposed Sizewell 'B' power station; and the Government welcomes the examination at the Public Inquiry of the issues set out in the Rule 5 Statement.

ANNEX

ENERGY PROJECTIONS 1982

I INTRODUCTION

1. These Projections have been prepared as part of the Department of Energy's evidence for the Sizewell Inquiry. They explore a reasonably wide range of possible developments for UK energy demand into the first decade of the next century. This range is based on a number of combinations of economic assumptions which have been chosen to point up the different ways in which that demand might develop.

2. The assumptions themselves - and the Projections developed from them - are necessarily very uncertain. The assumptions include: the level of world economic activity; the internationally traded prices of oil, coal and gas; the growth and structure of the UK economy, in particular the balance between the manufacturing and service sectors.

3. The last set of Energy Projections was published by the Department in December 1979. Since that time prospects for economic growth have become less optimistic and the world oil market has weakened. The recession has significantly affected the structure of the British economy. The background to the current round of Projections is therefore very different from that which underlay the 1979 exercise.

4. The changes which have occurred over the last three years underline the importance of looking at a range of possible futures, and of the dangers inherent in trying to select any one of them. Take for instance the higher economic growth rate tested over the 30 year period 1980-2010. On the one hand, although it was an exception in British economic history, such growth was achieved in the UK in the 25 years after the Second World War. On the other hand, seen against what has occurred in the last 10 years, it could be regarded as unrealistically high. But that is not to say that any of the other cases studied should be regarded as a central or preferred case. They are each merely useful points on the range studied, and serve to illustrate the radical effect of change on only one or two key assumptions.

5. Not only is it unwise to take a single view of the future, it is also unnecessary to envisage supplying the country's energy needs totally from domestic production. This country has a long history as a trading nation. It may prove economic to import some fuels which are expensive to produce at home and to plan for profitable exports where suitable opportunities arise. Furthermore, future mis-matches of demand and supply

for tradable energy products may be accommodated by imports and exports at world prices. For this reason it is unnecessary to produce projections for future supplies of the primary fuels. Individual investments in the nationalised industries producing these fuels will be considered on an individual basis in the circumstances then current to ensure that they earn a satisfactory return on capital.

6. Opportunities for international trade in electricity are limited, although these should not be completely discounted. Unexpected future mismatches of demand and supply of electricity are not easily accommodated by imports or exports at the margin, unlike other more easily tradable energy products. Supply investment for electricity therefore needs to be set against the background of projections of electricity demand, to minimise the risk of significant over or under supply. Electricity demand must be analysed within the demand for all types of fuel.

7. Although government policies can have some impact, most of the decisions which shape the future level and structure of energy demand are determined by market forces. Consumers decide their choice of fuel and its efficiency in use largely in the light of their income or level of activity and the fuel and equipment prices in the market. The projection method takes into account the effects of energy prices on energy use and corresponding increases in the efficiency of energy consumption.

8. The energy projections set out in this paper present the Department of Energy's present view on possible energy futures, as a framework for policy considerations in government.

II PROJECTION METHOD

9. The methods employed in preparing the energy projections are outlined in Appendix I to this paper. A number of major modifications have been made to the methods used for earlier projection exercises. The most important development has been the redesign and estimation of the energy demand calculation in which market prices now play an explicit role, along with economic activity, in determining the demands for each fuel in each consuming sector.

10. For a given set of assumptions, including those for fossil fuel prices, detailed projections of demand for the main fuels (solid fuel, oil, gas and electricity) have been prepared for each of the consuming sectors - domestic, iron and steel, other industry, transport, other consumers and non-energy uses. The consequences for the supply of electricity have then been prepared. Equilibrium is established between the supply and demand for electricity at the calculated electricity prices in each projection year using an iterative calculation.

11. A calculation of this type, however complex, is inevitably a highly simplified description of how the real world is likely to develop. The structure of the calculation and the many assumptions used in it are important sources of uncertainty in the projections presented in this Annex.

Energy Conservation

12. The explicit role of market prices in determing energy demand removes the need for a separate allowance for energy conservation. No attempt is made, in preparing the projections, to account for the effects of individual conservation measures.

13. The method used for calculating energy demand has two important features. There is a non-price effect which arises mainly as a result of technical change. If fuel prices rise at the same rate as general price inflation (i.e. constant real fuel prices) then total demand for energy tends to rise less quickly than economic activity (GDP). The second feature involves additional energy savings as fuel prices rise faster than general inflation. In this case other inputs (such as capital for additional insulation or improved boiler controls) are substituted for energy as fuel prices rise relative to other goods. In addition consumers tend to use relatively less energy, to use it more efficiently and to undertake more energy conservation measures, the faster energy prices rise in real terms. In this way the 'price' and 'non-price' components of increasing efficiency in energy use are incorporated into the projections. Quantitative estimates of the reduction in energy use from rising real energy prices in the projections are provided at paragraphs 33-35 below.

III ASSUMPTIONS

14. Projections of future energy demands in the United Kingdom are based on assumptions about world economic activity, world energy prices, real exchange rates and the growth and future structure of the British economy.

15. These assumptions are interdependent. At given future levels of world supplies of energy a faster long-term rate of growth in the world economy will place more pressure on energy supplies and lead to higher energy prices. In addition, the importance of international trade to Britain implies that faster world economic growth will, as in the past, also lead to a higher rate of economic growth in this country.

16. It is sometimes suggested that high world energy prices would prevent the achievement of high rates of economic growth. Although high energy prices are likely to place some constraints on economic activity, the fundamental forces generating economic growth arise, in the main, outside the energy sector. Account has been taken of these factors in choosing assumptions for economic growth and increases in real energy prices. While temporary output losses may follow from world energy price shocks, over the longer term markets will adjust with increased energy conservation, inter-fuel substitution and the discovery and exploitation of new energy supplies on the one hand and with increased absorption and recycling of any financial imbalances on the other.

Energy Price Assumptions

17. However, future levels of world energy supplies and the efficiency with which energy is used world wide are also uncertain and subject to shocks. For this reason two sets of assumptions for fossil fuel prices, at the world level, have been taken. The upper set covers average annual increases between 1980 and 2000 of 2.9% to 5.4% and could accommodate one or more major shocks in world energy markets. The lower set, covering annual average increases of -0.7% to 2.7% a year, is more surprise free and assumes more rational world responses to the need to use energy efficiently. These ranges are expressed as percentage increases in OPEC crude marker prices suitably deflated to 1980 price levels. These crude oil price movements are translated into sterling terms and converted to market prices for petroleum products in the UK using refining and distribution margins.

18. The delivered prices of NCB coal are currently close to the sterling cost of imported coal for most consumers and this relationship is expected to continue. Future paths for world coal prices have been prepared in association with the oil price assumptions. For the low end of both oil price assumption sets, in the medium to long term, world coal prices are based on estimates of the marginal production cost of coal. At higher oil prices in each assumption set world coal prices are expected to be higher than the marginal production costs of coal as a result of competition with oil in end uses.

19. In the long run it is assumed that the price of gas landed in Britain will move broadly in line with prices in West European gas trade which will in turn be related to the prices of competing oil products. Distribution margins are added to the 'beach price' to arrive at final consumer prices. In the short to medium term the path of prices reflects a movement from the present structure towards the longer term prices.

20. Final consumer prices for electricity are calculated in the projections from marginal generating costs based on the other fuel price assumptions. This is a difficult calculation and the projections of electricity prices are particularly uncertain.

21. The detailed price assumptions for all fuels are listed at Table A.

Economic Growth Assumptions

22. Three views of possible future UK economic growth have been adopted. A high rate of 2½% per annum GDP growth is slightly less than that achieved between 1948 and 1972. An intermediate rate of 1½% p.a. GDP growth is close to the long-run average rate of the last 80 years. A low growth assumption of ½% p.a. is broadly similar to that achieved during the depressed conditions since 1973. For each of these views the path of GDP assumes lower growth during the first half of the 1980s and a correspondingly faster rate over the rest of the period to 2000. Beyond 2000 the average growth rate for GDP in each case has been adopted.

Assumptions for Economic and Industrial Structure.

23. For each GDP growth rate path, alternative combinations of more and less energy intensive industries within manufacturing, and of manufacturing and service sectors, can lead to significantly different energy demands. A range of assumptions concerning the outputs of these sectors has been selected to span the greater part of the uncertainty.

24. It should be stressed that these assumptions made by the Department of Energy are purely for the purposes of testing the sensitivity of impacts on energy demand. There is no presumption that the output trends are planned to arise from Government policies or that the Government thinks that these output levels will or should arise in the future.

25. Ideally, an integrated economic model covering the whole economy should be used to investigate alternative economic structures. No such suitable model was found to be available for this purpose. As an alternative, an analysis has been made of the performance of the major energy using industries over past periods of faster and slower economic growth. The results of this analysis have provided, for each GDP growth assumption, both a high and a low assumption for the growth rates of those industries, with the less energy intensive industrial and service sectors making up the assumed future levels of GDP. Both industrial structure assumptions have been adopted for the central GDP growth case yielding two separate projections. The high GDP growth/low energy intensive structure case and the low GDP growth/high energy intensive structure case have been omitted as their energy projections would fall within the range of energy demands of the other cases.

Exchange Rate Assumptions.

26. The exchange rates assumed in these projections should not be regarded as forecasts, but as assumptions about long term trends in the relative real values of different currencies. They are real rates of exchange corrected for differences in rates of inflation of the currencies concerned, and expressed in terms of the real value of the US dollar as it stood in 1980 against an appropriate basket of currencies. The path of this particular real sterling exchange rate over the period 1980 to 2010 will be subject to a number of influences. It may rise or fall with the value of North Sea oil production implying a sensitivity to both the volume of oil production and to real oil prices. More rapid economic growth in the UK tends to be associated with better non-price competitiveness and hence with a higher real effective exchange rate. In the short term the success of the Government's policy in reducing inflation will reduce real effective sterling exchange rates since the lower the price-level the lower the real rate corresponding to a given nominal rate. These considerations together with the small reduction which has occurred since 1980, in the real effective sterling exchange rate, form the basis of the exchange rate assumptions used in these projections.

The Projection Cases

27. The separate sets of assumptions which underlie the main projections are set out schematically in Table 1 and are listed in detail in Tables A and B. Eight separate projections are provided, as indicated in Table 1, representing the various combinations of assumptions adopted for world energy prices, UK economic growth and economic and industrial structure. The energy projections for each case presented in this paper are identified by the labels given at the head of Table 1, namely X, YU, YL, Z, A, BU, BL, and C. Thus in Cases X and A, high world economic growth generates high world prices for the traded fossil fuels and contributes to high UK economic growth. The other cases are characterised by corresponding combinations of such assumptions.

