Contents:

1. Introduction: Energy and the environment.

The current political scenario is largely focusing on the environment. It is polemic, it is a problem, and governments are expected to find a solution. There are multiple areas that are concerned: pollution, biodiversity, poverty, disease, climate change…,etc. However they all go back to one central problem: the need for sustainability within a society that is running wild, with no looking ahead into the future.

The DTI clearly states that 'the production and consumption of energy can impact on the environment, whether from exploration, production, transportation, storage, conversion, distribution or the final use and disposal of waste products'. [1]

Not only reducing the energy demand is necessary but also to better understand and predict the mix of fuels and their source, especially because of government expectations to meet the Renewables Obligation by which 10% of electricity must come from renewable resources by 2010. Since 1990 use of natural gas has increased by 85%, largely due to the removal of the EC charge in generation of electricity from gas [2] and the use of CCGT technology, but already the amount of natural gas that can be obtained from the North Sea is declining.[3] Predicting the mix necessary can be as important as predicting the demand, since it will influence policy, especially in the cases where certain options lead to dependency on foreign supply or an increase in nuclear, which also has added safety issues under politics dominated by a threat of terrorism. (Figure 1)

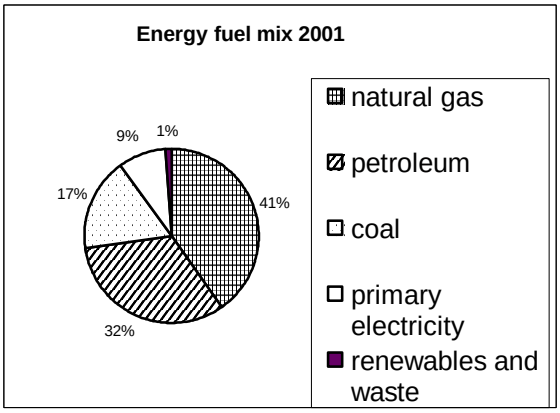


Figure 1. Energy fuel mix in 2001, figures represented as percentage of total by source type. Source: econsumpuk.pdf p9

It is to be noted that decisions on energy have to be taken well in advance as they take a long time to become effective (e.g: legislations have to be passed through Parliament, technical changes need time for industry to adapt to them and more time for the public to change habits, creation of power plants takes planning and time…). The energy sector contributes greatly to GDP, in 2003 it accounted for 3.3% of GDP in the UK [4], at the moment both GDP and energy growth seem to be associated, this is a problem that must be solved. This report will focus on transport energy consumption and future demand as an important piece in the battle to achieve a balanced and sustainable society. More attention will be paid to road transport and aviation than the other modes, as they have the highest impact. Final figures by source will be attained.

2. Transport:

Transport is one of the most debated issues at the moment. The government has recently come up with the 10 Year Plan for Transport covering the period until 2010/11. Amongst criticisms, is the fact that, though it addresses each subsector quite accurately, the plan accepts the current trends; measures involve improvement upon current situation but not a decrease in consumption or any conservation measures. Looking at the overall picture in demand, one can see that, current trends aren't acceptable in a society fighting climate change nor economically beneficial in the long-term. (Figure 2)

