Understanding the Low Carbon Economy
14th November 2007 - Birmingham

STRATEGIC PATHWAY TO A LOW CARBON FUTURE

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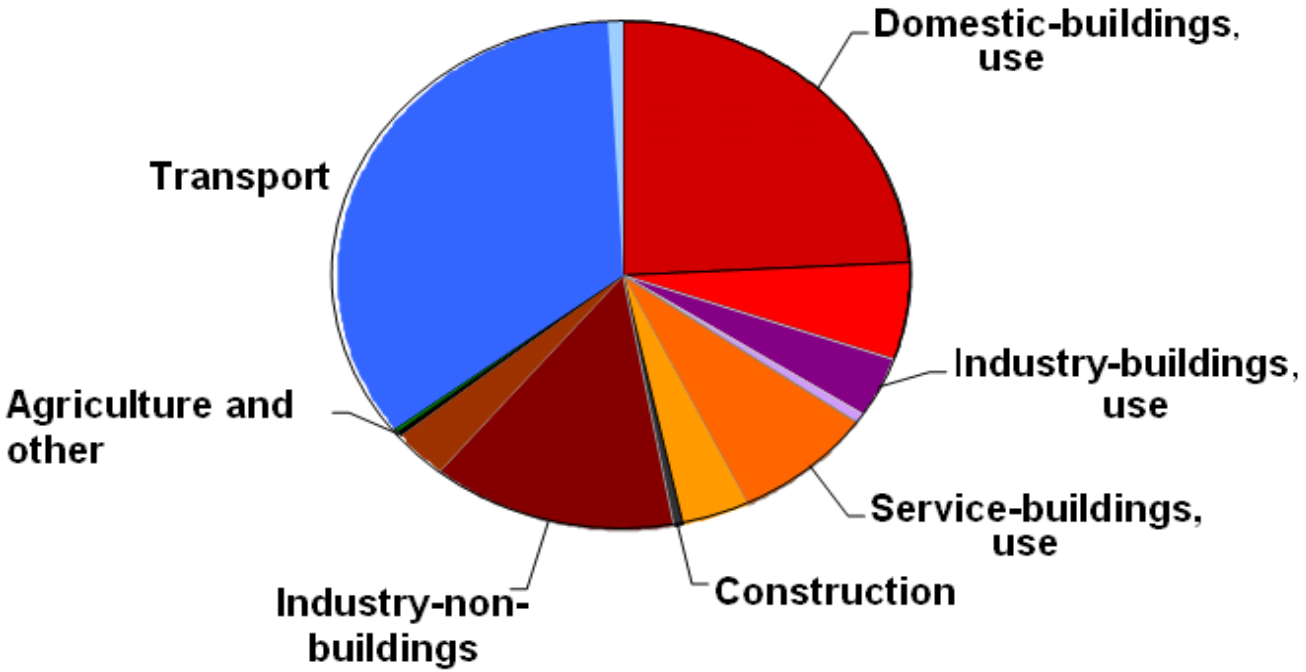
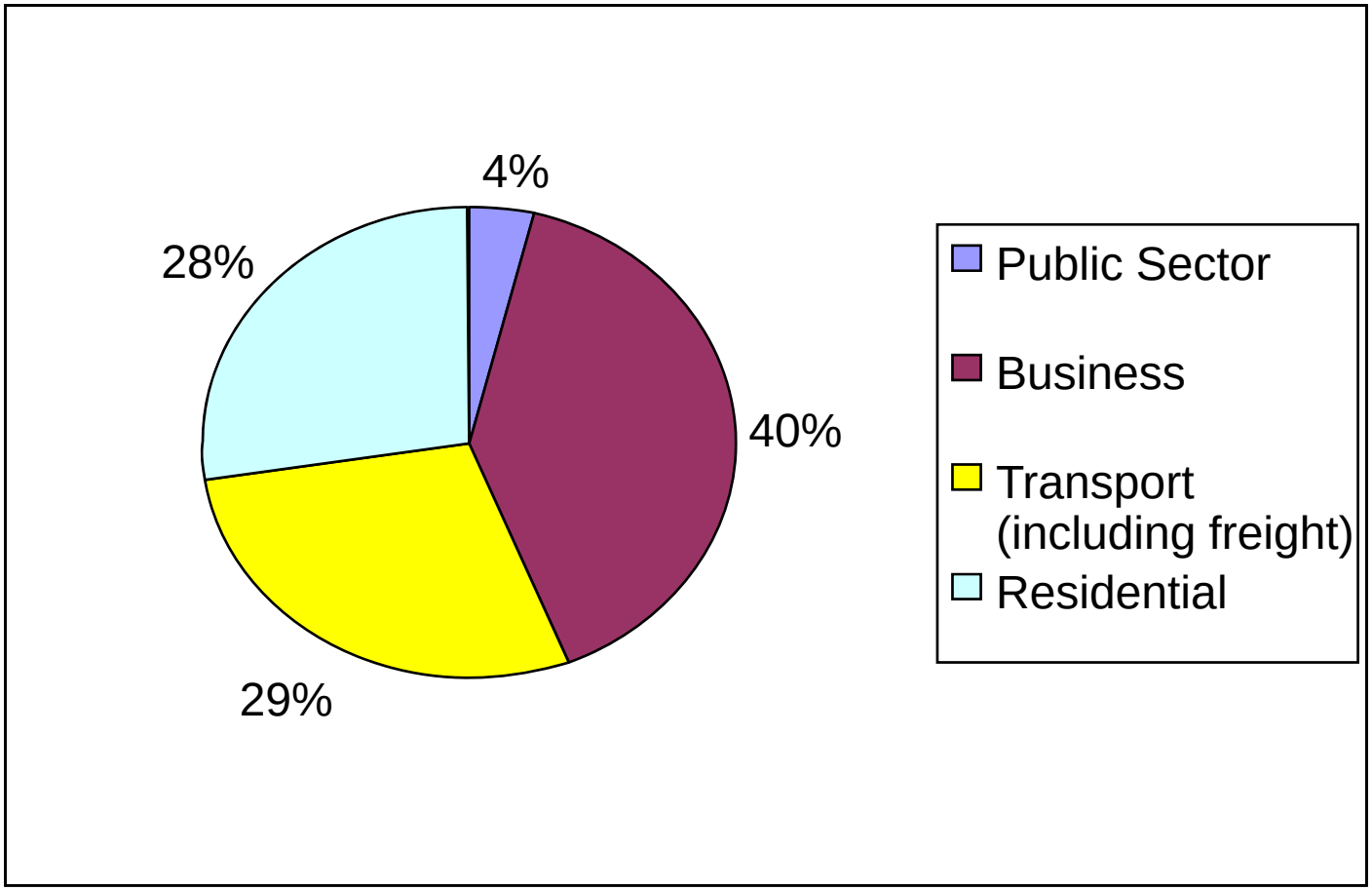
UK direct energy consumption 2002
Total 157 Mtonnes of oil equivalent

