Future Industrial Energy Demand

The industrial sector contains more than 3 million establishments engaged in manufacturing, agriculture, fishing, forestry, construction and mining. All of these industries demand energy for lighting, space and water heating, cooling, appliances and ventilation. In fact much of the industrial energy consumption occurs within buildings to meet these requirements. As well as using energy in processes such as generating electricity, extracting minerals and powering various manufacturing processes, some industries require additional energy fuels for use as feedstocks in their production processes (EIA, 1999). It soon becomes decisively clear that the industry exhausts a vast range of our UK energy.

The industrial sector is composed of a number of sub-sectors that each consume and demand energy: iron and steel, chemicals, metal products/machinery, food/beverages/tobacco, paper/printing/publishing, other industries, mineral products, electrical and instrument engineering, vehicles, textiles/clothing and construction. High energy-intensive industries such as iron and steel use substantial amounts of energy for high quantities of electricity and high temperature heat processes. Energy use in the industrial sector has altered over the years according to its structure and energy use. As a result total industrial energy consumption has considerably declined since 1970. Figure 1 shows how consumption has fallen by 44% since 1970 and by 10% since 1990.

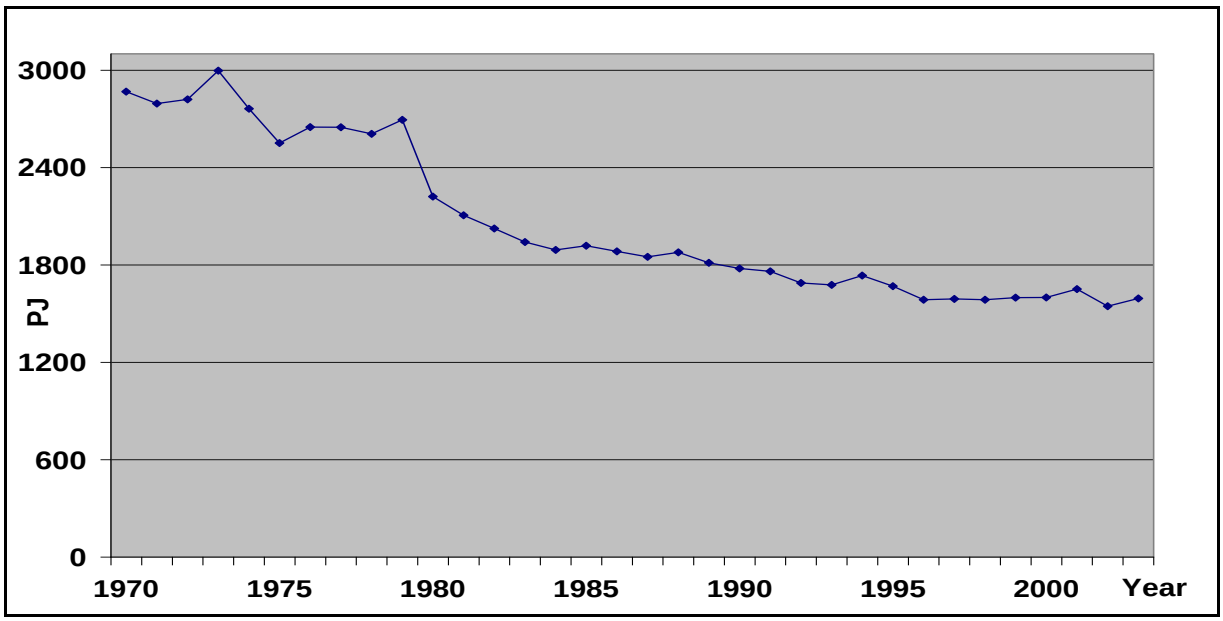

Fig. 1. Total industrial energy consumption, 1970 to 2003 (DTI, 2004).

There have been a number of fluctuations in this trend. More recently, consumption increased between 1996 and 2001 due to rises in consumption of the textile, chemical, electrical engineering and vehicle industries. Although there was a change in definition used to classify the industrial sector between 1995 and 1996, energy used in transformation activities, such as generating electricity or manufacturing coke, is excluded from the total from 1996 onwards (DTI,

2004). Nevertheless this overall significant decrease has stemmed from improvements in machinery efficiency and the development of technologies that have enabled alternative fuels to be used and, as a result, we have become much less dependent on those high energy-intensive resources such as coal and oil.

