Industrial Energy

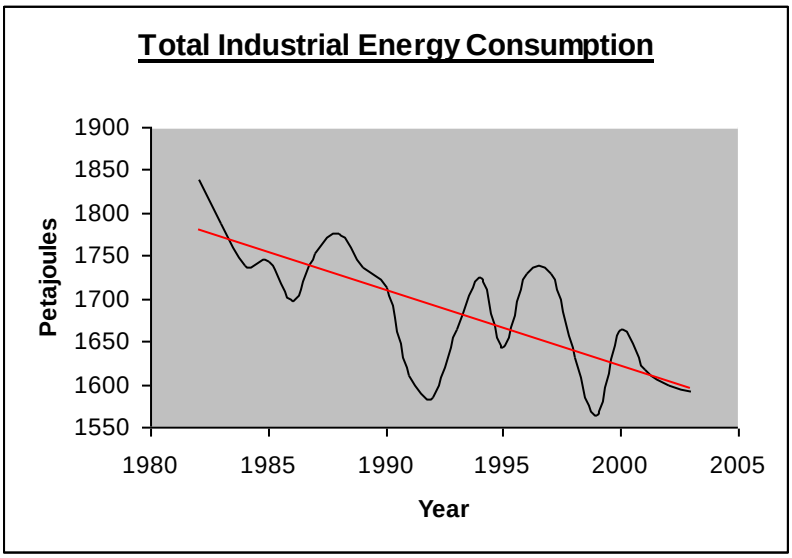
Introduction

Industry uses 23% of the energy used in the UK while its energy consumption has dropped by 4% between 1990 and 2000 (UK manufacturing sector, 2002). The industrial sector primarily consists of the manufacturing industry. The main industries; iron and steel, food, drink and tobacco, paper printing and publishing and chemicals, have been covered. All other sectors are categorised under others. Most industrial energy consumption occurs within buildings. Therefore a large amount of energy is used for lights, appliances, cooking, heating and water heating as in the domestic sector. Most industries also use large amounts of heat and power for various specialised processes.

In order to accurately predict future energy demands total industrial energy use has been split into the main sectors and for each sector the estimated level of growth/decline has been made and these have then been totalled for the final estimates. The data from the last twenty years have been examined allowing relatively accurate predictions to be made for future demands.

The overall energy consumption in the industrial sector has dropped from 1840 petajoules in1982 to 1593 petajoules in 2003; Fig.1. A general trend line has been drawn on the graph showing a decline of 13 petajoules per year. This overall decrease is due to improved energy efficiency, fuel switching, lower demand and a shift to less energy intensive industries. This is a general trend and can be assessed a lot more accurately by analysing each individual sector.

Fig. 1.

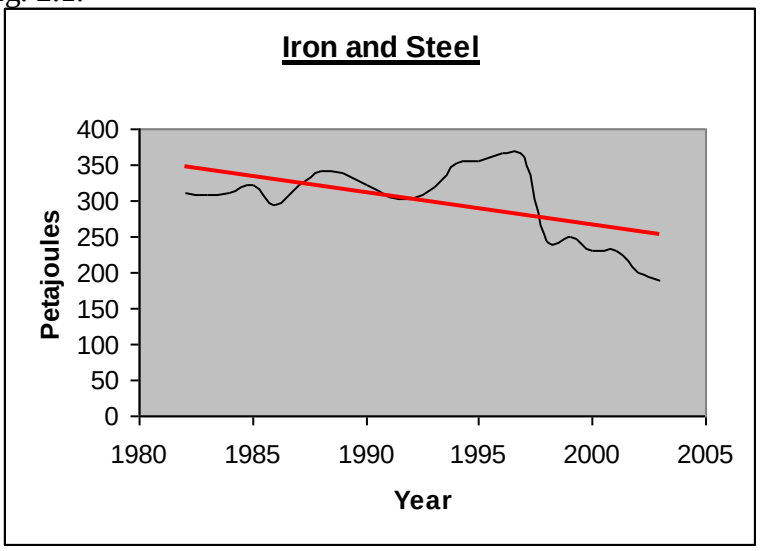


Iron and steel

The iron and steel industry is one of the two main contributors to the industrial energy demand. The overall trend line indicates decreasing energy consumption from 310 petajoules in 1982 to 190 petajoules in 2003, Fig.2.1. This is a huge decrease of 39%. The decrease is complex being caused by a number of factors. De-industrialisation has occurred in the UK, whereas the iron and steel industries used to be the main industries