TABLE 1

ASSUMPTIONS FOR THE PROJECTIONS CASES.

CASES	X	YU	YL	Z	A	BU	BL	C
World Fossil Fuel price assumptions	High Set				Low Set			
World Oil Price in 2000 $ / bbl	88	65	65	55	52	43	43	27
UK GDP Growth % pa	2½	1½	1½	½	2½	1½	1½	½
UK industrial growth	high	high	low	low	high	high	low	low

IV PROSPECTS FOR ENERGY DEMAND

Final Energy Demand

28. Projections of the total amount of energy delivered to final consumers for the eight projection cases are set out in Table 3. These totals are subdivided into totals for consuming sectors and for fuels in Panels 1 and 2 of Tables C and D at the end of the paper.

29. The projections in Table 3 are determined by the assumptions underlying each case, i.e. by the rate of rise of energy prices in real terms and by the economic growth and industrial structure assumptions. In all cases the average annual rates of growth in total final energy demand over the projection period are substantially less than the assumed GDP growth rates over the same period. These growth rates may be compared with the corresponding rates for the two decades of the 1960s and 1970s set out in Table 2.

TABLE 2

HISTORIC GROWTH IN ENERGY DEMAND ECONOMIC ACTIVITY
AND REAL ENERGY PRICES FOR THE UNITED KINGDOM

% pa

	1960-1970	1970-1980
Total final energy	1.34	-0.52
Total primary energy	2.42	-0.52
Gross Domestic Product	2.89	1.6
Manufacturing production (excluding North Sea activity)	2.93	-0.3
Real energy prices		
Domestic[1]	0.1	-0.7
Industrial[2]	-1.0	4.3

1 deflated by retail price index.

2 deflated by wholesale output price index.

30. As can be seen from Table 2 the experience of the last two decades has shown wide variation in the rate of growth of energy demand. The main factors have been the variation in economic growth (GDP), the wide divergence between economic growth and manufacturing production and the rapid rise in real industrial energy prices over the 1970s. However, in the 1970's the cost of energy to domestic consumers was held down, mainly by falls in the real price of gas. The projections of growth in total final energy demand can be seen to fall within the range of the experience of the last two decades.

31. The projections for individual fuels within the totals for final energy demand can be seen in the second panels of Tables C and D. The direct consumption of solid fuel is expected, in the main, to increase over the projection period, except in Case C. In the higher fossil fuel price assumption cases gas consumption increases during the 1980s and then declines over the period to 2010 as its price increases in real terms. However, with lower gas price assumptions in Cases A, BU, BL and C, gas demand rises to 1990 and then mainly remains flat to the end of the projection period. Electricity consumption increases in all the projections apart from Cases C and Z where the increases are small. The direct demand for oil products rises from 1980 in some projection cases and falls in others as the increase in demand for transport purposes offsets substitution out of oil for bulk heating uses to a greater or lesser extent. The direct consumption of biofuels and renewable sources, mainly in the form of solid fuel waste, is assumed to provide a small contribution to final energy use by 2010 in all the cases.

32 The position of gas inthe industrial market is uncertain because it is difficult to take account of the possible effects of the Oil and Gas (Enterprise) Act as it is too early to assess the timing and extent of its impact. The analytical approach used, which is dependent in large part on historical experience, is unable to reflect fully the effect of opening this market to greater competition and, in particular, the removal as a result of the Act of current unsatisfied demand. The results are therefore subject to greater uncertainty than has been the case previously. Further details of the consumption of individual fuels in each of the consuming sectors are provided in Tables E and F. These results are discussed in detail in Appendix II.

TABLE 3

UK FINAL ENERGY DEMAND PROJECTIONS

bn therms

Higher world energy prices	GDP growth rate % pa	1980 actual	1990	2000	2010	Average annual growth 1980-2010 % pa
Case X	2.5		59.2	63.8	71.4	0.88
YU	1.5		56.7	59.3	62.8	0.45
YL	1.5	54.8	55.7	57.0	59.4	0.27
Z	0.5		53.9	51.5	51.4	-0.21
Lower World energy prices						
Case A	2.5		61.7	69.5	76.8	1.13
BU	1.5	54.8	59.3	62.5	65.9	0.61
BL	1.5		58.3	60.1	62.3	0.43
C	0.5		56.7	56.1	55.3	0.03

Effects of Rising Real Energy Prices on Energy Demand.

33. An assessment has been made of the effects of rising real energy prices on the projections of final energy demand, excluding uses in transport. The energy demands for these final consumers have been recalculated using the real energy price of 1980 throughout the projection period but maintaining all the other assumptions. The resulting energy demand levels from this calculation are all higher than those in the projections. The following table provides the percentage reductions in total useful energy below these calculated levels produced by the higher real energy prices in the projections.

TABLE 4
Final Energy Demand Excluding Transport Uses
Percentage Savings in Total Useful Energy From
Rising Real Energy Prices

Case	1990	2000	2010
X	13	24	29
YU	10	20	25
YL	10	21	25
Z	9	19	23
A	9	17	23
BU	6	15	20
BL	6	15	21
C	3	8	15

34. The figures in this table may be compared with the corresponding figure of 20% for the year 2000 used as an assumption in Energy Projections 1979 rather than derived by calculation. The figures for 2000 in Case X, YU YL and Z are very close to 20%.

35. A similar form of calculation, which estimates what energy demand would have been for these consuming sectors in 1980 had energy prices remained constant at their 1973 levels, yields a reduction of 5.9% in these energy demands as a result of rising real energy prices over the period 1973-1980. On an annual basis this represents an average saving of 0.82% pa which is lower than the rate of 0.92% pa for a 20% saving over the period 1980-2000. Since, in the domestic sector, many of the more cost-effective energy conservation measures such as tank lagging and roof insulation in owner-occupied houses have already been taken up, the projections represent a significant challenge for energy saving in the future. However, in the industrial sector, many potential energy saving opportunities are held up because of the present business uncertainty.

Primary Energy Demand

36. Table 5 provides projections of total UK primary demand for energy including non-energy uses. This measure of energy demand takes account both of final energy consumption and of energy use and losses in production and distribution within the energy industries.

37. As for total final energy demand the average projected growth rates of total primary energy demand over the projection period for each of the cases fall within the range of historical experience set out in Table 2.

38. Figure 1 provides a diagrammatic display of the projected range of primary energy demands together with a comparison with Energy Projections 1979. The spread of possible primary energy demand is very wide in the year 2010 reflecting fundamental uncertainty about the future path of the economy and of fuel prices. The range in 2000 is wider than that given in Energy Projections 1979, mainly because of the much wider spread of GDP growth rates assumed, as indicated in Figure 1. Allowing for differences in methodology, in the many assumptions underlying the two projection exercises and in the timing and level of the base point, the 2.5% pa GDP growth Case A lies between the 2% and 3% pa GDP growth cases for the year 2000 in Energy Projections 1979 and the higher energy price Case X lies just below the Energy Projection 1979 range.

39. The long-term nature of the energy projections implies not only the timescale of the projection period but also the absence of any attempt to project the effect of economic cycles on energy demands and supplies. For this reason the dotted lines in Figure 1 are meant only as a broad indication of the development of energy demand between snapshot years.

TABLE 5

UK PRIMARY ENERGY DEMAND PROJECTIONS

mtce

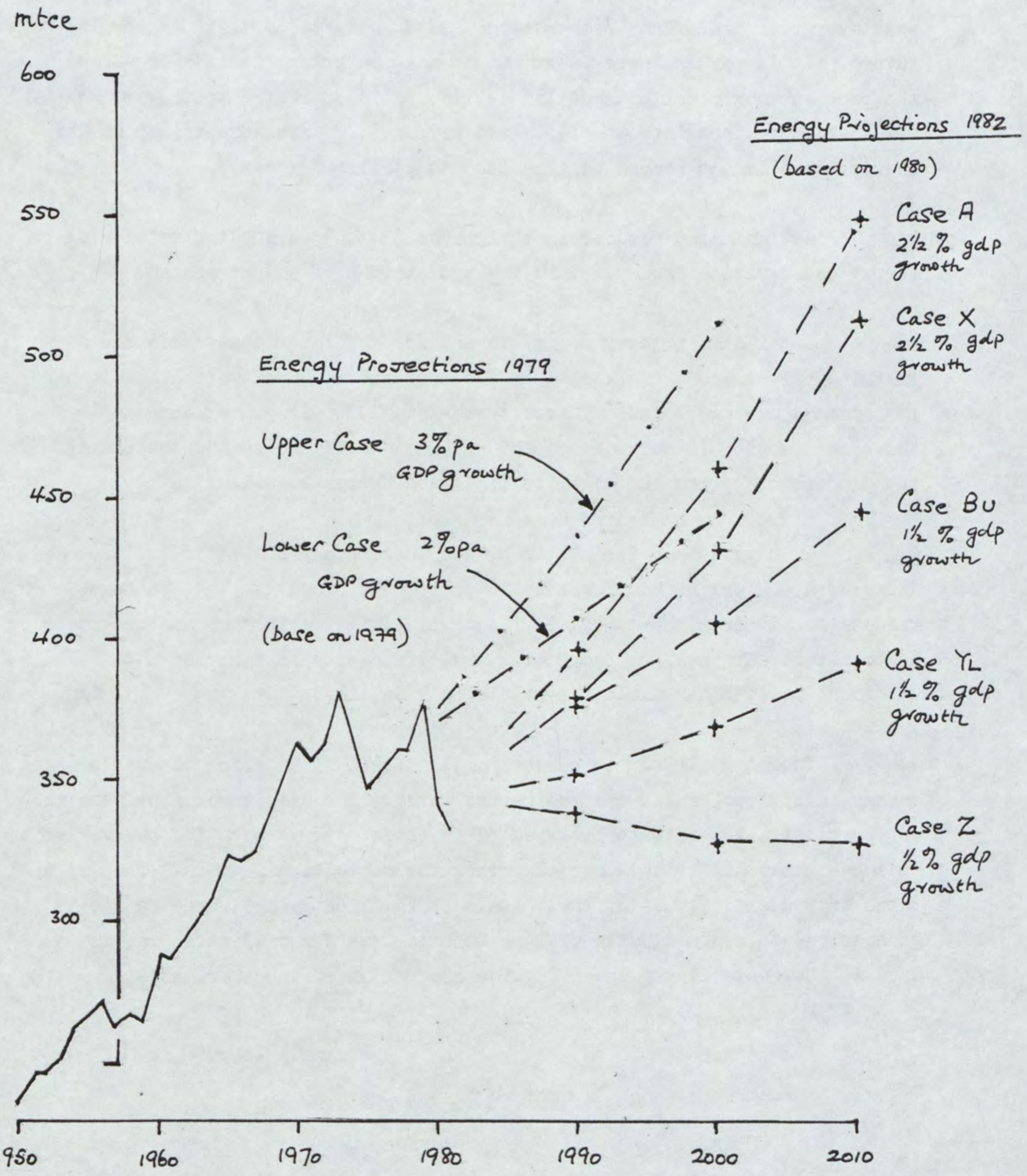
Higher World energy prices	GDP growth rate % pa	1980 actual	1990	2000	2010	Average annual growth 1980-2010 % pa
Case X	2.5		380	431	512	1.33
YU	1.5	345	360	388	420	0.66
YL	1.5		352	370	392	0.43
Z	0.5		339	328	327	- 0.17
Lower World energy prices						
Case A	2.5		396	461	549	1.57
BU	1.5	345	376	406	446	0.86
BL	1.5		368	387	415	0.62
C	0.5		355	350	353	0.08

Figure 1

COMPARISON WITH ENERGY PROJECTIONS 1979

TOTAL PRIMARY ENERGY DEMAND

including non-energy uses



40. In considering the decline in primary energy consumption over the 1970s displayed in Figure 1, it is tempting to ask whether energy demand will ever rise again and whether even Case Z looks too optimistic for the future. It is perhaps more important to ask the prior question of whether the poor economic performance and decline in industrial output over the 1970s will continue into the 1990s and beyond. If this were to happen then energy demand would indeed be projected to decline further.