In 2003, industrial energy consumption totalled at 1579 PJ accounting for more than one fifth of all energy consumption in the UK. Since 1990 Energy consumption in the chemicals industry has increased by 22% to 328 PJ, and by 8% in paper, printing and publishing (Figure 2). The chemicals industry is becoming the cornerstone of our national economy. It provides building blocks for many other manufacturing industries and is a top wealth creator implying that this increasing trend is very likely to continue.

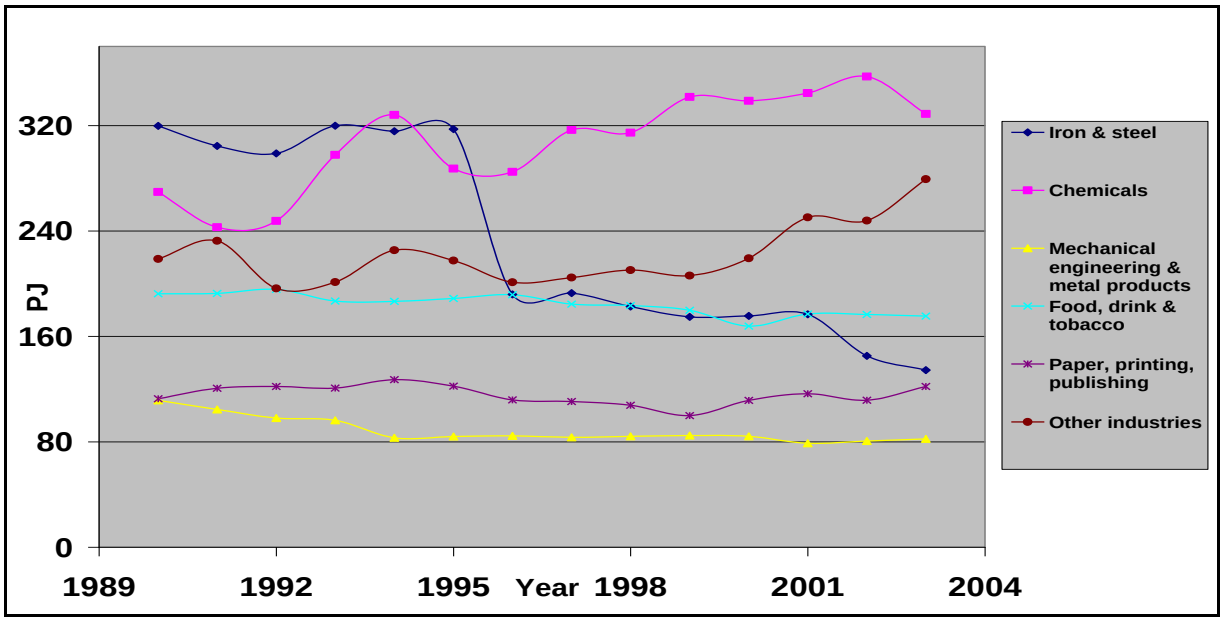

Fig. 2. Industrial energy consumption by sub-sector, 1990 to 2003 (DTI, 2004).