now service sectors dominate. In particular with the demise of the ship building industry the energy consumption in this sector has decreased. The decrease is in part due to increased energy efficiency in the iron and steel industries and some dematerialisation in the industry. It may also be due to fuel switching to more energy efficient sources. Although the trend line shows a decrease it is not likely that this trend will continue into the future. This is mainly because large amount of energy will be needed for the push for renewable energy sources, in particular wind turbines. Although there will be a decrease in energy consumption due to improved energy efficiency, overall there will be a small increase in energy consumption. The estimated energy consumption in 2010 is 200-210 petajoules, 2020 is 200-210 petajoules and 2030 is 190-200 petajoules.

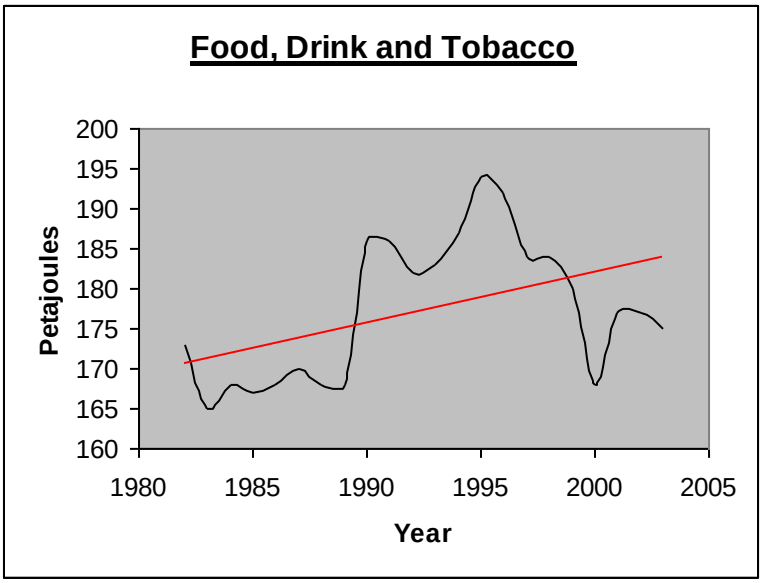
Fig. 2.1.



Food, drink and tobacco

The energy consumed by the food, drink and tobacco industry has remained relatively static over the observed period and the trend line suggests that this will continue into the future, Fig.2.2. This may be explained by a steady demand for these products, which is unlikely to dramatically change in the future. The population of the UK has remained stable over the past few generations and is now at a point where there is almost nil growth therefore it can be assumed that this is further reason for the energy use in this sector to remain at its present levels. As smoking becomes increasingly unpopular for medical reasons and as taxes on it increase it is likely that demand for tobacco products will become less causing a subsequent decrease in energy. Energy efficiency measures will further decrease the energy demand from this sector possibly up to 30% or even 40% according to research on the UK manufacturing sector (www.europa.eu.int/com/energy_transport/atlas/homeu.thml). Therefore the prediction for this sector for 2010 will be 170-175 petajoules, 2020 will be 145-155 petajoules and 2030 will be 120-130 petajoules.

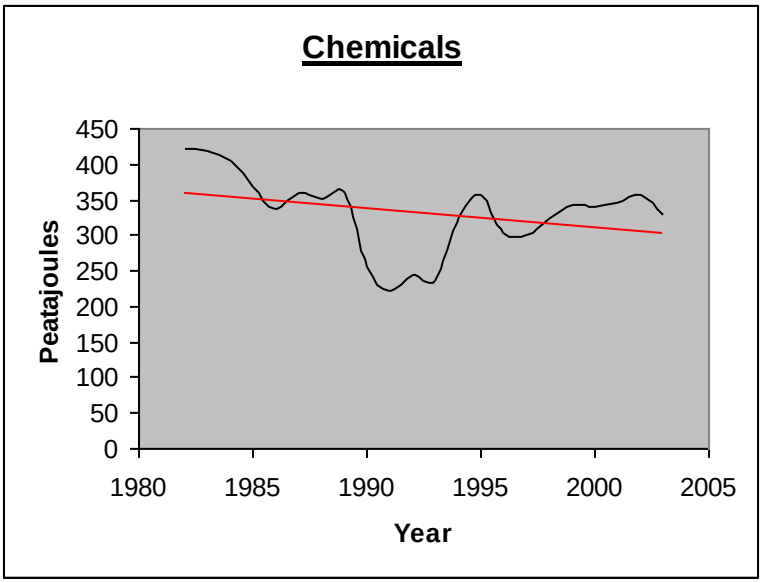
Fig. 2.2.



