3B7 2012 CRIB

As mentioned in the lectures, all questions are of essay form.
An essay consists of

(i) An introductory paragraph that scopes the overall essay.
(ii) 3-5 paragraphs, each making a different and substantial point, and
(iii) A concluding paragraph that draws the arguments together and comes to some form of conclusion.

The lecture notes contain many more than 5 substantive points on each of the essays.

1: Introduction: The scale of the problem – 80% reduction in CO2 allows us to use as much fossil enegry per capita as we did with our total enegry per person in 1800. All ground travel, manufactured good and domestic comforts above that level have to be provided by non-carbon means.
Substantive points for a paragraph each include, but are not limited to:

(i) Balance of major energy usage – 33% on ground transportation, 45% heating air and water in buildings, 22% on energy intensive industry and issues specific to each sector.
(ii) Quick wins and deep efforts needed in each case. The second 40% reduction will be much more difficult than the first 40%, and will need major focussed R&D to prepare technologies.
(iii) Renewables a very dilute source of enegry and unlikely to do the job – nuclear rebuild will be essential.
(iv) Wider enegineering issues: the economy (subsidies can't go on for ever), the ergonomics (people's attitudes and behhave to change).
(v)

Conclusion: The only previous history of engineering on the required total scale was in WWII, and that required requisition of goods and people to achive, and there is no popular will for such. It also bankrupted the uK. Progress will be made, but the target is unlikely to be met without a French solution fo a major relainace on nulcear power.

2. Introduction: Present structure and eventual structure of grid needed – contrast a centralised production system versus a localised multi-centre production system for electricity.
Substantive points for a paragraph each include, but are not limited to:

(i) Current system allows bidirectional energy flow in transmission but uni-directional in distribution. The latter will have to become bi-directional.
(ii) The control systems for such a grid are not available, evidenced by grid instability in Germany.
(iii) A great extension of the grid will be needed as, for example, when off-shore wind-farm energy is brought ashore – it has to be connected to the

main grid. There will be many more electricity pylons all over the country.

(iv) The required level of spinning reserve is not known, and unlikely to be less than now, and may have to increase to cover intermittency.

(v) In the short term 30% of grid's generating capacity has to be decommissioned because of EU CO2 directives or end-of-life issues. The scale and cost of rebuild is very great and not reflected in the current level of action to ensure delivery – meaning that EU directives will be broken or nuclear power plant life will have to be extended.

(vi) If all sectors electricity their energy sue, based on clean sources of energy, the grid capacity will have to increase by between 50% and 100%.

Conclusion: The challenge of the next decade, and how it is met, will largely determine that way that the UK will be powered in 2050.

3. Introduction: 45% of energy use in buildings, and 27% in homes. 87% of buildings here now will form 70% of 2050 building stock. How can we reduce the energy consumption? The domestic and non-domestic sectors are very different.

Substantive points for a paragraph each include, but are not limited to:

(i) Current domestic work – Warm front etc: loft, cavity wall insulation, double glazing and draught proofing went from 35% to 65% compliance between 1990 and 2005, with a 4% net reduction in CO2 emissions – net because of increase in number of homes (10%) and increase in home appliances (plasma TVs, home electronics...). Even 100% compliance will only get another 4% reduction.

(ii) New materials needed for better insulation, both inside and outside – treble glazing and/or vacuum glazing, deeper loft insulation, ...

(iii) With 22M homes, it is clear that some major national campaign will be needed, last seen in transfer from town to natural gas, and there is much evidence of owners not trusting workmanship with inadequate guarantees.

(iv) Non-domestic buildings (offices, factories, hotels, hospitals, warehouses) tend to have makeovers more often than domestic sector, and there are greater opportunities for deep retrofitting.

(v) Test cases how that a 60% CO2 reduction can be achieved by insulation measures combined with local alternative energy generation but the cost onlt becomes affective if a deep makeover is being done in parallel.

(vi) The scale of the retrofit is at about £50K per household, or £1T by 2050, on a par with the complete DIY sector at present. We would need to double the workforce and throughput of building supplies.

Conclusion: There is no market for retrofit at present, the scale of the work and the readiness of the population makes the challenge even harder.

4 Introduction: Western civilization since 1800 has advanced just as in line with the increasing per capita travel of its citizens, and 40% of the personal energy use of citizens in the EU is based on ground and air travel and the logistics associated with personal consumption of goods.

Substantive points for a paragraph each include, but are not limited to:

(i) Air travel: improvements in airframe and engine efficiency are at about 1% per year, but this will be more than offset by an estimated doubling of air transport by 2050. No alternative to fossil fuels for air transport within 40 years, so other parts of world economy will have to compensate.

(ii) For ground transport there are improvements in fuels and in engine and car design. The use of biofuels will reduce the net CO2 emissions, but by just how much is controversial, and the very large areas needed for growing biofuels conflicts with future needs of land for food.

(iii) Electrification of cars in progressing, but the early battery technologies are having problems of fires/explosions in deployment as well as considerations of fear of finite range and the time for refuelling.

(iv) People behaviour will need to change if public transport is to grow – fortunately that tends to happen in large cities and more people are living in cities.

Conclusion: The challenge for transport is great, but much more in the hands of engineers and innovation, as for example cars last only for 10 years – homes for centuries.