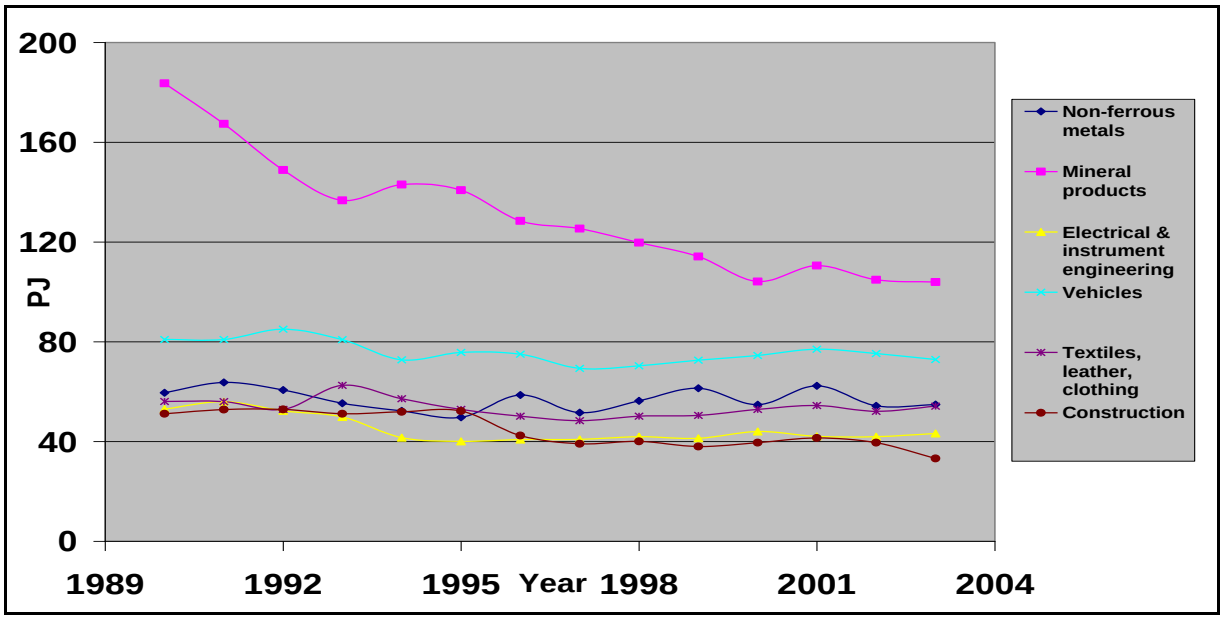

Fig. 3. Industrial energy consumption by sub-sector, 1990 to 2003 (DTI, 2004).

The iron and steel industry has seen a substantial 58% decrease in energy consumption since 1990 reaching a value of 134 PJ. Consumption has also decreased by 26% in the mechanical engineering industry, by 8% in the food, drink and tobacco industry, by 44% in the mineral products industry, by 35% in the construction industry, by 17% in the electrical engineering industry and by 10% in the vehicle industry (Figure 3).

Many of the reductions in industries have been a result of improvements in the efficiency of manufacturing processes and products. Industries such as food, drink and tobacco are likely to continue decreasing with government initiatives aiming for smoking and binge drinking bans. Although the construction industry is on the decline I predict that if we do move towards a renewable future then we there will be a considerable energy demand for the construction of projects such as wind farms. As a result, we could potentially see a great rise in energy consumption from the construction industry. The advantage of renewable energy is that it comes from continuously available sources which do not rely on exhaustible fossil fuels like coal and oil and could therefore help minimise the large declines that have been occurring in these resources.

The distribution and use of different fuels within the industrial sector reflects changes in the way that energy is used in different processes and industries. Since 1970 there have been major decreases in petroleum oil and coal consumption (Figure 4). As we move away from energy-intensive industries coal and oil demand have fallen by 96% and 74% of their original values respectively.