Chemicals

The chemicals industry has shown a steady decline in energy consumption from 420 petajoules in 1982 to 317 petajoules in 2003, Fig.2.3. This is a decrease of 25% over twenty years. During this period there was a large drop of just over 200 petajoules between 1991 and 1993, then a sharp increase to the previous trend line. This decrease illustrates the vulnerability of the chemical sector to market changes making it more difficult to predict than the previous sector. The trend line shows a decline in energy consumed by the chemical industry of 12 petajoules per year however as this industry appears to be quite variable the estimate will be more conservative to reflect this. The overall decrease in consumption may be due to increasing energy efficiency in this sector and changes in demand. It would be expected that energy consumption will continue to fall and improved energy efficiency could help to further decrease it. The estimated energy consumption from the chemical sector is 300-310 petajoules in 2010, 270-280 petajoules in 2020 and 240-250 petajoules in 2030. These estimates are based on the large amounts of energy that can be saved as a result of greater energy efficiency and some losses due to the general decline in the industry.

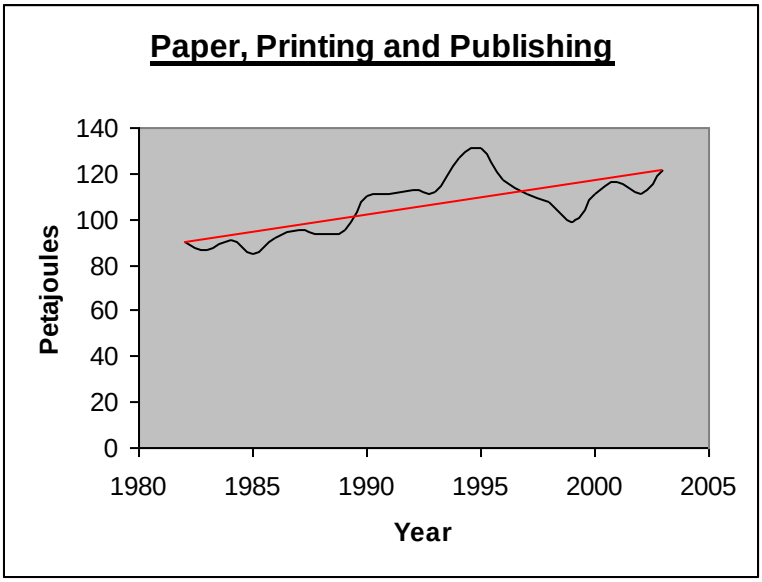
Fig. 2.3.



Paper, printing and publishing

The paper, printing and publishing sector is the only sector where energy consumption has increased over the observed period. It has increased from 80 petajoules in 1982 to 120 petajoules in 2002, Fig.2.4. This is a substantial increase of 50% over twenty years. The increase is due to increased and possibly due to a lack of energy efficient practices. The trend line indicates that the energy consumption is increasing by 7 petajoules per year and there is little reason to indicate that this trend will not continue. However improved energy efficiency and a focus on fewer paper products and more energy efficient methods such as email newspapers may cause an overall decrease in the energy consumption or it may remain static. The estimated consumption in 2010 is 125-130 petajoules, 2020 is 110-120 petajoules and 2030 is 100-110 petajoules.