41 As indicated earlier in paragraphs 33 to 35 a substantial degree of energy conservation is implied in the projections of energy demand.

42. Details of primary energy demand for the individual fuels are given in the upper sections of Panel 4 in Tables C and D. Substantial levels of coal demand are projected in Cases A and X in 2010 with lower amounts in the other cases. Primary demand for natural gas falls towards the end of the projection period as its price rises **and UK reserves decline.**

43. Primary demand for oil is higher in 2000 and 2010 than in 1980 in Cases A, X, BU and BL and lower in Cases YU, YL, C and Z. This pattern results mainly from the combined effects of variation in the rate of growth in transport services, increasing fuel efficiency in vehicles and substitution of other fuels for oil in bulk heating.

44. There are likely to be some small direct demands for renewable energy in biofuel, solar and geothermal forms. The main uncertainties arise in the penetration rate to be expected in these energy forms and the variation of these rates with rises in real prices for conventional fuels. The projections show a growing use of these fuels (both directly and for electricity generation) to reach 21 mtce p.a. in 2010 in Case X and 17 mtce p.a. in Case A. Correspondingly lower figures are projected in other cases.

45. The timing of the full-scale use of coal in the production of synthetic natural gas (SNG) is extremely uncertain. On the basis of the energy price projections in this study full scale production appears unlikely until the end of the projection period. However, the eventual decision will require a detailed economic analysis reflecting the range of options available at the time. Full-scale use of coal to produce liquid fuels or feedstocks has been assumed to be uneconomic over the projection period.

V. PROSPECTS FOR ELECTRICITY SUPPLY

46. This section discusses some possible implications for electricity supply which emerge from the demand projections discussed in the previous paragraphs. Once projections of overall levels of demand for electricity have been prepared a quite separate range of issues needs to be taken into account in considering how that demand might be met. In addition to the economic variables, there are non-economic factors which will influence the outcome. For electricity we cannot rely on international trade to build up and absorb future imbalances in domestic supply and demand. We need to consider carefully what supply options are open to us and what may be both economic and acceptable. The detailed analysis which follows, whilst recognising the very real uncertainties, attempts to illustrate how capacity might evolve. Clearly each investment option will be analysed at the time it arises in the circumstances then current. In considering these projections for electricity supply the reader should not be misled by the apparent mathematical precision of the figures; they can only have a broad indicative value. They represent neither programmes nor predictions.

47. Electricity demand grew rapidly during the 1960s at an average annual rate of 6.6% pa. This rate of growth slowed during the 1970s to 1.5% pa. Table 6 gives details of UK demand for electricity over the projection period for each of the cases. As can be seen from the lower part of the table the projected rates of growth are well below those experienced in the 1960s and are particularly low in Cases C and Z. In all the cases the projected rates of growth in electricity demand through the 1980s are lower than the overall rates of growth through to 2010 reflecting the similar paths assumed for growth in economic activity. The level of real energy prices and the price of electricity relative to other fuels will both affect the growth rates in electricity demand to some extent, together with the assumption for industrial structure.

48. The annual demand for electricity in energy units is linked to generating capacity through the shape of the system load curve, yielding the associated level of peak demand, and the planning margin. Assumptions have been made for both these factors. In England and Wales the system load curve has become less peaked. This tendency has been assumed to continue into the future. The system load factor, of some 57% in 1980, is assumed to rise to 61% in 2000 and to 62% in 2010. The CEGB's current planning margin of 28% has been used for this exercise. The Electricity Council are however currently carrying out a review of the industry's security standard in generation which is a major determinant of the planning margin. A lower margin would of course reduce the capacity required for a given projection of electricity demand.

49. The capacities of generating plant for the United Kingdom required to meet the estimated electricity demands in each projection case are shown in Table 7. As indicated in paragraph 46 above a number of factors must be taken into account in considering how much new capacity, and of what type, will be needed to provide the projected future levels of generating capacity. The capacity existing in 1980 and new plant under construction are clearly important. They are listed in Table 7. Existing plant is assumed to be retired at the end of its normal life, with the possibility of extending the life of coal stations for 10 years beyond the assumed normal life of 30 years at a cost of £120 per Kw.

50. The method used for projecting the combination of types of new generating plant, and the extent of life extension to existing coal plant, for the supply system in England and Wales, involves minimising the present value of the total capital and operating costs of the supply system over the projection period.

51. On the assumptions of capital and non-fuel operating costs for new plant listed in Table 12, overall supply system costs would be minimised by substantial commissioning of nuclear plant, both in substitution for existing higher cost plant and to meet demand. It is however, likely that the actual rate at which nuclear plant can be built and commissioned will be determined by a number of factors, including questions of priorities in national resource allocation. The projections of the quantity of nuclear build in Table 8 have in each case been constrained below the level which would be indicated by an approach based purely on the minimisation of total supply system costs. The choice of particular limits is necessarily a matter for judgement.

52. If such limits were seen to diminish in the early 1990s then substantial numbers of new nuclear stations are calculated to be economic for ordering then and commissioning in the decade 2001-2010. These levels of unconstrained new build for 2001-2010 are shown in Table 11. They are presented in this Table for illustration only and have not been included in the projection cases.

53. Tables 8, 9 and 10 list the projections of build for nuclear, coal-fired and peaking plant and for life extension of existing coal-fired plant, assuming that nuclear build will be subject to constraints through the whole of the period 1990-2010. In Table 8 the assumed upper limits for nuclear build in the 1990s are fully utilised in all cases apart from Case C in which some 5.2 GW of the assumed upper limit of 10 GW is taken up in the 1990s. In all cases substantial quantities of new nuclear plant are calculated to be economic in the 1990s at the costs listed

in Table 12. If, in the event, the nuclear builds of 20 GW listed in Cases X and A in Table 8 are not achievable in the 1990s, then additional coal fired plant would be required in its place together with some small increase in peaking plant. Table 10 indicates that in no projection case does the maximum possible life extension of existing coal fired stations prove economic in the 1980s. This is mainly because of the scale of plant already under construction in relation to the projections of electricity demand growth. The assumptions for construction of coal fired combined heat and power schemes are assumed to be taken up in the electricity supply calculations, see paragraph 59.

54. Ranges of estimates of nuclear fuel cycle costs have been prepared combining possible paths for future uranium prices and views on likely processing costs. The resulting profiles over the projection period are provided in Table A at the end of the paper.

55. Details of fuel use in power stations are provided in panel 3 of Tables C and D. In cases A and X coal demand increases to 2000 and then declines as nuclear displaces coal. In the remaining cases the use of coal declines over the projection period.

56. Once nuclear plant enters the margin of operation the projected rate of growth of electricity prices slows in real terms. In all cases this occurs after the year 2000. In the projections it has been assumed that nuclear plant will, by 2000, be able to load-follow, i.e. to adapt its level of electricity output to the daily fluctuations in demand.

57. The projections for electricity supply described in this section depend upon the many assumptions indicated in this Annex including the generating plant costs contained in Table 12 which are uncertain.

TABLE 6

UK ELECTRICITY DEMAND PROJECTIONS

Twh

	1980	1990	2000	2010
Case X	231.1	264.8	357.8	478.1
YU		249.1	301.6	357.6
YL		243.8	285.4	326.3
Z		229.0	239.9	252.4
Case A	231.1	274.0	372.3	494.0
BU		253.9	304.6	359.1
BL		247.9	284.9	323.8
C		235.1	241.7	241.1

	Growth in GDP % pa				Growth in Electricity Demand % pa			
	1980-1990	1990-2000	2000-2010	1980-2010	1980-1990	1990-2000	2000-2010	1980-2010
Case X	2.3	2.8	2.5	2.5	1.4	3.1	2.9	2.5
YU	1.2	1.9	1.5	1.5	0.8	1.9	1.7	1.5
YL	1.2	1.9	1.5	1.5	0.5	1.6	1.3	1.2
Z	0.3	0.8	0.5	0.5	-0.1	0.5	0.5	0.3
Case A	2.3	2.8	2.5	2.5	1.7	3.1	2.9	2.6
BU	1.2	1.9	1.5	1.5	0.9	1.8	1.7	1.5
BL	1.2	1.9	1.5	1.5	0.7	1.4	1.3	1.1
C	0.3	0.8	0.5	0.5	0.2	0.3	0	0.1

TABLE 7

UK PUBLIC ELECTRICITY SUPPLY

PROJECTIONS OF TOTAL GENERATING PLANT CAPACITY
AND NEW PLANT COMMISSIONING

Case	Total Capacity GW 1980	Total Capacity GW 1990	Total Capacity GW 2000	Total Capacity GW 2010	Commissioning of new plant not yet ordered GW 1981-1990	Commissioning of new plant not yet ordered GW 1991-2000	Commissioning of new plant not yet ordered GW 2001-2010
Case X	68.3	77.4	96.4	127.1	0.4	31.8	64.9
YU		74.0	83.2	95.2	0.2	18.9	46.1
YL		72.9	79.4	87.0	0.2	18.2	38.6
Z		72.2	69.0	67.1	0.2	11.8	25.1
Case A	68.3	79.5	100.0	130.8	1.3	34.5	65.0
BU		74.8	83.8	95.4	0.2	19.5	45.7
BL		73.4	79.3	86.1	0.2	14.9	41.0
C		72.2	69.3	64.1	0.2	7.4	26.5