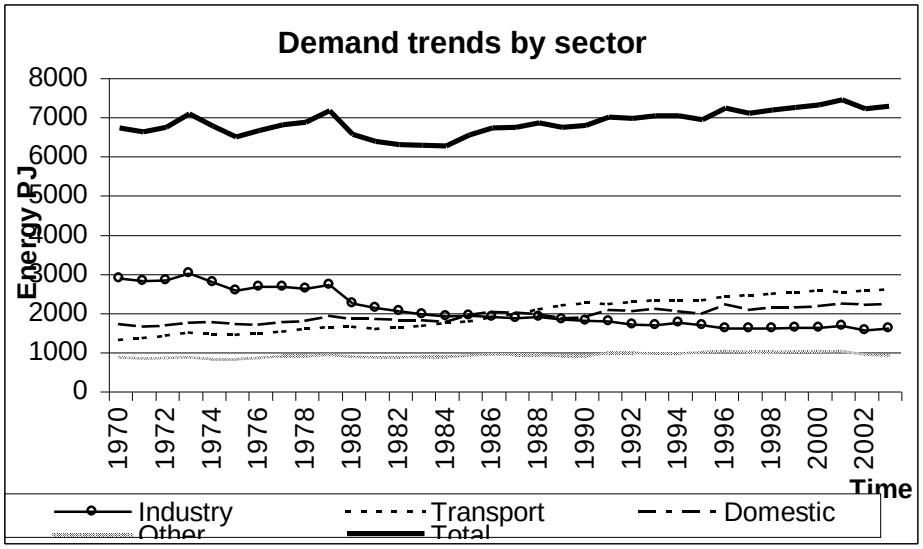


Figure 2. Demand trends by sector in PJ over time. Initial data source: Digest of UK Statistics 2003 Table 1.1.5

Taking into account past trends, we might conclude that the industrial sector will continue to decrease its energy demand especially since that is economically beneficial to them, whereas there are no incentives in either the domestic or transport sector to reduce what seems to be an unsustainable trend.

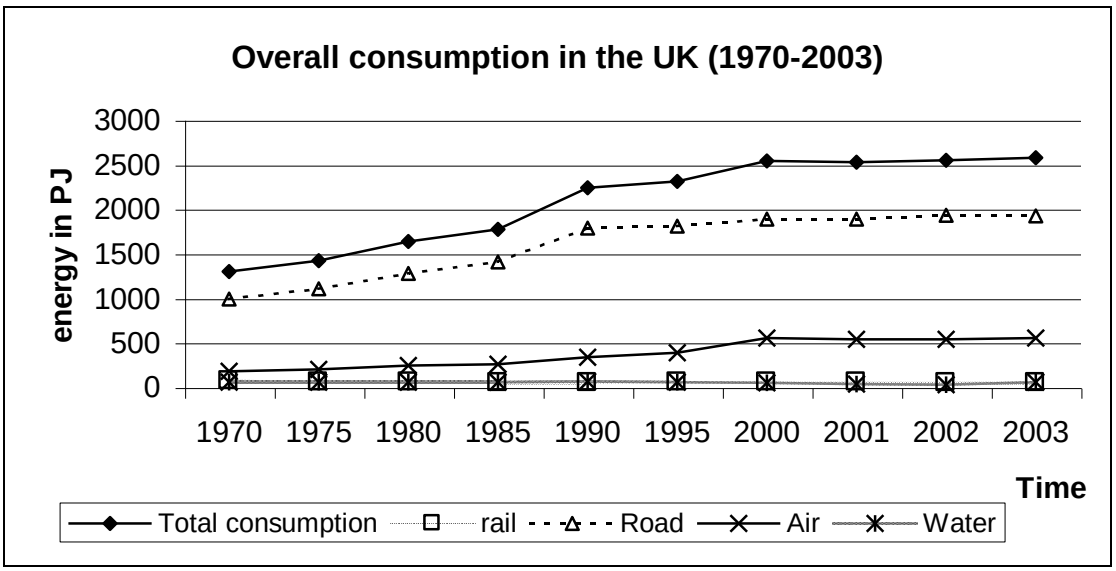


Figure 3. Overall consumption in the UK through the period 1970 and 2003, top line indicates total amount, next line down is road transport, followed by air transport and rail and water on a very close line. Data source: Digest of UK Energy Statistics 2003.

The transport sector has the highest increase in energy use; between 1980 and the year 2000 it experimented a growth of 55%. This increase, largely due to the increase in car ownership, has occurred throughout Europe, leading to congestion and pollution problems. [5]. In particular the highest increase has been in road transport with a 79% increase since 1980 (most of the increase was during the 80s decade, this suggesting a slower growth in the 90s and maybe the beginning of a change in current trends). [6]. Fig 1. Air transport appears to be increasing its demand at increasing rate, whereas both water and rail travel seem to be fairly stable.

3. Road transport.

Road transport is part of everyday life, the car has become a status symbol necessary for work (a license is a common requisite for jobs, including those related to the environment!), social and leisure activities.