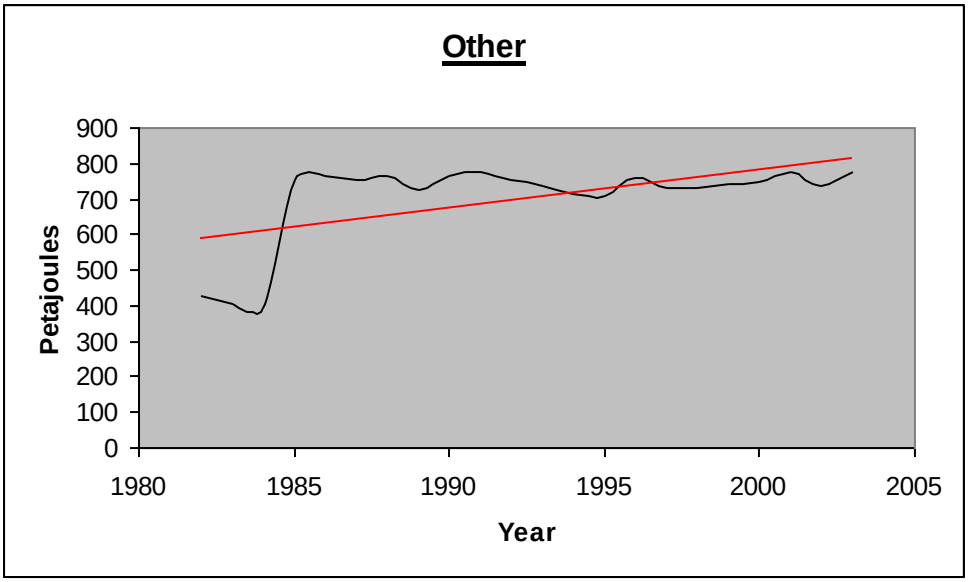
Fig. 2.4.



Other

This section comprises all the sections not previously mentioned, namely textiles leather and clothing, engineering and other metal trades, building materials, china earthenware and glass and cement. This sector has remained relatively static, Fig. 2.5, although as it is composed of so many industries it is difficult to predict accurately. It has increased by 30 petajoules over twenty years. A small decrease has been estimated due to increased efficiency but this is a conservative estimate due to the many unknowns in this sector. The estimated energy consumption in 2010 is 760-770 petajoules, 2020 is 740-750 petajoules and 2030 is 720-730 petajoules. It would have been more accurate to estimate each of these industries separately but time constraints prevented this.

Fig. 2.5.



Industrial Energy predictions

Table 1
Units: Petajoules

	Current	2010	2015	2020	2025	2030
Chemicals	329	300-310	290-300	270-280	260-270	240-250
Iron & steel	189	200-210	200-210	200-210	205-195	190-200
Paper & printing	122	125-130	115-125	110-120	105-115	100-110
Food & drink	175	170-175	160-170	145-155	130-140	120-130
Other	777	760-770	755-765	740-750	735-745	720-730
Total	1592	1555-1595	1520-1570	1465-1515	1435-1485	1270-1420

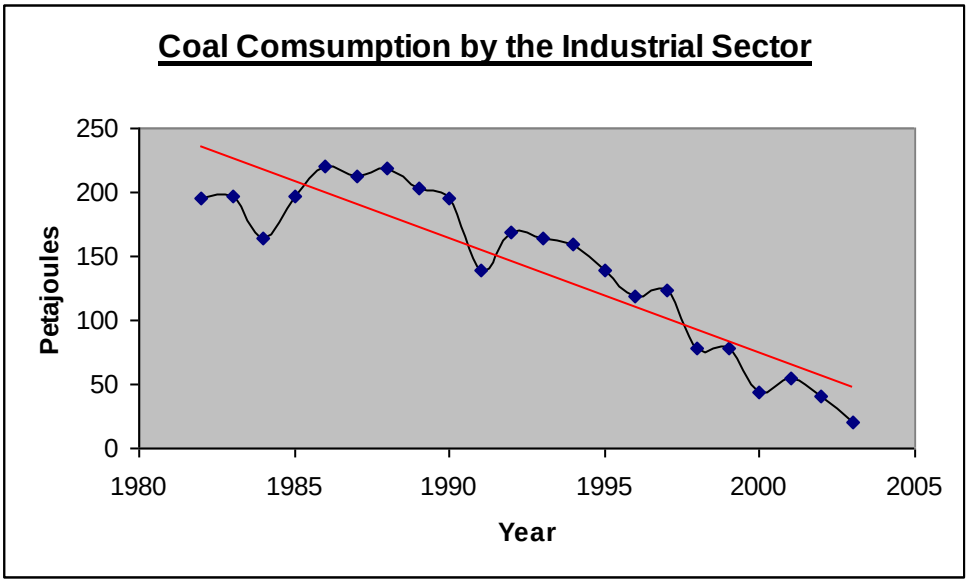
Energy consumed by fuel type in the industrial sector