New Capacity commissioned or under construction for commissioning during 1981-1990

	GW (Net)
Coal Fired	1.9
Oil Fired	5.3
Nuclear	5.6
Peaking Plant	1.4
Channel Link	1.8
TOTAL	16.0

TABLE 8

UK PUBLIC ELECTRICITY SUPPLY

ASSUMPTIONS FOR POSSIBLE COMMISSIONING OF NEW NUCLEAR PLANT AND NUCLEAR PLANT CAPACITY

	Nuclear plant Capacity GW				Commissioning of new nuclear plant not yet ordered. GW		
	1980	1990	2000	2010	1981-1990	1991-2000	2001-2010
Case X	5.8	10.8	28.0	65.5	0	20.5	42.6
YU			22.6	48.5		15.0	31.0
YL			22.6	47.2		15.0	29.7
Z			17.6	31.7		10.0	19.2
Case A	5.8	10.8	28.5	65.9	0	20.9	42.5
BU			22.6	48.5		15.0	31.0
BL			17.6	34.6		10.0	22.1
C			12.7	26.4		5.2[1]	18.8

1 Calculated value.

TABLE 9

UK PUBLIC ELECTRICITY SUPPLY

PROJECTIONS FOR COMMISSIONING OF NEW NON-NUCLEAR CAPACITY

	Commissioning of new coal fired plant[1] not yet ordered. GW			Commissioning of new peaking plant not yet ordered GW		
	1981 -1990	1991 -2000	2001 -2010	1981 -1990	1991 -2000	2001 -2010
Case X	0.2	6.7	16.0	0.2	4.7	6.4
YU	0.2	0.5	11.3	0	3.4	3.8
YL	0.2	0.5	5.4	0	2.7	3.5
Z	0.2	0.5	2.3	0	1.3	3.6
Case A	0.2	8.4	17.0	1.1	5.1	5.5
BU	0.2	0.6	11.3	0	3.8	3.4
BL	0.2	1.1	15.3	0	3.8	3.6
C	0.2	0.5	4.6	0	1.7	3.1

1 Includes assumptions for the commissioning of new coal fired combined heat and power schemes of 0.2 GW in 1981-1990, 0.5 GW in 1991-2000 and 1.4 GW in 2001-2010.

TABLE 10

PROJECTIONS OF LIFE EXTENSION TO EXISTING COAL PLANT BEYOND A 30 YEAR LIFE

GW

	1981 -1990	1991 -2000	2001 -2010
Case X	4.3	15.3	14.6
YU	1.8	15.2	14.6
YL	0.6	12.1	14.6
Z	0	8.1	14.6
Case A	4.9	15.3	14.6
BU	2.6	15.3	14.6
BL	1.2	15.3	14.6
C	0	12.8	14.6
Maximum possible life extension	5.5	15.3 [1]	14.6

In addition Case X includes withdrawal of 0.6 GW of oil fired capacity from reserve in 1981-1990 and Case A includes 1.3 GW from reserve in the same period.

1 Includes 1.1 GW conversion of oil fired capacity to coal firing.

TABLE 11

UK PUBLIC ELECTRICITY SUPPLY

Estimates of Nuclear Capacity and Build on Cost Grounds Alone after 2000

	Nuclear Plant Capacity GW		Commissioning of new nuclear plant not yet ordered GW	
	2000	2010	1991 -2000	2001 -2010
Case X	28.0	106.2	20.5	83.3
YU	22.6	75.0	15.0	57.5
YL	22.6	66.5	15.0	49.0
Z	17.6	44.8	10.0	32.3
Case A	28.5	89.1	20.9	65.7
BU	22.6	61.3	15.0	43.8
BL	17.6	52.9	10.0	40.4
C	12.7	31.5	5.2	23.9

NOTE: THESE FIGURES ARE PROVIDED FOR ILLUSTRATION ONLY: THEY ARE NOT INCLUDED IN THE ENERGY PROJECTIONS CASES.

TABLE 12

ASSUMPTIONS FOR CAPITAL AND NON-FUEL OPERATING COSTS AND PERFORMANCE OF NEW GENERATING PLANT.

1980 prices

	Coal	Oil	Gas turbine	Coal CHP	Nuclear
Capital Cost £/Kw					
Main plant	510	460	225	590	1000
Interest during Construction	140	120	25	100	265
Transmission	60	60	40	60	70
Initial fuel cost					60
Decommissioning Cost					30
R & D					25
Total Capital Cost	710[1]	640[1]	290	750[1]	1450[2]
Fixed operating costs £/Kw p.a.	9.63	9.63	6.09	9.63	12.14
Non-fuel variables Operating costs incl. fuel handling p/Kwh	0.125	0.125	0.355	0.125	0.185
Thermal efficiency % (in use)	36	30	25	31½*	(36)[3]
Average availability %	72	72	80	72	65

* The thermal efficiency quoted is that of electricity production alone. When the plant is producing heat the thermal efficiency is taken as 86%, 37% of this energy being taken in the form of electricity.

1 Increases at ½% p.a. between 1980-2000 and constant thereafter

2 Increases at 1% p.a. between 1980-2000 and constant thereafter

All plant assumed to take 8 years to build except gas turbine which is assumed to be built in 5 years.

3 Nominal figure only for expressing nuclear fuel costs in p/therm.

Other Contributions to electricity supply:

Combined Heat and Power
and Renewable Sources.

58. The principal source of heat for district heating schemes has been assumed to be coal fired electricity generating plant which can produce both heat and electric power. The assumed profile of heat production from this source is in line with the Marshall Report on Combined Heat and Power. A number of lead city schemes are currently under consideration by consultants on behalf of the Department and the projections include a possible scheme of 200 MW electricity generating capacity by 1990, building up to a possible 2 GW capacity by 2010 producing some 300 m. therms of district heat p.a. The electricity produced is taken into account in the balance of supply and demand for electricity in each projection.

59. A combination of geothermal and wind power is likely to contribute to the production of electricity in situations where investment in nuclear generating plant is not developed to levels based on expected cost grounds alone. As noted in paragraph 51 nuclear build in generating plant has been set, in all the projection cases, below the level indicated on cost grounds alone and in consequence renewable energy sources are projected to contribute to power station fuelling 8 mtce pa in 2010 in Case X and 7 mtcw pa in Case A. Lower figures are projected in other cases. Details are provided in Tables C and D at the end of the paper. Use of the Severn Barrage for electricity production has been excluded from the projections as further decisions have yet to be made. Its inclusion would involve a saving of some 5 mtce pa of fossil fuel and possibly nuclear fuel in power station fuelling; there would also be a saving of up to 1 GW in the requirement for generating capacity.

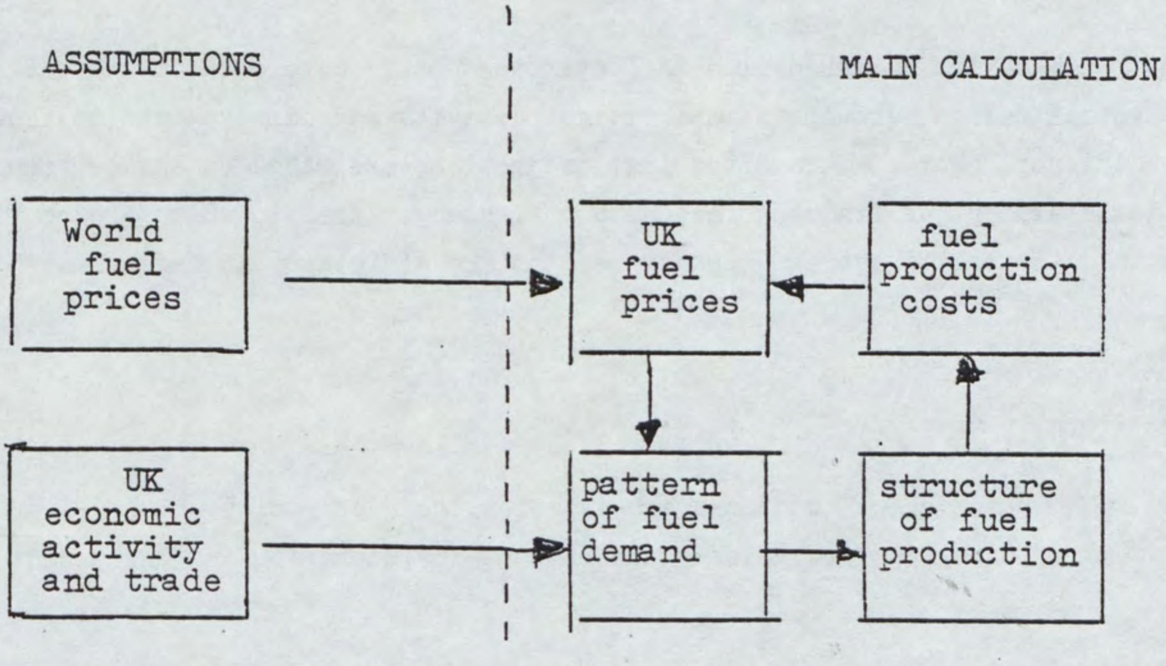
PROJECTION METHOD

1. This Appendix provides a description of the projection method employed as indicated in section II of the paper.

2. Figure 1 illustrates the main outline of the calculation. In a given year fuel demands in each sector of the economy are determined principally by UK fuel prices and levels of economic activity. These demands, together with the pattern of trade, provide the structure of fuel production which gives rise to costs of production for each fuel. UK fuel prices are influenced partly by production costs at home and partly by world fuel prices.

Figure 1

METHOD OF THE PREPARATION OF ENERGY PROJECTIONS



For tradable fuels, for example oil or coal, domestic prices are likely to be influenced strongly by world price levels. In such cases domestic production costs together with either taxes or grants affect the level of domestic production.

Energy Demand

3. The patterns of fuel demand in the main energy consuming sectors have been analysed over the period 1954-1979 and relationships established which relate the demands by each sector for each main fuel to levels of economic activity for the sector and both current and past fuel prices. Variations in annual temperature have been allowed for in this work.

4. Energy demands in transport are treated separately for road, rail, air and ships' bunkers. Demand for road transport is based on the Department of Transport models used to prepare National Road Traffic Forecasts. These forecasts are based on assumptions for GDP growth and fuel prices and provide estimates of vehicle kilometres per annum separately for cars, public service vehicles, light vans and heavy freight vehicles. Assumptions made on saturation levels for vehicle ownership, fuel efficiency and on fuel mix provide estimates of fuel use in road transport.