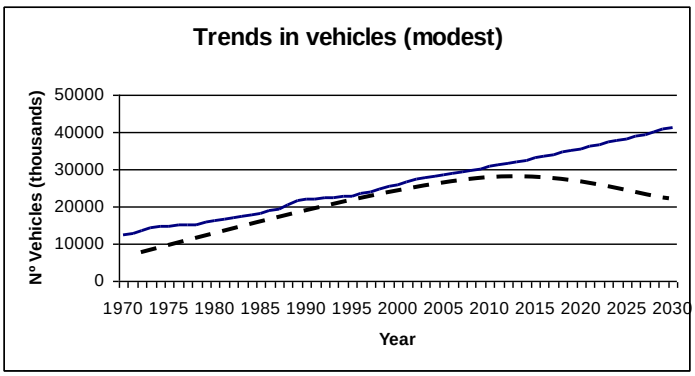


Figure 4. The graph line depicts what would happen if no changes occurred whereas the dotted line is more optimistic and more likely. It is expected that after 2015 light vehicle ownership will decrease. Data source: practical notes for Energy conservation course 2003-04

The number of light vehicles has been increasing through time steadily as cars became more accessible to people, and considered essential to everyday life (Figure 4). It is likely to continue increasing, though the rate appears to have decreased since 1998, it is likely to stabilize when reaching saturation point (0.55 cars/person). Predictions indicate that through social awareness, legislation, and the influence of congestion will lead to decreases around 2020.

Taking into account changes in fuel efficiency, distance travelled, population growth, and changes in light vehicle ownership, predictions for road transport demand were made. (For the exact values see attached table number at the end of the report.) (Figure 5).

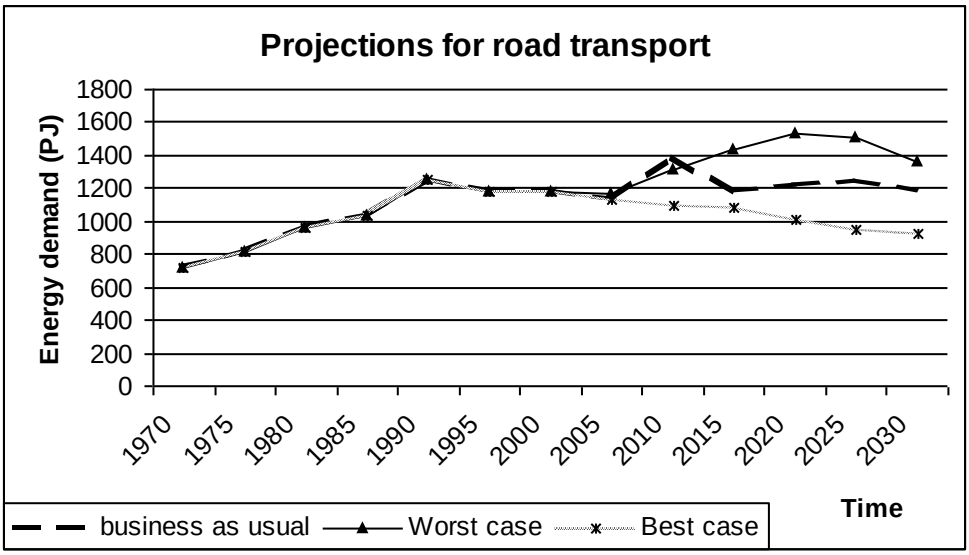


Figure 5. Projections for road transport demand in PJ through time. Three possible scenarios are shown through time. Initial data source: practical notes from Energy Conservation course 20003-04, N. Keith Tovey.

In the creation of this graph the following assumptions were taken into account:

1. Business as usual:
   - –assumes car saturation point at 0.55 cars per person reached at 2020,
   - –population estimates from the ONS were used to calculate the number of cars in each year, [7]
   - –no significant variation in distance travelled, and progressive improvements in efficiency (3% by 2005 and 10% by 2010, after which small improvement till 2020 where it remains static)
   - –overall is optimistic of changes in society through time.

2. Worst case:
   - –assumes saturation point 0.55 cars per person by 2015, over saturation 0.58 cars per person by 2020, after which the number of vehicles will go down
   - –also assumes an increase in distance until 2015 when no more roads can be built or legislation is in place
   - –no changes from 2002 levels of efficiency

3. Best case:
   - –assume highest ownership at 0.51 cars per person by 2020, after which there is a steady decrease as improvements in public transport and legislation measures take place
   - –1%distance reduction in 2010, 5%in 2015 and 10% by 2020, distance is stable at that point.
   - –energy efficiency improvements of the same scale as business as usual scenario

Road transport is going to have to undergo a change, though the use of LPG and hybrid diesel vehicles has become more common, it is expected that whole range of fuels such as biofuels, biodisesl, hydrogen and electricity will begin to gain impulse in the sector by 2020. By which time vehicle age may have ceased to affect the overall efficiency.