Coal

The coal industry provided the industrial sector with a reasonable amount of energy in 1970s and earlier but has steeply declined to only 21 petajoules in 2003, Fig.3.1. Coal use fell due mainly to fuel switching from coal to more economic fuels. There were an estimated 220 million tonnes of economically viable coal resources in mid-November 2001 (http://www.dti.gov.uk/energy/inform/energy_indicators/ind2_2004.pdf). Kenneth Fergusson, president of the Combustion Engineering Association, a former head of the

UK's Coal Authority said: "The UK has masses of unmineable coal, and if we could gasify it, it would be important for decades ahead, if not for a century. That means we need sequestration." (http://news.bbc.co.uk/1/hi/sci/tech/3930245.stm). Sequestration involves trapping $C0_2$ as it is emitted and storing it in huge reservoirs underground or under the sea. Therefore with the use of sequestration coal could be become one of the main fuels in the industrial sector in the future as the reserves would provide energy for over a century.

Fig. 3.1



Petroleum products

Petroleum products have shown a steady decrease, from 567 petajoules in 1982 to 337 petajoules in 2003, Fig.3.2. There are an estimated 1400 million tonnes of oil reserves in the UK in 2002, Fig.3.21. Only a small proportion of the estimated remaining recoverable reserves of oil are known with any degree of certainty. Estimates of the life expectancy of remaining UK oil reserves are therefore uncertain. As oil stocks in the UK run out probably over the next thirty to this sector will increasingly decline

Fig. 3.2

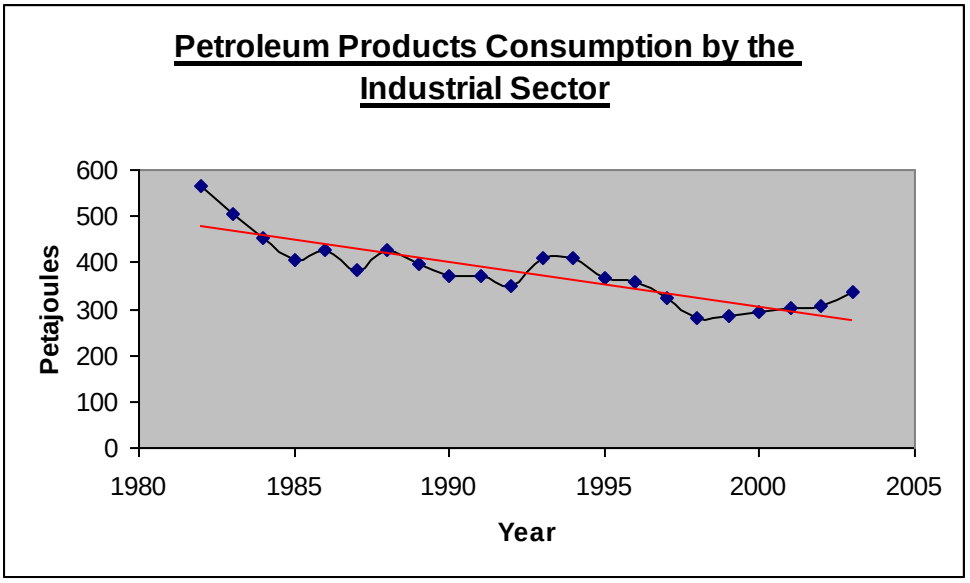


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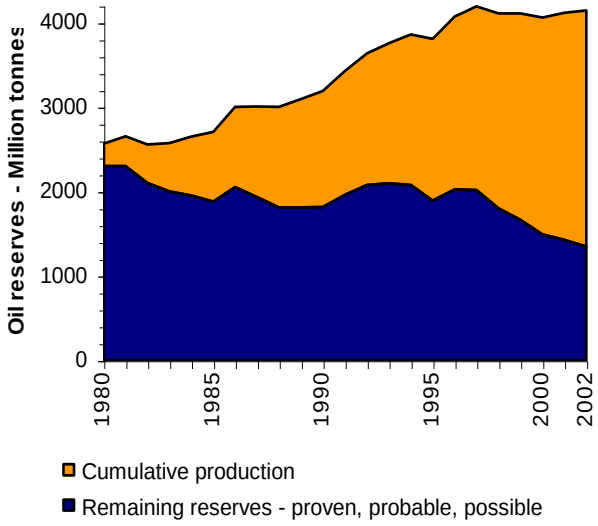
Fig.3.21