5. Advice is taken from the Department of Transport on future rail electrification, growth in rail freight activity and improvements in fuel efficiency. For air transport fuel projections are based on advice from the Department of Trade on forecasts of passenger traffic which are combined with estimates of average journey lengths and efficiency in fuel use.

Energy Supply

6. Detailed calculations are made for the electricity supply industry in England and Wales which chooses the operation and investment

plans for different generating plant types in order to minimise the present value of the future capital and operating costs of the generating system required to meet the estimated electricity demands arising from the demand calculation. The costs of producing electricity from marginal operating plant are used to prepare electricity prices for each consuming sector.

7. The prices of coal and petroleum products in the UK are related in the projections to assumed future paths for coal and crude oil prices in international trade. In the longer term the price of gas landed in Britain is assumed to move broadly in line with assumed future gas prices in European markets and that these will be related to prices of competing oil products.

8. Alternative projections of energy demand and of the supply patterns for electricity (for which international trade is insufficient to balance supply and demand) are prepared on the basis of these prices and the economic assumptions.

9. Individual investment possibilities for coal, oil and gas industries in the UK are assessed, as they arise, inter alia on the basis of the energy projections and circumstances available at the time the assessments are made.

10. For new forms of energy supply, such as biofuels, geothermal, solar, wind etc. estimates are made (i) of the date at which the new energy forms first become economic, (ii) of the potential level of competitive supply at the assumed future prices of other fuels and (iii) the likely rate of penetration of the new energy form. Judgement is required in assessing each of these factors. Estimates are also made of the likely customers of these energy forms and of the conventional fuels displaced. The contributions of the new fuels are not necessarily additive, especially for those used in electricity generation, as the adoption of one form such as tidal reduces the potential of other renewables eg wind power.

<u>The Calculation</u>

11. The calculation outlined in Figure 1 is made for each of a number of snapshot years in the future. These calculations are linked through time both by the lagged effect of prices on fuel demands and by the cost minimisation calculation for electricity supply.

12. The results of this form of calculation provide details of fuel consumption by each consuming sector and the pattern of electricity production. Alternative projections are prepared by varying the many assumptions underlying the calculations.

13. The form of this calculation is necessarily a highly simplified description of reality and contributes to the uncertainty attaching to the projections.

PROSPECTS FOR ENERGY DEMAND

SECTORAL ANALYSIS

1. Projections for energy demand by final consuming sectors are given in Tables E and F and are described below for each of the principal final consuming sectors; domestic, iron and steel, other industry, transport and other consumers. The last category consists of agriculture, public and private services. A further section provides details on non-energy uses of fuels.

2. The methodology used in all sectors, except transport and non-energy uses, is to project total useful energy demand (i.e. energy demand adjusted for efficiency in end use) for each sector, related to assumptions for future economic activity and real energy prices. Total useful energy demand is then allocated between fuels on the basis of their future real price movements, and, additionally in the case of electricity, of economic growth. In addition, technological information is used to derive the fuel allocation in the iron and steel sector. The projected useful energy demands in total and for individual fuels are then adjusted, using efficiency factors, to derive the heat supplied figures given in Tables E and F. Adjustments are also made to fuel allocation to allow for the impact of CHP, renewables and biofuels.

3. In the transport sector the economic basis for the energy demand estimates is supplemented by technological information provided by the Department of Transport.

Domestic Sector

4. No increase is projected for total delivered energy between 1980 and 1990 in case X. In cases Y and Z demand is expected to fall slightly, although in the lower fossil fuel price cases, small increases are projected in cases A, BU and BL. Between 1990 and 2010 an increase of 29% is projected in case A. At the lower end of the range in case Z, the projection is for a decline of 7%. Although these figures illustrate the importance of real income as a determinant of domestic energy demand, the effect on increased comfort levels and hence energy demand is offset by increases in real fuel prices stimulating the take-up of energy conservation measures within the space and water heating sector.

5. Despite large real increases in price, gas is expected to increase its market share in all projections in the decade to 1990 as consumers continue to move to gas from other fuels for space and water heating purposes. Between 1990 and 2010 as gas becomes relatively more expensive, this share is likely to decline, except in case C, as consumers tend to move to electricity for space heating purposes. Nevertheless by 2010 the share of gas in this sector in no case is below 57% compared with a 1980 figure of 53%. Solid fuel demand, declines to 1990 but its demand remains stable thereafter. Although fossil fuel demands in 2010 are generally higher in the lower price cases, an exception is solid fuel in Case C where the high coal price ratio to gas price prevents any substitution towards solid fuel.

6. The range of growth of electricity demand to 2010 is large and although some substitution of electricity for gas is projected after 2000, the figures reflect a large range of increases in demand for electricity specific uses which are dependent on real income growth. Electricity demand is less influenced by fuel price changes than fossil fuels and there is little difference between "higher price" and "lower price" cases.

7. Although renewables (solar and geothermal), biofuels and CHP do not make a significant impact until the next century, by 2010 they are estimated to account in total, for some 4-6% of this sector's use of energy, thereby displacing some gas and solid fuel.

Iron and Steel

8. Total energy demand is determined partly by the production level of this sector. In the most optimistic growth case A energy demand in 2010 is 30% above its 1981 level. In cases YL and Z the assumed decline in ferrous metal production is reflected in falls of 39% and 43% respectively in energy demands from 1981 to 2010. There are no significant differences between higher and lower fossil fuel price cases.

9. Solid fuel is expected to increase its share in all cases displacing oil and gas; market shares of 80-84% in 2010 are projected compared with a 1980 figure of 50%. In no case is solid fuel expected to regain its consumption levels of 1970 however. Gas and Oil demands decline in all cases and by 2010 their combined usage is very small. There are only small differences between higher and lower fossil price cases.

10. There is no significant difference in electricity consumption between higher and lower fossil fuel price cases. Demand is expected to increase in those cases where ferrous metal production increases and conversely decline when there is a decrease. In no case is electricity demand expected to exceed 0.5 bn therms or 12% of sectoral energy demand.

Other Industry

11. Between 1980 and 1990 industrial energy demands are expected to increase slightly, except in case Z where the very low growth rate assumed for manufacturing production is not sufficient to outweigh the influence of increased fuel prices which stimulate energy saving. Between 1990 and 2010, in all cases except C and Z where declines are projected, the growth rate in energy demand is higher due to an increased rate of growth of manufacturing output and to less rapid increases in real fuel prices. Although in Case Z energy demand in 2010 is still below its 1980 level, in case A it is almost 50% above.

12. An important feature is that solid fuel is expected to increase its market share in all cases by displacing oil and gas; in case Z it achieves its highest penetration of 45% in 2010 because of a very low ratio of the coal to fuel oil price. In the lower price cases A, BU, BL and C demands for gas and oil are higher than the corresponding 'higher price' cases. However for solid fuels, only in case A do lower solid fuel prices lead to higher demands than in case X. In case X, the highest fossil fuel price case, coal prices are assumed to accelerate faster than oil prices in the face of excess world demand leading to a rise in the coal/fuel oil price ratio. This effect produces the relatively low solid fuel consumption figure for case X. Given the high rate of economic and industrial growth assumed in this case, this solid fuel consumption figure may be too pessimistic. Further development of projection techniques for energy demand for this sector may throw further light on the interaction between growth in industrial output, movements in fuel prices and the rate of fuel substitution.

13. The very large range of increases in electricity demands is attributable to the large range of manufacturing growth assumptions between low and high growth cases. Though much of electricity use is specific to that fuel, such as motive power, the relatively low rate of growth of real electricity price implies some substitution to electricity from other fuels.

14. CHP demand is likely to be small for this sector and no renewables are included. However, the potential for the use of biofuels to displace solid fuel and gas is large, particularly in the higher fossil fuel price cases; penetration into delivered energy in case X is as high as 9%.

Other Consumers

15. Agriculture is a small consumer of energy within this sector. The main use of energy in this sector as a whole is in the form of space and water heating and lighting for employees and customers. Energy demand is projected by relating it to indicators of employment, economic growth and real energy prices. In the higher fossil fuel cases X, YU, YL and Z energy demand is projected to increase by 19% in case X between 1980 and 2010 and decline by 15% in case Z. Although substantial increases in activity and employment are assumed, the effect of real price increases in stimulating energy conservation could be large. In the lower fossil fuel price cases A, BU, BL and C conservation is more modest and energy demands are expected to increase by as much as 33% in case A.

16. Gas is expected to increase its share and quantity between 1980 and 2000 in all cases and thereafter remain stable. By 2010 its projected market share ranges between 25% in case X and 35% in case C. Oil demands decline over this period to well below current levels. No increase in the market share of solid fuel is expected except in case Z.

17. In common with other sectors, the range of growth of electricity demand to 2010 is large, reflecting primarily the wide range of assumptions on growth of economic activity and employment within this sector. Nevertheless, because electricity increases less rapidly in price than other fuels, some substitution into electricity for space and water heating purposes may occur.

18. Although CHP is only expected to contribute 0.1bn therms to total demand, biofuels and renewables in total could account for as much as 7% of delivered energy in this sector by 2010. However, in the case of lower fossil fuel prices, this penetration is expected to be lower.

Transport

19. Energy demand in the transport sector is derived from separate analyses of the requirements for road, rail, air and water transport. For cases A, B, X and Y the sector shows steady growth in energy demand over the period to 2010. However in both cases C and Z, demand reaches a plateau of around 15 billion therms in 1990 and there is little projected change in demand through the period to 2010.

20. The principal component of fuel use in road transport is motor spirit consumption by cars. Motor spirit price assumptions are presented in Table A. The underlying tax assumptions are that the present two-tier tax structure will remain in force with VAT continuing at 15 percent, and motor spirit duty will remain constant in real terms (as opposed to remaining a constant proportion of the untaxed price). Projections are obtained by combining car traffic forecasts using the Department of Transport model together with assumptions about the future development of fuel efficiency in cars. The latter has been assumed to improve from its present level of about 30 mpg to 40 mpg in 2000 and 45 mpg in 2010. Whilst the present use of derv in cars is negligible, by 2000 its use is assumed to increase to 8% and by 2010 to 11%. It has been assumed that electrically driven vehicles will not make a significant contribution to energy demand over the projection period.

21. Projections of fuel use for air transport are based on projections of terminal passengers at UK airports prepared by the Department of Trade in conjunction with a saturation level for the more distant future of 180 million terminal passengers pa. Demand for aviation fuel is derived from estimates of terminal passengers, average distance travelled and plane size.