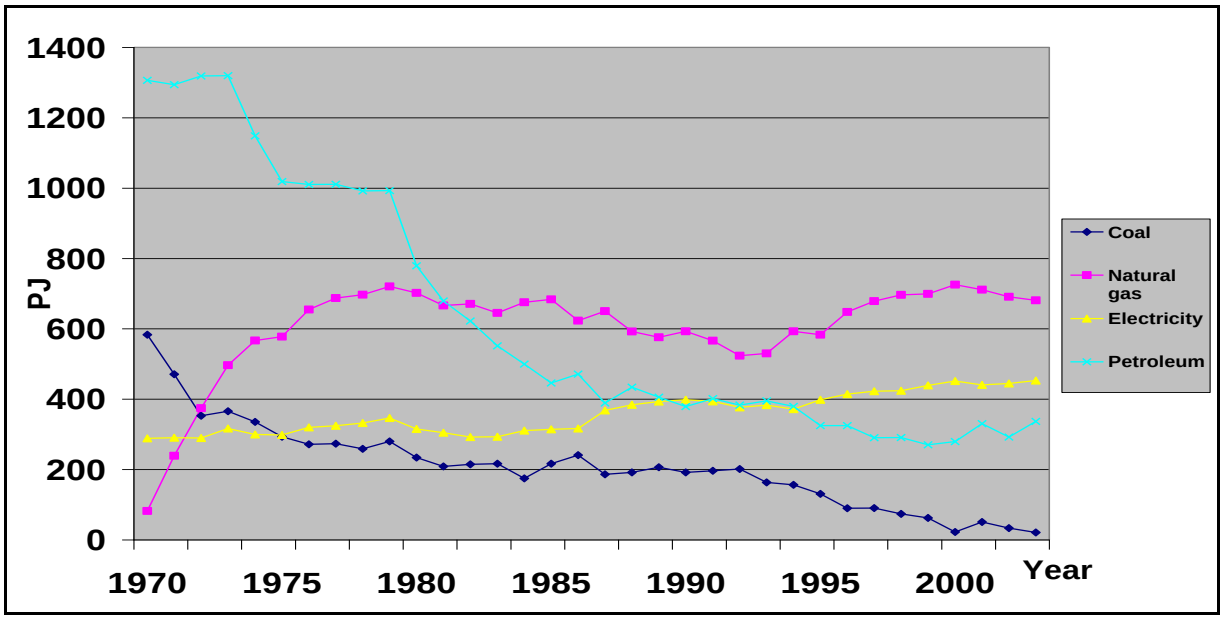

Fig. 4. Industrial energy consumption by fuel, 1970 to 2003 (DTI, 2004).

Since 1970 natural gas consumption has seen a substantial eight fold increase to reach a value of 680 PJ. This increase in gas is replacing solid fuels which have been declining to make way for alternative fuels. Electricity consumption in the industrial sector has risen by 56% to 452

PJ. This increase is likely to continue as more and more appliances, technologies and processes are run on electricity. Household consumption of electricity is also rising. As the number of people per household decreases and the average person invests in more revolutionary electrical goods the average household electricity consumption will considerably increase.

This relatively varied pattern of fuel use reflects the diverse end uses to which energy is put. Energy within the industrial sector is consumed for high and low temperature processes, drying and separation, space heating and motors. Intensity and output effects both influence the total industrial energy consumption where the difference between the intensity effect and the actual consumption value can be attributed to changes due to output. It is estimated that changes due to intensity led to a fall in industrial energy consumption of 193.2 PJ between 1990 and 2000 and a fall in output led to a fall in industrial energy consumption of 9.2 PJ (DTI, 2004). As with total energy consumption, industrial energy intensity has fallen since 1970. This is due to the decline in importance of energy-intensive industries in the economy along with the improvements in energy efficiency and technologies used in production processes.

In order to look to industrial energy demands in the future, projections need to be made. We know that efficiency, production output, the type of end use and fuel used all affect industrial energy consumption so by assuming efficiency will increase the following predictions for fuel and consumption can be made. Before addressing future total industrial energy consumption the individual sub-sectors need to be projected. Predictions were made for the main sub-sector groups by carrying on previous average trends (Figures 5 and 6).