Discovered UK oil, cumulative production plus estimates of remaining reserves in present discoveries, 1980 to 2002

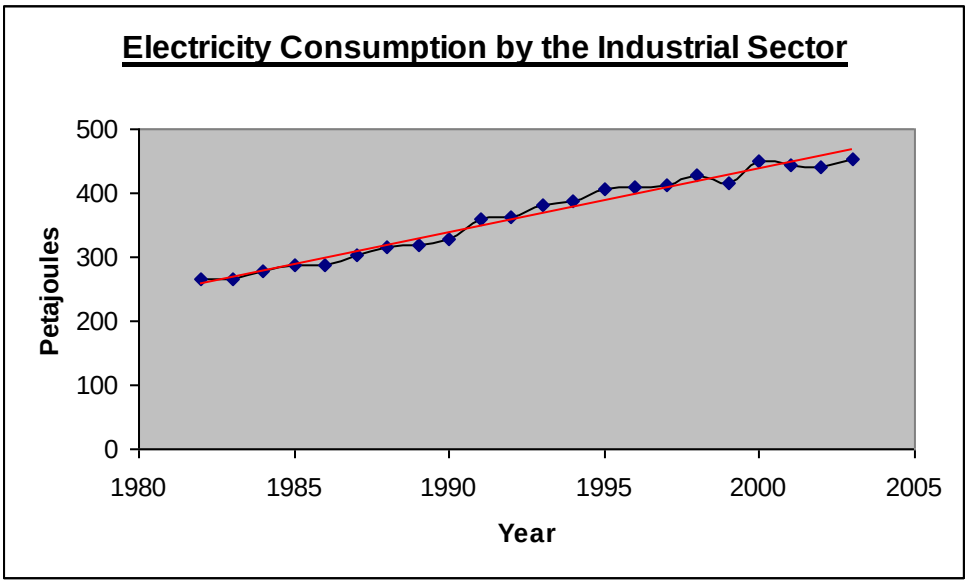


Source: http://www.dti.gov.uk/energy/inform/energy_indicators/ind2_2004.pdf

Electricity

Electricity is a major energy provider for the industrial sector and consumption has increased from 266 petajoules in 1982 to 453 petajoules in 2003, Fig.3.3. Electricity use would also be reduced as more environmentally friendly sources are promoted.