22. Rail transport is split between passenger and freight traffic. Projections of passenger traffic are based on the projection included in the Review of Main Line Electrification prepared jointly by the British Rail Board and the Department of Transport. The proportions of traffic hauled by electricity and diesel fuels are consistent with central options in the Review. 75% of passenger traffic and 54% of freight traffic is assumed to be electrically hauled by 2005 with no increase thereafter. The rest is assumed to be hauled by diesel locomotives. The fuel efficiency of diesel and electric trains has been static in recent years. No improvement in diesel or electricity used per kilometre is incorporated in these projections.

Non-Energy Uses and Bunkers

23. The largest non-energy use for oil and gas is as a feedstock for petrochemical plants. The world demand for chemicals is expected to grow rapidly over the next twenty years. Although continuing improvements in efficiency are likely, the use of feedstocks is also expected to show a rapid growth. The chemical industry operates in a highly competitive international market, expansion in world activity may be concentrated where there is access to cheap feedstocks (e.g. in the Middle East), so there is considerable uncertainty about the future for the UK industry. The projections show a strong growth in oil feedstocks - naphtha and natural gas liquids - but a decline in gas.

24. The other non-energy uses (lubricating oil, bitumen, etc) are projected to show little change from the 1980 level.

25. Much of the oil used as bunker fuel is for tankers carrying imported crude oil, so this use is expected to grow after the peak in North Sea production is passed.

ENERGY PROJECTIONS

1982

TABLES A-F

Figures are quoted in these tables with sufficient significant figures to display consistency within each projection case. The reader should not be misled by the apparent mathematical precision of the figures: they are subject to considerable uncertainty.

UK ENERGY PRICE PROJECTIONS — TABLE A

Lower Fossil Fuel Price Assumptions

Price indices 1980 = 100 (unless otherwise indicated)
Price level - p/therm unless otherwise indicated.

	1980 level	1982 Q3 estimates index	1990 A	1990 BU	1990 BL	1990 C	2000 A	2000 BU	2000 BL	2000 C	2010 A	2010 BU	2010 BL	2010 C
DOMESTIC														
Gas	22.5	129 [8]	169	165	165	149	236	211	211	155	322	275	275	195
Oil	39.0	116	123	99	99	82	177	158	158	114	237	203	203	144
Coal	23.5	99	123	111	111	99	164	150	150	124	209	176	176	145
Electricity (average) [1 7]	4.41 p/Kwh	104	111	100	100	92	131	127	129	109	153	140	143	140
electricity (marginal) [1 2]	2.60 p/Kwh	106	118	99	99	86	146	139	143	109	178	156	161	155
INDUSTRY														
Gas 3	17.6	108 [8]	148	118	118	95	215	190	190	132	343	289	289	194
Fuel Oil	22.5	104	129	100	100	80	191	169	169	116	262	220	220	149
Gas Oil	35.0	105	121	99	99	80	180	160	160	117	240	206	206	146
Coal 3	13.4	104	122	107	107	93	175	160	160	130	227	190	190	160
Coal 4	14.6													
Electricity 1	2.37 p/Kwh	98	130	109	109	94	160	153	156	119	196	171	176	170
POWER STATIONS														
Coal 5	14.3	100	121	107	107	93	170	156	156	128	219	184	184	156
Fuel Oil	22.0	105	130	100	100	80	193	170	170	116	266	223	223	150
Nuclear Fuel Cycle Cost	4.0	NA	159	131	131	105	211	159	159	119	264	185	185	131
PRIVATE SERVICES														
Gas	24.3	102 [8]	140	136	136	121	202	179	179	127	282	238	238	164
Oil	36.0	104	121	99	99	81	178	158	158	117	236	203	203	144
Solid Fuel	36.6	90	122	113	113	102	159	144	144	121	199	169	169	138
Electricity 1	3.64 p/Kwh	105	117	104	104	94	140	135	137	113	165	150	153	149
PUBLIC SERVICES														
Gas	24.3	102 [8]	140	136	136	121	202	179	179	127	282	238	238	164
Oil	36.0	104	121	99	99	81	178	158	158	117	236	203	203	144
Coal	16.3	104	118	106	106	94	161	149	149	125	204	174	174	149
Electricity 1	3.39 p/Kwh	105	118	104	104	93	141	136	139	113	168	151	155	151
RAILWAYS														
Diesel Oil	35.0	105	121	99	99	80	180	160	160	117	240	206	206	146
Electricity 1	2.68 p/Kwh	106	121	102	102	89	148	141	145	112	180	158	163	157
ROAD TRANSPORT														
Motor Spirit	129 p/gall	110	122	111	111	102	150	142	142	121	180	164	164	136

$/bl

INTERNATIONAL CRUDE 6 OIL PRICE	30.8 $/bl	34	36	27	27	20	52	43	43	27	74	55	55	33

1. Calculated for each projection.. All other prices are assumptions.
2. For domestic customers between 750 and 7500 Kwh consumptions p.a.
3. Average price for large industrial consumer.
4. Typical price for an industrial consumer.
5. Estimate of price for new contracts.
6. (1980) $ per bbl in all years, expressed in terms of an international basket of currencies denominated in US $.
7. For domestic customers between 0 and 2500 Kwh consumption p.a.
8. Late 1982 estimates.

NA Not Available.

UK ENERGY PRICE PROJECTIONS

Higher Fossil Fuel Price Assumptions

Price indices 1980 = 100 (unless otherwise indicated)
Price level - p/therm unless otherwise indicated.

	1980 level	1982 Q3 estimates index	1990				2000				2010			
			X	YU	YL	Z	X	YU	YL	Z	X	YU	YL	Z
DOMESTIC														
Gas	22.5	129 [8]	194	185	185	180	357	293	293	269	440	363	363	338
Oil	39.0	116	155	141	141	118	264	214	214	196	318	260	260	242
Coal	23.5	99	151	131	131	120	235	186	186	158	281	217	217	185
Electricity (average) 1 7	4.41 p/Kwh	104	130	110	111	103	162	138	138	126	184	155	154	146
electricity (marginal) 1 2	2.60 p/Kwh	106	149	115	118	104	198	157	157	137	230	181	180	166
INDUSTRY														
Gas 3	17.6	108 [8]	192	174	174	146	340	274	274	250	479	390	390	361
Fuel Oil	22.5	104	176	160	160	131	309	249	249	227	376	304	304	280
Gas Oil	35.0	105	154	140	140	119	266	217	217	199	320	263	263	246
Coal 3	13.4	104	167	137	137	122	287	212	212	175	331	242	242	204
Coal 4	14.6	--												
Electricity 1	2.37 p/Kwh	98	163	127	129	114	218	173	173	151	252	198	197	183
POWER STATIONS														
Coal 5	14.3	100	163	135	135	121	275	205	205	170	317	233	233	198
Fuel Oil	22.0	105	177	161	161	132	314	252	252	230	382	309	309	284
Nuclear Fuel Cycle Cost	4.0	NA	159	131	131	105	211	159	159	119	264	185	185	131
PRIVATE SERVICES														
Gas	24.3	102 [8]	162	154	154	149	314	255	255	233	391	319	319	296
Oil	36.0	104	153	139	139	118	261	214	214	196	314	258	258	242
Solid Fuel	36.6	90	143	128	128	119	210	172	172	150	256	204	204	175
Electricity 1	3.64 p/Kwh	105	139	115	117	107	177	148	148	134	202	167	166	157
PUBLIC SERVICES														
Gas	24.3	102 [8]	162	154	154	149	314	255	255	233	391	319	319	296
Oil	36.0	104	153	139	139	118	261	214	214	196	314	258	258	242
Coal	16.3	104	155	131	131	118	253	192	192	161	290	217	217	186
Electricity 1	3.39 p/Kwh	105	142	116	118	107	182	150	150	135	208	170	169	159
RAILWAYS														
Diesel Oil	35.0	105	154	140	140	119	266	217	217	199	320	263	263	246
Electricity 1	2.68 p/Kwh	106	150	118	120	107	199	159	159	140	230	182	181	168
ROAD TRANSPORT														
Motor Spirit	129 p/gall	110	138	132	132	121	192	169	169	160	219	191	191	184
											$/bl			
INTERNATIONAL CRUDE OIL PRICE 6	30.8 $/bl	34	51	44	44	34	88	65	65	55	107	79	79	67

1. Calculated for each projection. All other prices are assumptions.
2. For domestic customers between 750 and 7500 Kwh consumptions p.a.
3. Average price for large industrial consumer.
4. Typical price for an industrial consumer.
5. Estimate of price for new contracts.
6. (1980) $ per bbl in all years, expressed in terms of an international basket of currencies denominated in US $.
7. For domestic customers between 0 and 2500 Kwh consumption p.a.
8. Late 1982 estimates.

NA Not Available.

UK ENERGY PROJECTIONS TABLE B

ECONOMIC ASSUMPTIONS

indices 1975 = 100 unless otherwise indicated.

	1980	1990 X A	1990 YU BU	1990 YL BL	1990 Z C	2000 X A	2000 YU BU	2000 YL BL	2000 Z C	2010 X A	2010 YU BU	2010 YL BL	2010 Z C
GDP (output at factor cost)index	107.2	134	121	121	111	176	146	146	120	225	170	170	129
Real personal disposable income index	114.9	134	125	125	118	176	151	151	127	226	175	175	137
Cases Real exchange rate (X YU YL Z)	2.33	2.10	2.02	2.02	1.94	2.00	1.87	1.87	1.75	2.00	1.84	1.84	1.69
$/£(1980 prices) (A BU BL C)	2.33	1.98	1.90	1.90	1.85	1.87	1.75	1.75	1.63	1.90	1.69	1.69	1.53
UK population (million)	56.0	57.0	57.0	57.0	57.0	58.3	58.3	58.3	58.3	58.8	58.8	58.8	58.8
Persons per household (Nos.)	2.58	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52
Agriculture, forestry and fishing output index	120.5	157	140	133	124	218	175	155	132	293	209	174	140
Industrial output indices													
Iron and Steel mlh 311-313	67.1	88	82	68	65	106	94	62	56	126	104	56	50
Chemical and Allied mlh 271-279	109.7	182	146	129	115	336	222	164	127	587	312	199	140
Building materials mlh 461-469	90.6	118	105	100	93	164	131	116	99	220	157	131	105
Other manufacturing mlh 211-240, 321-450, 471-499	95.6	122	109	106	99	161	132	122	106	204	154	138	112
Total manufacturing	95.1	124	110	105	98	172	138	122	104	231	165	137	110
Service sector indices													
Distributive trades output index	106.1	141	122	120	110	198	154	145	119	271	185	168	128
Miscellaneous services output index	116.4	133	125	132	121	158	140	159	130	184	153	184	140
Private, financial, professional and scientific services employment index	111.5	136	129	126	116	174	162	150	126	217	193	173	137
Public services employment index	101.2	113	108	112	106	129	118	130	113	146	127	146	122