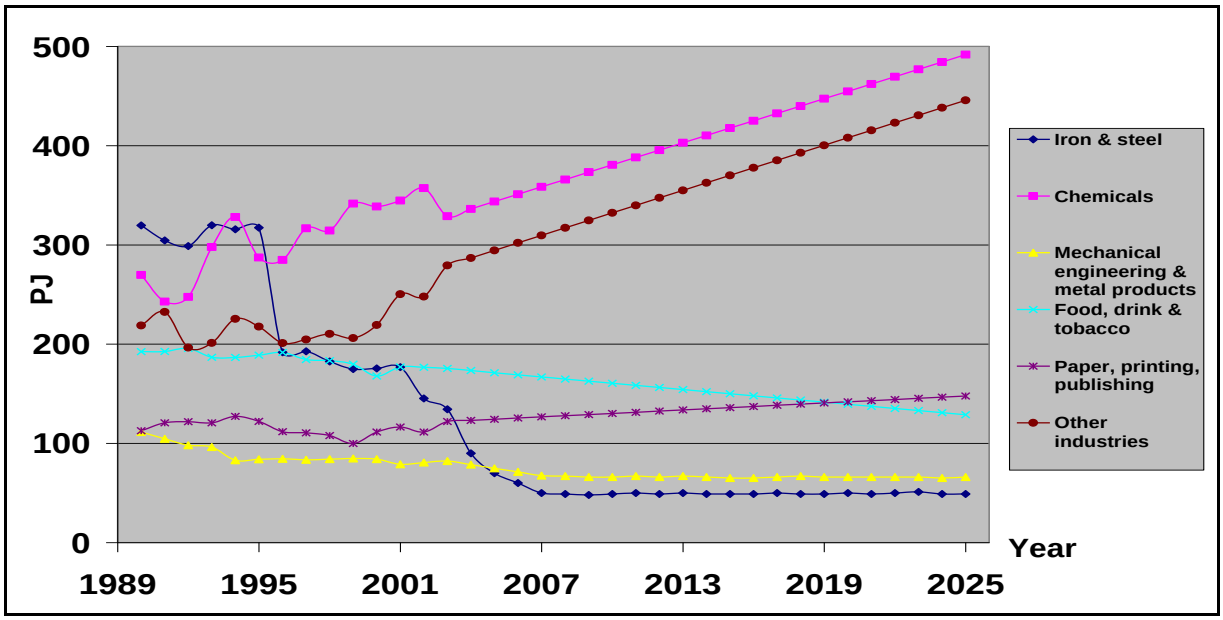

Fig. 5. Industrial energy consumption predictions by sub-sector, 2003 to 2025.

I predict there will be a continued increase in the chemicals industry reaching up to 491 PJ in 2025. This industry is already a vast energy demander and as research continues into areas such

as GM crops, cancer causes and cures consumption will inevitably increase. Iron and steel and mechanical industries will considerably decrease due to lack of demand. If current trends were to continue then these industries would be negligible by 2010 but keeping in mind these industries will still remain in some respect then I have predicted the industries will plateau off to reach values of 41 PJ and 66 PJ respectively. As government initiatives begin to set in we will see a decrease in the food, drink and tobacco industry particularly due to declines in smoking reaching a value of 128 PJ.

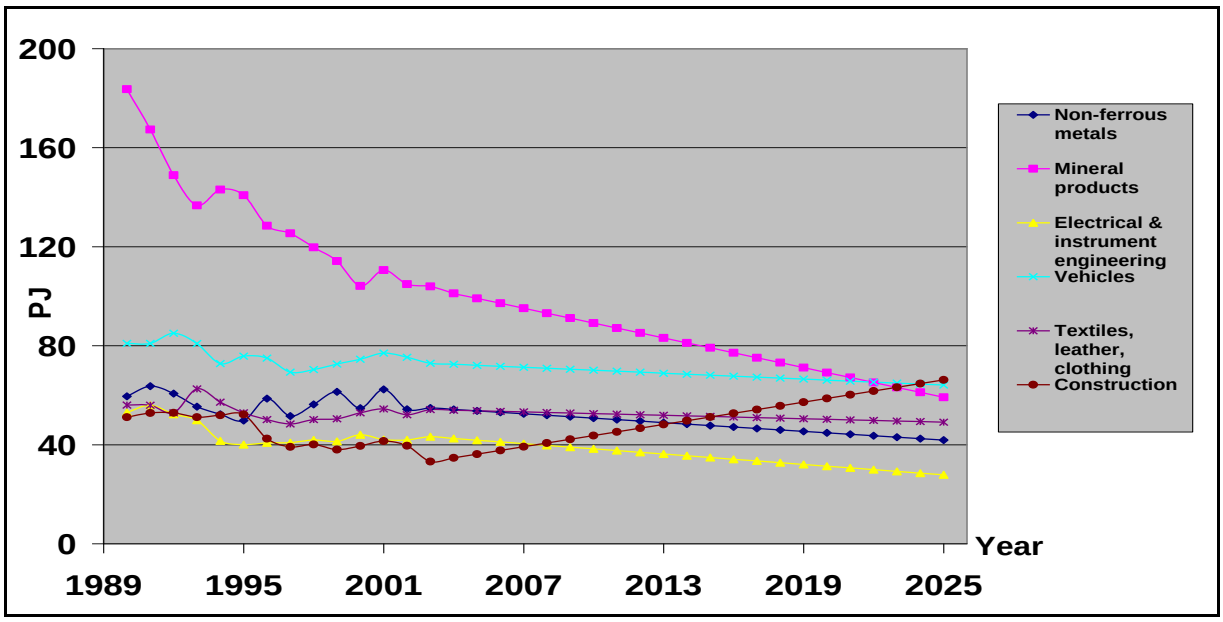

Fig. 6. Industrial energy consumption predictions by sub-sector, 2003 to 2025.