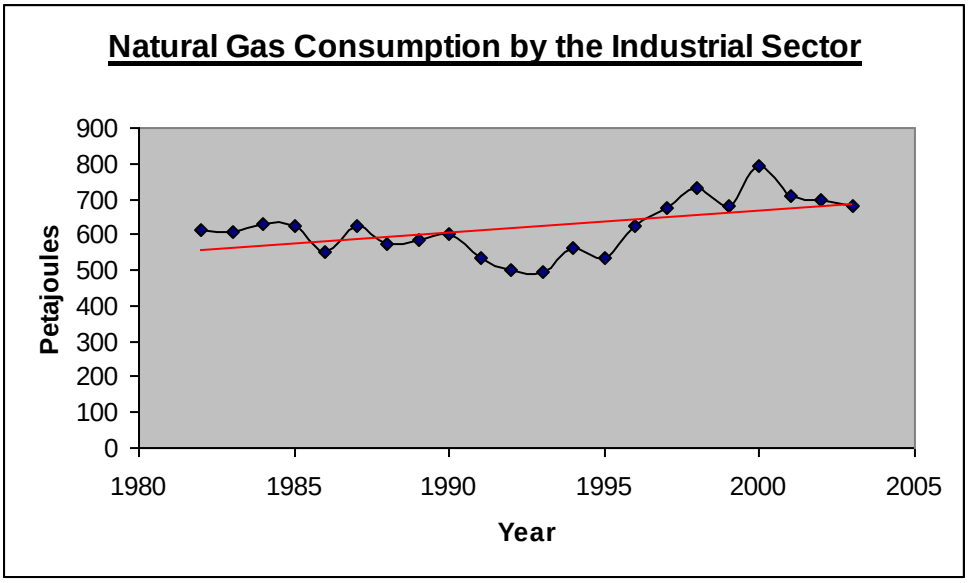
Fig. 3.3



Natural gas

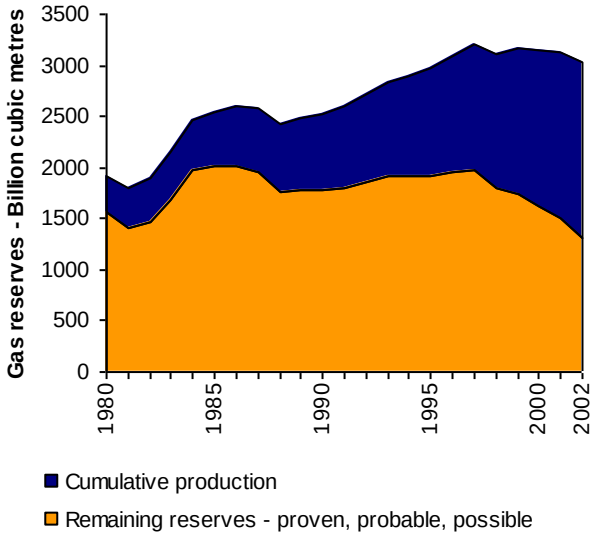
Natural gas provides the majority of energy to the industrial sector. The energy consumption varies from 495 to 794 petajoules, Fig.3.4, and has slightly risen overall since 1982. Remaining gas reserves have increased slightly since the 1980s but revision of estimates is low at 1350 billion cubic metres in 2002, Fig.3.41. The life expectancy of gas reserves by the end of 2003 was approximately 12 years at current rates of extraction (http://www.statistics.gov.uk/cci/nugget.asp?id=129).

Fig. 3.4.



Discovered UK gas, cumulative production plus estimates of remaining reserves in present discoveries, 1980 to 2002

Fig.3.41

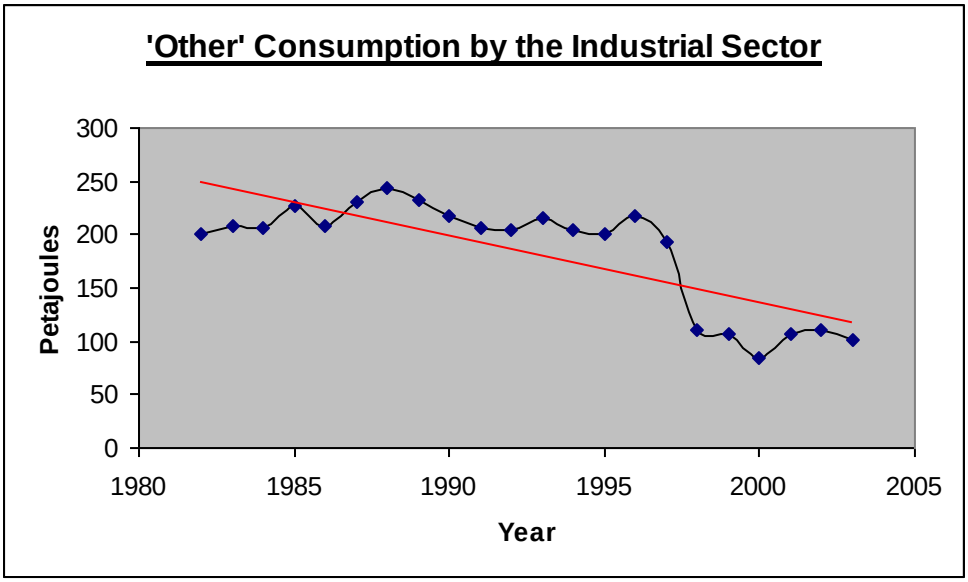


Source: http://www.dti.gov.uk/energy/inform/energy_indicators/internet_04_e2.1wp.xls

Other

This covers mainly coke and breeze and a very small amount from renewable sources and nuclear. This section is small at present, 101 petajoules in 2003, Fig. 3.5. It will be the section which is most increased in the future.

Fig. 3.5.