UK ENERGY PROJECTIONS
Higher Fossil Fuel Price Assumptions

TABLE C

bn therms

UK FINAL ENERGY DEMAND BY SECTOR

	1960	1970	1980	1990				2000				2010			
				X	YU	YL	Z	X	YU	YL	Z	X	YU	YL	Z
Domestic	14.4	14.6	15.8	16.0	15.4	15.4	14.8	17.0	15.7	15.7	13.9	19.6	16.8	16.7	13.8
Iron and Steel	7.1	7.2	2.9	3.6	3.4	2.9	2.8	3.8	3.5	2.4	2.2	4.1	3.5	2.0	1.9
Other Industry	14.3	17.3	14.6	15.8	15.3	14.8	14.5	17.4	16.3	15.1	14.2	19.9	17.5	15.7	14.4
Transport	8.8	11.2	14.1	16.4	15.4	15.4	14.8	17.9	16.6	16.6	14.8	19.0	17.3	17.3	15.1
Other Consumers	5.9	7.4	7.5	7.3	7.1	7.1	6.9	7.8	7.2	7.2	6.5	8.9	7.7	7.6	6.4
TOTAL	50.5	57.7	54.8	59.2	56.7	55.7	53.9	63.8	59.3	57.0	51.5	71.4	62.8	59.4	51.4

UK FINAL ENERGY DEMAND BY FUEL

bn therms

	1960	1970	1980	1990				2000				2010			
				X	YU	YL	Z	X	YU	YL	Z	X	YU	YL	Z
Solid Fuel	32.1	18.5	7.5	8.1	8.8	8.3	7.7	8.6	10.1	8.9	8.9	9.5	11.1	9.3	10.3
Gas	2.6	5.5	14.8	17.3	16.2	16.0	15.6	16.0	14.6	14.4	12.8	15.8	13.6	13.4	11.0
Electricity	3.4	6.6	7.7	8.8.	8.3	8.1	7.6	12.0	10.1	9.5	8.0	16.1	12.0	10.9	8.4
Oil	12.4	27.2	24.8	24.7	23.3	23.0	22.9	25.7	23.3	23.0	21.0	26.3	23.2	22.8	19.5
CHP				0	0	0	0	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.4
Biofuels				0.3	0.2	0.2	0.1	1.1	0.8	0.8	0.5	2.7	2.1	2.1	1.4
Renewables				0	0	0	0	0.3	0.3	0.3	0.1	0.6	0.5	0.5	0.3
TOTAL	50.5	57.7	54.8	59.2	56.7	55.7	53.9	63.8	59.3	57.0	51.5	71.4	62.8	59.4	51.4

UK POWER STATION FUELLING

mtce

	1960	1970	1980	1990				2000				2010			
				X	YU	YL	Z	X	YU	YL	Z	X	YU	YL	Z
Coal	53.5	77.3	89.7	90.8	82.3	79.3	72.7	92.6	81.6	74.6	63.5	62.0	48.7	38.2	37.7
Oil	9.3	21.4	11.2	6.3	5.7	5.5	5.0	10.8	7.3	5.9	4.7	3.2	2.0	1.7	1.9
Nuclear and Hydro 1	2.6	11.8	15.3	35.1	35.1	35.1	35.1	71.9	60.1	60.1	49.1	153.6	117.1	114.2	81.2
Renewables 2		0.2	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	7.9	2.4	1.9	0.3
TOTAL	65.5	110.7	116.8	132.6	123.4	120.2	113.1	175.6	149.4	141.0	117.6	226.8	170.2	156.0	121.2

UK PRIMARY DEMAND

mtce

PRIMARY DEMAND	1960	1970	1980	1990				2000				2010			
				X	YU	YL	Z	X	YU	YL	Z	X	YU	YL	Z
ENERGY USES															
Coal	198.6	156.9	120.8	125.2	119.3	114.2	105.0	128.3	123.3	111.2	99.9	138.9	104.9	83.7	80.0
Natural Gas	0.1	17.1	64.2	74.8	70.4	69.8	67.8	69.6	63.6	62.8	56.3	43.2	52.2	53.6	48.7
Oil	68.1	150.0	121.4	117.2	109.9	108.6	107.3	128.7	113.3	109.9	99.9	124.3	108.0	105.7	91.3
Nuclear and Hydro [1]	2.6	11.9	15.4	35.1	35.1	35.1	35.1	71.9	60.1	60.1	49.1	153.6	117.1	114.2	81.2
Biofuels				1.2	0.7	0.7	0.5	4.5	3.3	3.3	2.1	10.9	8.5	8.5	5.6
Renewables				0.1	0.1	0.1	0.1	1.1	1.0	1.0	0.6	9.9	3.9	3.4	1.4
TOTAL ENERGY USES	269.4	335.9	321.8	353.6	335.5	328.5	315.7	404.1	364.6	348.3	307.9	480.6	394.7	369.1	308.2
NON ENERGY USES															
Natural Gas		0.8	6.9	6.4	6.4	6.4	6.4	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0
Oil (feedstock)	7.0	17.0	11.8	16.5	15.1	14.8	14.3	20.9	17.8	16.7	14.6	27.9	21.6	19.4	15.8
Oil (Bunkers)	9.4	9.4	4.2	3.1	2.7	2.7	2.9	3.7	3.6	3.4	3.2	3.9	3.7	3.7	3.2
TOTAL NON ENERGY USES	16.4	27.2	22.9	25.9	24.2	23.9	23.6	26.6	23.4	22.1	19.8	31.8	25.3	23.1	19.0
TOTAL PRIMARY DEMAND	285.8	363.1	344.7	379.5	359.7	352.4	339.3	430.8	388.0	370.3	327.7	512.4	420.0	392.2	327.2

1. Includes Channel Link and Pumped Storage.
2. Includes a small amount of gas.

UK ENERGY PROJECTIONS

Lower Fossil Fuel Price Assumptions

TABLE D

UK FINAL ENERGY DEMAND BY SECTOR

bn therms

	1960	1970	1980	1990				2000				2010			
				A	BU	BL	C	A	BU	BL	C	A	BU	BL	C
Domestic	14.4	14.6	15.8	16.8	16.1	16.1	15.8	19.2	17.3	17.2	16.2	21.7	18.3	18.3	16.2
Iron and Steel	7.1	7.2	2.9	3.7	3.6	3.0	2.9	4.0	3.6	2.4	2.3	4.2	3.6	2.0	1.9
Other Industry	14.3	17.3	14.6	16.7	16.2	15.7	15.5	19.1	16.9	15.7	15.2	21.6	18.1	16.2	14.8
Transport	8.8	11.2	14.1	16.6	15.8	15.8	15.0	18.4	16.9	16.9	15.1	19.4	17.6	17.6	15.3
Other Consumers	5.9	7.4	7.5	7.8	7.7	7.7	7.5	8.8	7.8	7.8	7.4	10.0	8.3	8.2	7.1
TOTAL	50.5	57.7	54.8	61.7	59.3	58.3	56.7	69.5	62.5	60.1	56.1	76.8	65.9	62.3	55.3

UK FINAL ENERGY DEMAND BY FUEL

bn therms

	1960	1970	1980	1990				2000				2010			
				A	BU	BL	C	A	BU	BL	C	A	BU	BL	C
Solid Fuel	32.1	18.5	7.5	8.4	7.8	7.4	7.1	10.1	8.5	7.4	5.8	11.8	10.1	8.4	5.4
Gas	2.6	5.5	14.8	17.8	16.6	16.5	16.3	18.4	16.6	16.4	16.5	18.2	16.1	15.9	16.0
Electricity	3.4	6.6	7.7	9.1	8.4	8.2	7.8	12.5	10.2	9.5	8.0	16.6	12.0	10.8	8.0
Oil	12.4	27.2	24.8	26.1	26.2	26.0	25.3	27.4	26.3	25.8	25.1	27.2	25.4	24.9	24.1
CHP				0	0	0	0	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.4
Biofuels				0.3	0.2	0.2	0.1	0.8	0.6	0.6	0.4	1.9	1.4	1.4	1.1
Renewables				0	0	0	0	0.3	0.2	0.2	0.2	0.6	0.5	0.5	0.3
TOTAL	50.5	57.7	54.8	61.7	59.3	58.3	56.7	69.5	62.5	60.1	56.1	76.8	65.9	62.3	55.3

UK POWER STATION FUELLING

mtce

	1960	1970	1980	1990				2000				2010			
				A	BU	BL	C	A	BU	BL	C	A	BU	BL	C
Coal	53.5	77.3	89.7	95.4	85.0	81.7	75.6	97.8	82.8	85.8	75.9	68.0	49.5	64.9	44.1
Oil	9.3	21.4	11.2	7.2	5.9	5.9	5.3	10.7	7.6	6.1	4.9	3.4	2.0	2.3	2.3
Nuclear and Hydro [1]	2.6	11.8	15.3	35.1	35.1	35.1	35.1	73.0	60.1	49.1	38.1	154.8	117.2	86.6	69.2
Renewables 2		0.2	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	7.2	1.9	0.3	0.3
TOTAL	65.5	110.7	116.8	137.9	126.3	123.0	116.2	182.0	150.9	141.4	119.3	233.4	170.6	154.1	115.9

UK PRIMARY DEMAND

mtce

PRIMARY DEMAND	1960	1970	1980	1990				2000				2010			
				A	BU	BL	C	A	BU	BL	C	A	BU	BL	C
ENERGY USES															
Coal	198.6	156.9	120.8	130.9	118.0	112.7	105.8	139.7	118.0	116.2	100.0	176.0	129.0	135.1	102.3
Natural Gas	0.1	17.1	64.2	77.0	72.1	71.7	70.7	79.5	72.1	71.3	71.6	38.0	43.9	44.7	44.8
Oil	68.1	150.0	121.4	124.3	123.5	122.2	117.4	135.4	127.4	123.3	116.5	129.7	119.3	116.7	110.1
Nuclear and Hydro [1]	2.6	11.9	15.4	35.1	35.1	35.1	35.1	73.0	60.1	49.1	38.1	154.8	117.2	86.6	69.2
Biofuels				1.0	0.7	0.7	0.5	3.1	2.3	2.3	1.8	7.7	5.5	5.5	4.2
Renewables				0.1	0.1	0.1	0.1	1.1	0.9	0.9	0.6	9.1	3.4	1.8	1.4
TOTAL ENERGY USES	269.4	335.9	321.8	368.4	349.5	342.5	329.5	431.8	380.9	363.2	328.5	515.3	418.3	390.4	331.9
NON ENERGY USES															
Natural Gas		0.8	6.9	6.4	6.4	6.4	6.4	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0
Oil (feedstocks)	7.0	17.0	11.8	17.2	16.3	15.6	15.1	22.3	19.0	17.5	15.5	29.4	22.6	20.2	17.0
Oil (Bunkers)	9.4	9.4	4.2	3.6	3.7	3.7	3.9	4.6	4.4	4.4	4.1	4.8	4.6	4.4	4.4
TOTAL NON ENERGY USES	16.4	27.2	22.9	27.1	26.5	25.8	25.4	28.9	25.5	23.9	21.6	34.2	27.2	24.6	21.4
TOTAL PRIMARY DEMAND	285.8	363.1	344.7	395.6	376.0	368.3	355.0	460.7	406.4	387.2	350.1	549.4	445.5	415.1	353.4