The remaining sub-sectors are generally experiencing decreases in consumption. If the current decline in the minerals industry continues, which looks likely with new fuel alternatives, then we could be seeing values of 59 PJ by 2025. The electrical engineering and vehicles industries should steadily decrease with technological improvements while construction, as previously mentioned, could be set to increase to meet renewable construction demand. Even if the energy demand were to increase by 1% each year, as projected here, then we could be reaching 66 PJ by 2025. Perhaps more likely though, would be to see a considerable increase on the offset of such projects, then after a period of time the benefits would cause an overall further decline in energy consumption.

Continuing current trends in fuel distribution sees increases in natural gas by 12% and by 24% in electricity reaching 782 PJ, 562 PJ respectively (Figure 7). I predict that future technologies and industries will be less energy-intensive and as a result will be able to rely on fuels such as gas and electricity opposed to coal and oil. Both coal and petroleum oil will continue to decline in energy consumption as we move to new technologies and further exhaust our current resources.

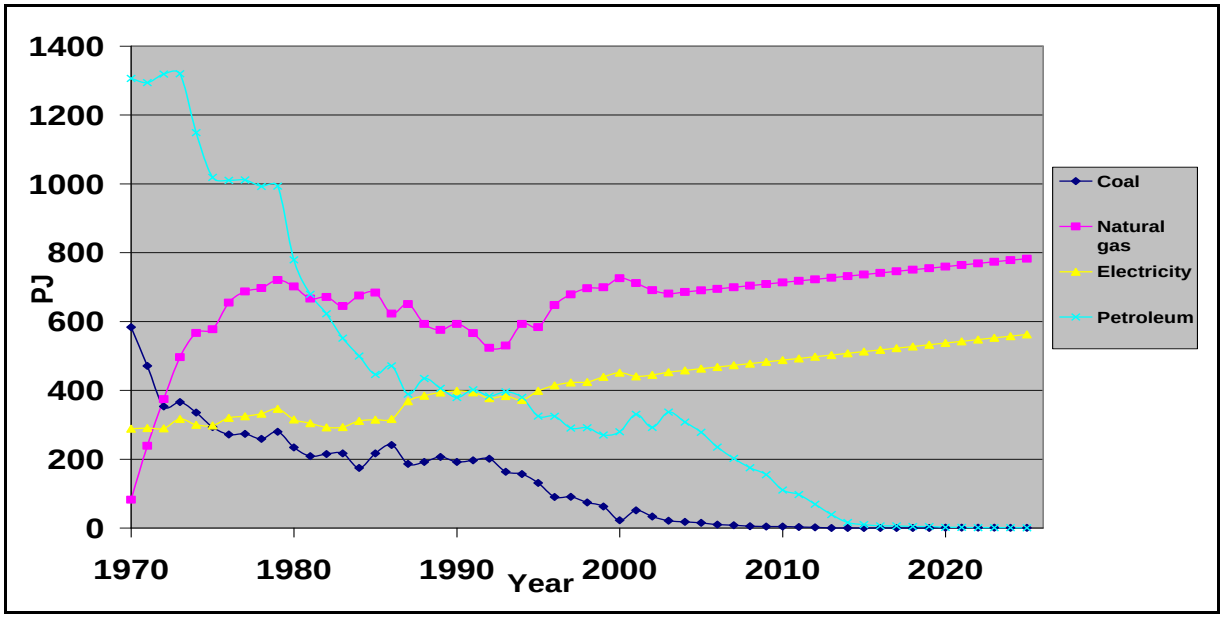

Fig. 7. Industrial energy consumption by fuel predictions, 2003 to 2025.

The total future industrial energy consumption can be predicted in a number of ways: continuing the current trend seen since 1970 (equivalent to a ≈10% decrease), aggregating all the values predicted from the individual sub-sectors and finally projecting an increase in energy consumption (10% rise). These three projections can be seen in figure 8.