4. Air transport.

Following road transport, air transport is the sector with the next highest increase, and unlike road transport it does not seem to be reducing it's rate of increase. All forecasts, assume continued growth.

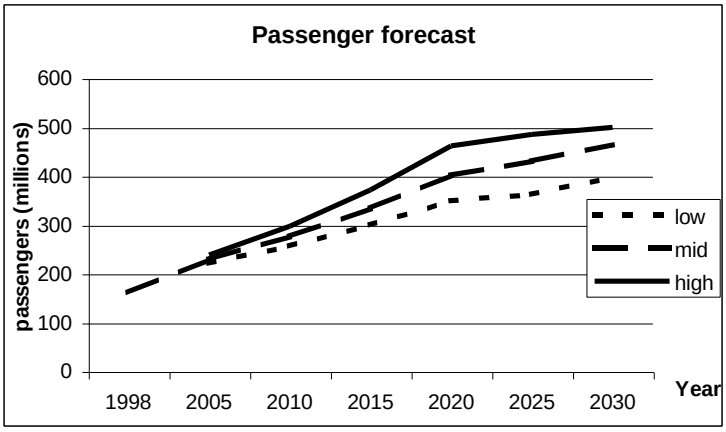


Figure 6. Passenger forecast, shows 3 scenarios, all expect some increase.
Data source: 2000 Forecasts Aviation pdf 503314 p7

The UK fleet currently involves 48 commercial companies which total 903 aircraft. The average distance travelled on UK airlines on international flights is 2,959 km/passenger. To put this into context if we assume 80% occupancy rates (currently oscillating between 75-79%) [3,8], each flight contributed on average 1281'47 kgCO_2, which is GHG that affects climate change.

It is assumed that the distance travelled is going to remain stable (flights go everywhere at the moment, only the frequency of flight could increase, which seems to be the case) except for very minor increase, changes in efficiency are too costly and difficult at the moment but assume improvement by 2015 (1.5%); and using the mid-range passenger scenario trends in air transport demand will increase 2015 when they begin to drop (Figure 7)

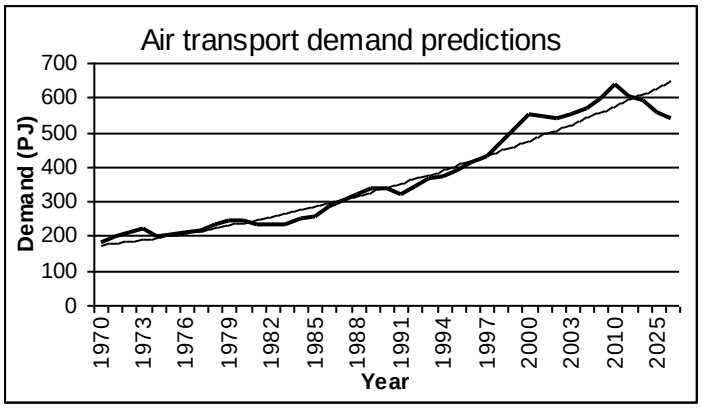


Figure 7. Air transport demand predictions until 2030. Initial data source: Digest of UK Statitistics 2003 Table 1.1.5

The demand for air transport has been in the past solely through petroleum as fuel, predictions assume petroleum as fuel, due to difficulty with aviation fuel and DERV fuel. Thoughts for the future involve some hybrid system that incorporates use of biodiesel, though companies seem reluctant to invest in research due to the impracticalities and the cost. With Kyoto coming into force, some change will be seen, especially for cheap companies that rely on low fuel prices.