1. Includes Channel Link and pump storage.

2. Includes a small amount of gas.

UK ENERGY PROJECTIONS

TABLE E

Higher Fossil Fuel Price Assumptions

UK FINAL ENERGY DEMAND BY SECTOR AND FUEL

bn therms

DOMESTIC

	1960	1970	1980	1990				2000				2010			
				X	YU	YL	Z	X	YU	YL	Z	X	YU	YL	Z
Solid Fuel	11.3	7.1	3.3	1.7	1.8	1.8	1.8	1.5	1.6	1.6	1.6	1.7	1.8	1.8	1.8
Gas	1.3	3.5	8.4	10.8	10.2	10.1	9.7	10.8	9.9	9.8	8.6	11.5	9.8	9.7	7.9
Electricity	1.1	2.6	2.9	3.0	2.9	2.9	2.8	3.9	3.5	3.5	3.0	5.1	4.2	4.2	3.3
Oil	0.7	1.3	1.1	0.5	0.5	0.5	0.6	0.3	0.3	0.3	0.4	0.2	0.2	0.2	0.2
CHP				0	0	0	0	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3
Biofuels				0	0	0	0	0.1	0.1	0.1	0.1	0.4	0.3	0.3	0.2
Renewables				0	0	0	0	0.2	0.2	0.2	0.1	0.4	0.3	0.3	0.3
TOTAL	14.4	14.6	15.8	16.0	15.4	15.4	14.8	17.0	15.7	15.7	13.9	19.6	16.8	16.7	13.8

IRON AND STEEL

	1960	1970	1980	1990				2000				2010			
				X	YU	YL	Z	X	YU	YL	Z	X	YU	YL	Z
Solid Fuel	5.7	4.2	1.4	2.5	2.4	2.0	2.0	2.9	2.7	1.8	1.7	3.4	2.9	1.6	1.5
Gas	0.1	0.2	0.5	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Electricity	0.2	0.4	0.3	0.4	0.4	0.3	0.3	0.5	0.4	0.3	0.3	0.5	0.4	0.2	0.2
Oil	1.0	2.3	0.7	0.4	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0
TOTAL	7.1	7.2	2.9	3.6	3.4	2.9	2.8	3.8	3.5	2.4	2.2	4.1	3.5	2.0	1.9

OTHER INDUSTRY

	1960	1970	1980	1990				2000				2010			
				X	YU	YL	Z	X	YU	YL	Z	X	YU	YL	Z
Solid Fuel	9.1	5.3	2.2	3.5	4.1	4.0	3.4	3.9	5.3	5.0	5.0	4.1	5.9	5.4	6.4
Gas	0.7	1.0	3.9	3.4	3.1	3.0	3.2	2.5	2.2	2.1	1.9	2.0	1.7	1.6	1.3
Electricity	1.3	2.1	2.4	3.1	2.9	2.7	2.5	4.6	3.6	3.1	2.7	6.6	4.4	3.5	2.7
Oil	3.1	8.9	6.1	5.6	5.1	4.9	5.3	5.6	4.6	4.3	4.2	5.3	4.0	3.7	2.9
CHP				0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1
Biofuels				0.3	0.2	0.2	0.1	0.8	0.6	0.6	0.4	1.9	1.5	1.5	1.0
TOTAL	14.3	17.3	14.6	15.8	15.3	14.8	14.5	17.4	16.3	15.1	14.2	19.9	17.5	15.7	14.4

TRANSPORT

	1960	1970	1980	1990				2000				2010			
				X	YU	YL	Z	X	YU	YL	Z	X	YU	YL	Z
Coal	2.9	0.1	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Oil	5.9	11.0	14.0	16.3	15.3	15.3	14.7	17.7	16.4	16.4	14.6	18.7	17.1	17.1	14.9
TOTAL	8.8	11.2	14.1	16.4	15.4	15.4	14.8	17.9	16.6	16.6	14.8	19.0	17.3	17.3	15.1

OTHER CONSUMERS

	1960	1970	1980	1990				2000				2010			
				X	YU	YL	Z	X	YU	YL	Z	X	YU	YL	Z
Solid Fuel	3.1	1.7	0.6	0.4	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.3	0.5	0.5	0.6
Gas	0.5	0.8	2.1	2.7	2.6	2.6	2.4	2.5	2.3	2.3	2.1	2.2	2.0	2.0	1.8
Electricity	0.6	1.4	1.9	2.2	2.0	2.0	1.8	2.8	2.4	2.4	1.9	3.7	2.8	2.8	2.0
Oil	1.7	3.6	2.9	2.0	2.0	2.0	2.2	1.9	1.8	1.8	1.8	2.0	1.8	1.7	1.5
CHP				0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1
Biofuels				0	0	0	0	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.2
Renewables				0	0	0	0	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1
TOTAL	5.9	7.4	7.5	7.3	7.1	7.1	6.9	7.8	7.2	7.2	6.5	8.9	7.7	7.6	6.4

UK ENERGY PROJECTIONS

Lower Fossil Fuel Price Assumptions

UK FINAL ENERGY DEMAND BY SECTOR AND FUEL

TABLE F

bn therms

DOMESTIC

	1960	1970	1980	1990				2000				2010			
				A	BU	BL	C	A	BU	BL	C	A	BU	BL	C
Solid Fuel	11.3	7.1	3.3	1.9	2.0	2.0	2.0	1.8	1.8	1.8	1.6	2.0	1.9	1.9	1.5
Gas	1.3	3.5	8.4	11.1	10.2	10.2	10.0	12.5	11.2	11.1	10.9	13.3	11.3	11.4	10.9
Electricity	1.1	2.6	2.9	3.1	3.0	3.0	2.9	4.1	3.5	3.5	2.9	5.2	4.0	4.0	2.9
Oil	0.7	1.3	1.1	0.6	0.8	0.8	0.8	0.5	0.5	0.5	0.6	0.3	0.3	0.3	0.3
CHP				0	0	0	0	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3
Biofuels				0	0	0	0	0.1	0	0	0	0.2	0.2	0.2	0.1
Renewables				0	0	0	0	0.2	0.2	0.2	0.1	0.4	0.3	0.3	0.3
TOTAL	14.4	14.6	15.8	16.8	16.1	16.1	15.8	19.2	17.3	17.2	16.2	21.7	18.3	18.3	16.2

IRON AND STEEL

	1960	1970	1980	1990				2000				2010			
				A	BU	BL	C	A	BU	BL	C	A	BU	BL	C
Solid Fuel	5.7	4.2	1.4	2.5	2.4	2.0	2.0	2.9	2.7	1.8	1.7	3.6	2.9	1.6	1.5
Gas	0.1	0.2	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Electricity	0.2	0.4	0.3	0.4	0.4	0.3	0.3	0.5	0.4	0.3	0.3	0.5	0.4	0.2	0.2
Oil	1.0	2.3	0.7	0.4	0.4	0.3	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
TOTAL	7.1	7.2	2.9	3.7	3.6	3.0	2.9	4.0	3.6	2.4	2.3	4.2	3.6	2.0	1.9

OTHER INDUSTRY

	1960	1970	1980	1990				2000				2010			
				A	BU	BL	C	A	BU	BL	C	A	BU	BL	C
Solid Fuel	9.1	5.3	2.2	3.4	2.8	2.7	2.6	4.8	3.5	3.3	2.1	5.7	4.8	4.4	2.2
Gas	0.7	1.0	3.9	3.6	3.7	3.6	3.7	2.7	2.7	2.6	2.8	2.1	2.1	2.0	2.4
Electricity	1.3	2.1	2.4	3.2	2.8	2.7	2.5	4.8	3.6	3.1	2.7	6.9	4.5	3.5	2.7
Oil	3.1	8.9	6.1	6.2	6.7	6.5	6.7	6.2	6.6	6.3	7.2	5.4	5.6	5.2	6.7
CHP				0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1
Biofuels				0.2	0.2	0.2	0.1	0.6	0.5	0.5	0.3	1.4	1.0	1.0	0.8
TOTAL	14.3	17.3	14.6	16.7	16.2	15.7	15.5	19.1	16.9	15.7	15.2	21.6	18.1	16.2	14.8

TRANSPORT

	1960	1970	1980	1990				2000				2010			
				A	BU	BL	C	A	BU	BL	C	A	BU	BL	C
Coal	2.9	0.1	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Oil	5.9	11.0	14.0	16.5	15.6	15.6	14.8	18.3	16.8	16.8	14.9	19.2	17.5	17.5	15.2
TOTAL	8.8	11.2	14.1	16.6	15.8	15.8	15.0	18.4	16.9	16.9	15.1	19.4	17.6	17.6	15.3

OTHER CONSUMERS

	1960	1970	1980	1990				2000				2010			
				A	BU	BL	C	A	BU	BL	C	A	BU	BL	C
Solid Fuel	3.1	1.7	0.6	0.5	0.6	0.6	0.5	0.6	0.5	0.5	0.4	0.6	0.5	0.5	0.2
Gas	0.5	0.8	2.1	2.7	2.3	2.3	2.3	2.9	2.5	2.5	2.6	2.8	2.5	2.5	2.5
Electricity	0.6	1.4	1.9	2.3	2.1	2.1	1.9	3.0	2.5	2.5	2.0	3.8	2.9	2.9	2.1
Oil	1.7	3.6	2.9	2.3	2.7	2.7	2.8	2.2	2.2	2.1	2.3	2.2	2.0	1.9	1.9
CHP				0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1
Biofuels				0	0	0	0	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.2
Renewables				0	0	0	0	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1
TOTAL	5.9	7.4	7.5	7.8	7.7	7.7	7.5	8.8	7.8	7.8	7.4	10.0	8.3	8.2	7.1