Estimated Fuel Mix

Units: Petajoules

	Current	2010	2015	2020	2025	2030
Petroleum products	337	310	250	200	160	130
Coal	21	50	100	200	300	350
Electricity	453	445	435	350	330	270
Natural gas	681	650	630	590	500	415
Other	101	120	130	150	170	180
Total	1593	1575	1545	1490	1460	1345

The estimates have been based on the past trends and the effects of the scheme to increase and decrease certain fuel types. It has also been based on Estimated amounts of reserves of the un-renewable energy types. Other has increased due to renewable energy sources.

Improving Energy Efficiency

Energy consumption in the industrial sector is decreasing and could decrease further if energy efficiency is improved and through dematerialisation. Since much of the energy consumption from the industrial sector is from building energy requirements, similar methods to those used in the domestic sector can be used to decrease energy consumption. The main requirements are for space and water heating, lights and appliances and air conditioning.

Improved levels of insulation in walls, roofs and floors reduce heat loss. Draught-proofing and heat recovery systems can be used to reduce heat loss through ventilation but still retaining sufficient fresh air within the building. More efficient boilers can be

used which require a smaller fuel input to achieve a certain level of space or water heating alongside improved insulation of pipes to reduce heat distribution losses. Energy efficient lights, such as compact fluorescent bulbs, can be used which use one quarter of the electricity consumed by standard light bulbs.

Energy efficiency can also be improved within the specific industrial processes. For electrically powered machinery switching off equipment when not in use and fitting higher efficiency motors can reduce energy consumption. Compressed air can cause high-energy consumptions. Fixing leaks, switching it off when it is not needed and where possible switching to electrically powered tools reduces energy consumption. Regular maintenance of machinery reduces energy consumption because well-maintained machinery wastes less energy and materials. Boilers and steam can waste a lot of energy, checking them regularly; insulating, using the lowest possible steam temperature and watching out for leaks can reduce this. Better process control systems are the key to improving energy efficiency in many production operations. Processes are frequently overheated or run for more than the optimal time wasting a lot of energy. Another very important way of decreasing the energy consumption from the specific industrial process is cascading of energy uses. This is where waste heat from a high-temperature process is used to provide energy to a lower temperature process.

Dematerialisation is the measures that can be adopted by an industry where the material content of products is reduced. An example of this is drinks cans where thinner metals can be used without any reduction in the required strength, or the substitution of less energy-intensive materials, as in the use of plastic instead of steel for car bumpers. Dematerialisation also includes social change to less energy intensive industries, such as the deindustrialisation, which occurred in the UK.

Appendix

Table 2
Units: Petajoules

Year	Iron & steel	Food & drink	Paper & printing	Chemical	Other
1982	310	173	90	421	427
1983	308	165	87	418	407
1984	310	168	91	404	395
1985	322	167	85	369	752
1986	294	168	92	338	767
1987	322	170	95	361	751
1988	341	168	94	352	766
1989	340	168	95	359	726
1990	321	186	110	257	767
1991	306	186	111	223	779

1992	302	182	113	244	751
1993	320	183	112	235	739
1994	353	187	127	327	715
1995	355	194	131	356	709
1996	368	192	117	304	758
1997	362	184	111	301	732
1998	244	184	108	323	733
1999	249	180	99	342	741
2000	230	168	111	339	750
2001	231	177	116	345	774
2002	201	177	111	357	738
2003	189	175	122	329	777

Source: Digest of UK Statistics

Table 3

Units: Petajoules

Year	Coal	Natural gas	Petroleum products	Electricity	Other	Total
1982	196	611	567	266	200	1840
1983	197	609	504	267	109	1787
1984	164	632	454	279	207	1738
1985	197	625	406	286	227	1743
1986	220	553	429	288	208	1698
1987	213	622	384	302	231	1752
1988	218	571	426	317	244	1777
1989	203	586	395	320	233	1737
1990	195	601	373	327	218	1714
1991	139	537	370	358	206	1611
1992	168	501	349	363	204	1585
1993	164	495	410	381	215	1665
1994	159	564	411	387	204	1725
1995	139	533	365	406	200	1643
1996	118	627	358	408	218	1729
1997	124	674	324	414	193	1729

1998	78	732	281	429	111	1631
1999	78	680	283	417	106	1564
2000	43	794	293	449	85	1664
2001	54	709	302	445	107	1617
2002	40	699	308	442	110	1599
2003	21	681	337	453	101	1593

Source: Digest of UK Statistics

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