5. Rail.

Railways are an essential part of the country's infrastructure, as the economy grows it is expected that there be a higher demand for good transport services [9] The Governments 10 Year Transport Plan, includes a huge fund towards railways and rail industry, in the order £3.8bn by Government and private sector each (same dft page section 1.31); behind this is the thought that as the economy grows so do expectations and demand for effective passenger and freight transport. (Figure 8)

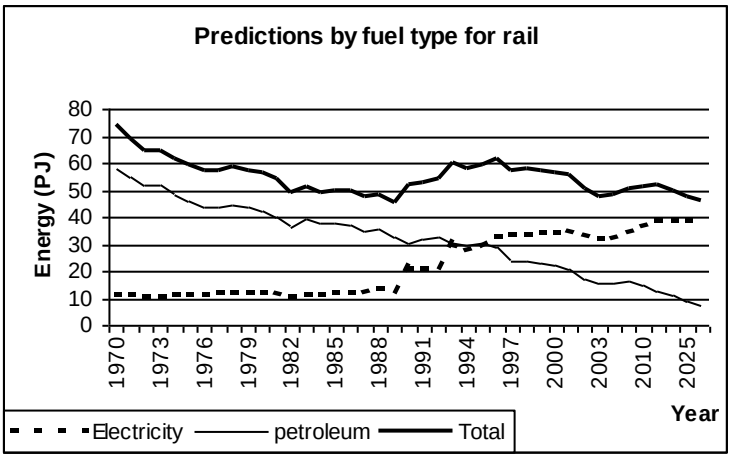


Figure 8. Predictions by fuel type for rail. It is the only sector with clear combination of fuels. Initial data source: Digest of UK Statistics 2003, table 1.1.5.

The 10 Year Plan for Transport, also includes funding for the creation of more rail lines, and improvements on the current infrastructure, with that in mind, an increase in rail travelling is to be expected. The shift in the source used will continue to phase out petroleum and increase the electricity, and is essential when predicting demand; changing to electricity, though it does decrease emissions overall, does have its own problems such as the increase in electricity demand which will be affected by the Renewables Obligation (though at the moment it would only mean a rail contribution of 0.08% to the 10% target).

6. Freight and water transport.

A significant proportion of water transport is due to freight, to distinguish between them, especially when data for freight is so mixed up with air transport and units for freight lifted vs. on road differ so much, was quite difficult, using historical trends in water transport demand, future demand was estimated. (Figure 9). Energy use for freight transport is dependent on the weight carried as well as distance travelled, together with the mix of sizes of vehicles used and their fuel efficiency. [4] In the last decade there has been an 8% increase in freight lifted and an 18% increase in tonne/km in UK [10].

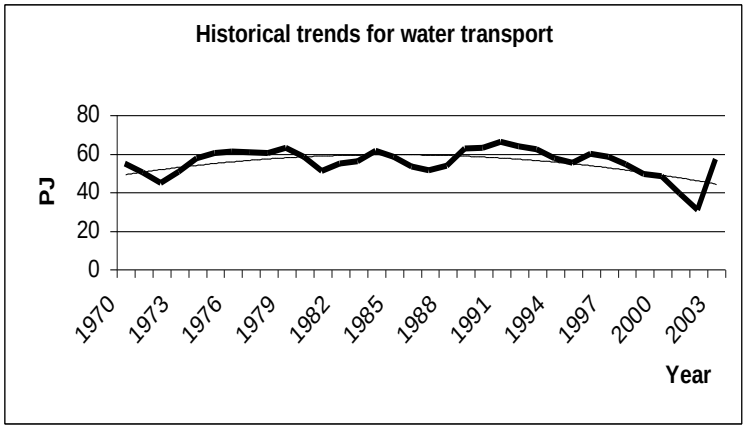
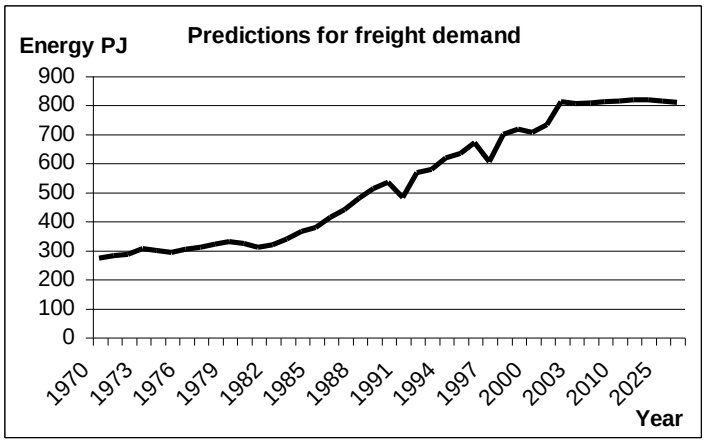


Figure 9. Historical trends for water transport. Though it varies, overall stable between 30-66 PJ. Data source: Digest of UK Energy Statistics 2003, table 1.1.5.