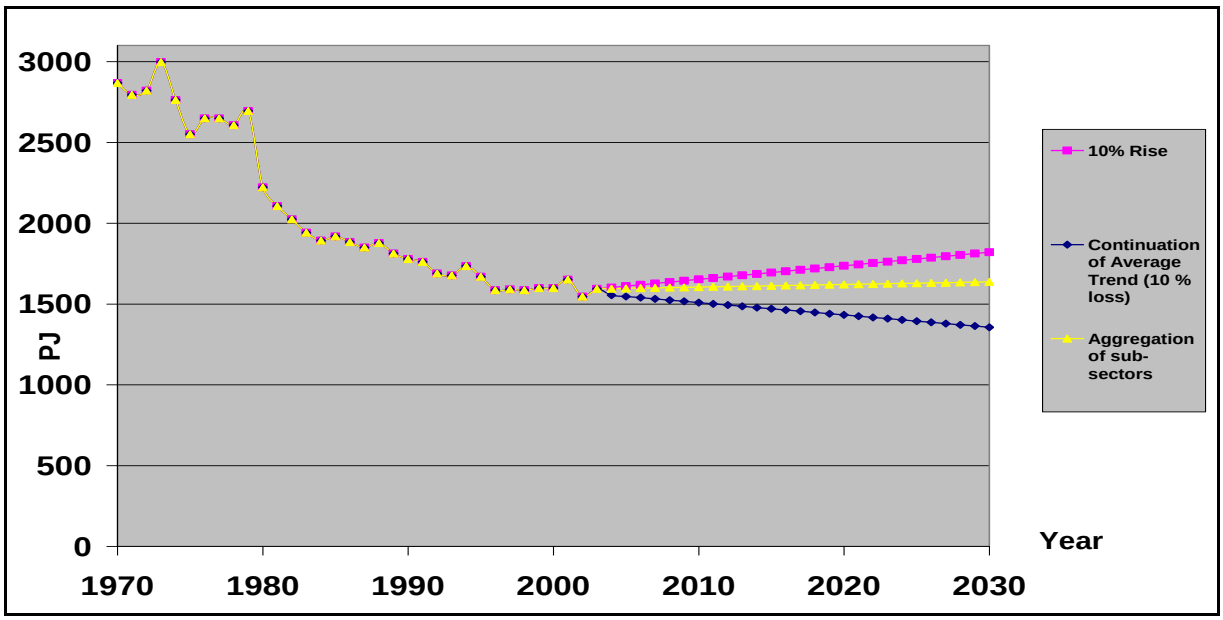

Fig. 8. Total industrial energy consumption predictions, 2003 to 2030.

Therefore, if the current decline in industrial energy consumption was to continue, which is likely until new energy sources are taken on board, then there would be a demand for only 1355 PJ by 2030. However, when aggregating the predicted values from the individual sub-sectors this value increases to 1636 PJ by 2025 perhaps making a more representative calculation (assuming all individual projections are correct). If energy consumption were to greatly increase through construction of new energy sources then there would be a demand of 1820 PJ by 2030. As

previously mentioned though, it is possible that this could only be an initial substantial increase to meet energy demand. Table 1 summarises the final projection values for each sub-sector by 2025. Table 2 summarises the main projections made for future total industrial energy demand. Table 3 summarises the future industrial energy consumption distribution by fuel.

Industry	Predicted Energy Demand for 2025 (PJ)
Iron & steel	49
Non-ferrous metals	42
Mineral products	59
Chemicals	492
Mechanical engineering & metal products	66
Electrical & instrument engineering	28
Vehicles	64
Food, drink & tobacco	128
Textiles, leather, clothing	49
Paper, printing, publishing	148
Construction	66
Other industries	445

Table 1. Industrial energy demand by sub-sector for 2025.

	Year						
	2003	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Continuation of average trend (10% decrease)	1593	1546	1508	1470	1432	1393	1355
Aggregation of sub-sector data	1593	1596	1604	1612	1620	1628	1636
10% Increase	1593	1610	1652	1694	1736	1778	1820

Table 2. Future total industrial energy demand projections (PJ).

	Current	2010	2015	2020	2025	2030
Coal	23	4	1	1	1	1
Oil	336	210	150	1	1	1
Gas	680	713	736	759	780	782
Electricity	452	487	512	537	562	590
Total	1491	1414	1399	1298	1344	1374

Table 3. Future industrial energy consumption by fuel.

References:

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