In a business as usual scenario, freight increases as economic growth calls for increases in transport of consumables, (government's prediction). In 2003 freight in ports decreased by 1% to 533.7 mill. Tonnes. [10]. Predictions for freight assume business as usual scenario for other transport sector correct (data for freight based on historical trends, obtained subtracting all other sectors from total transport demand).



Assume also that past 2015 saturation or legislation limit imposed and freight would remain more or less static. It is possible that with earlier aviation restrictions, freight would shift a percentage towards water and road based freight.

7. Total demand.

Government projections expect increases in aviation fuel, decreases of DERV throughout all transport post 2005, but in general an increase, especially with transport increasing. It is necessary to understand how each sector contributes to the overall demand for transport. (Figure 10)

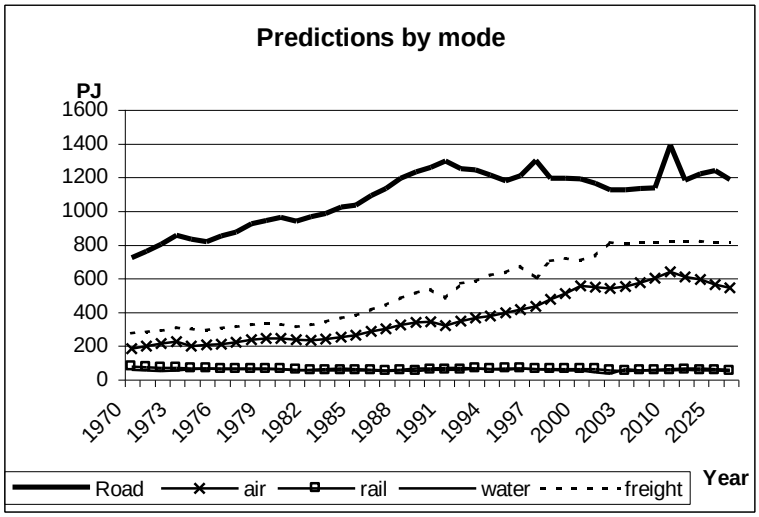


Figure 10. Predictions by transport sector until 2030 in total PJ. Assumptions follow a business as usual scenario, and medium growth in air passengers.

Extensive planning is needed that takes into account variations in other demand sector, to achieve an integrated approach to energy consumption. Careful legislation is essential, continuing the Government's decision that appropriate levels of fuel duties will in future be decided on a Budget by Budget basis, though it is the way forward, must take into account more than just economics and re-define their policy especially the 10 Year Plan for Transport to include measures of energy conservation. [11] If nothing is changed, and public's awareness doesn't improve it might become difficult to meet the demand we shall need. (Table 1)

Total Demand by Source Type (PJ)				
Year	Petroleum	Electricity	Biodiesel/biofuel	Total PJ
2000	2509,89	34,09		2543,98
2005	2610,43	34,27		2644,7
2010	2908,61	35,93		2771,3
2015	2669,14	38,78	3	2710,92
2020	2684,16	38,59	10	2732,75
2025	2656,51	38,50	15	2719,01
2030	2576,07	38,41	17	2631,47

Table 1. Total Demand by Source Type (PJ).

	Projections for road transport demand in PJ		
Year	Business as usual	Worst case	Best case
2005	1132,466	1168,544	1132,466
2010	1386,42	1319,267	1093,867
2015	1179,828	1441,111	1077,728
2020	1215,823	1537,806	1014,66
2025	1236,145	1509,596	950,708
2030	1183,089	1364,426	921,446

Table 2. Projections for road transport over time. Assumptions stated already

8. References.

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[11] DTI. Energy Paper 68
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Others (mostly used for calculations and graphs):

–Digest of UK Energy Statistics 2003, table 1.1.5

–Practical notes. Energy Conservation Course 2003-2004, Tovey NK. School of Environmental Sciences, UEA.