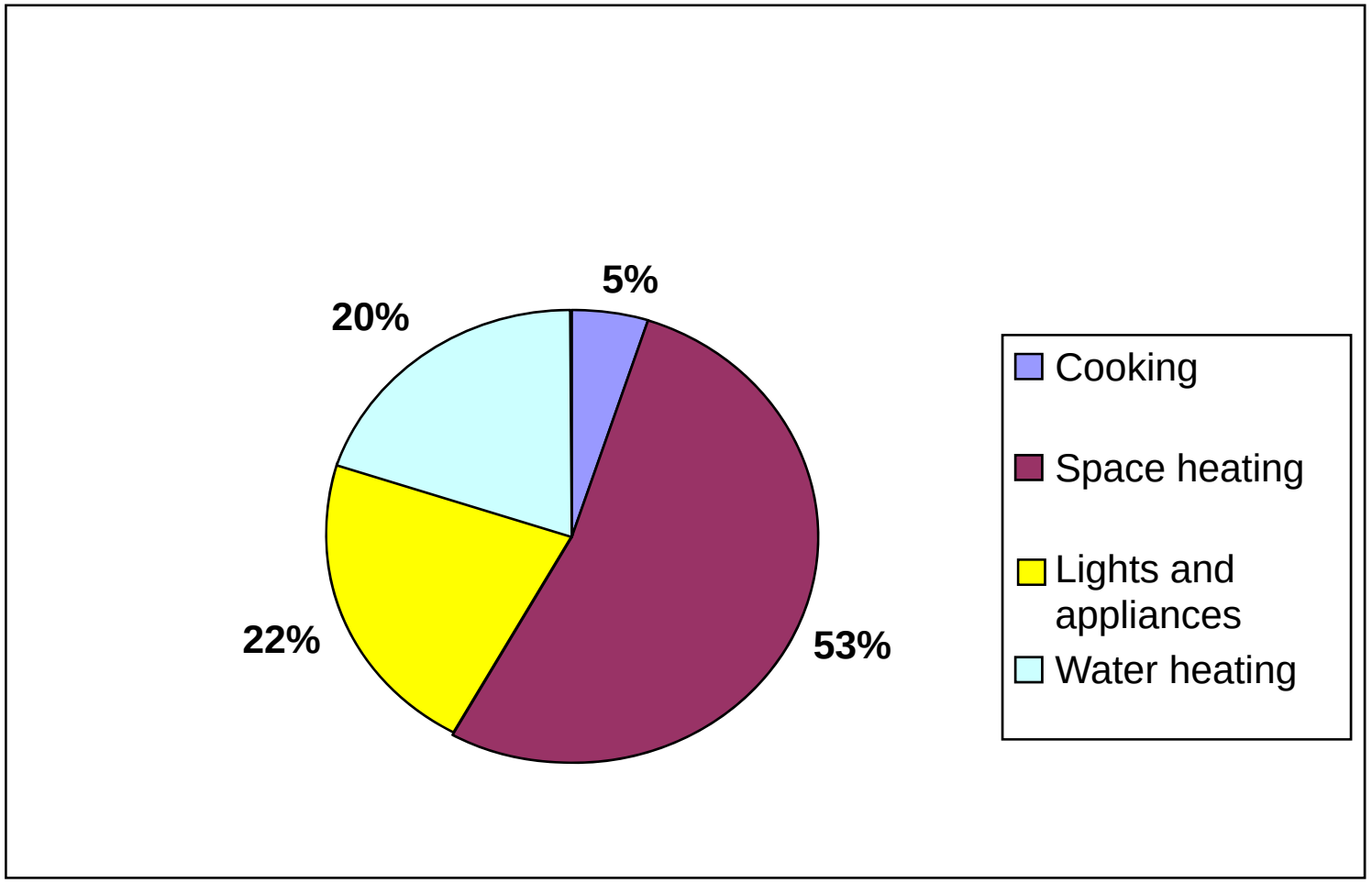
Electricity consumption is shown in lighter shades



Carbon dioxide emissions by end user in the UK, 2004



Residential carbon dioxide emissions, 2003:



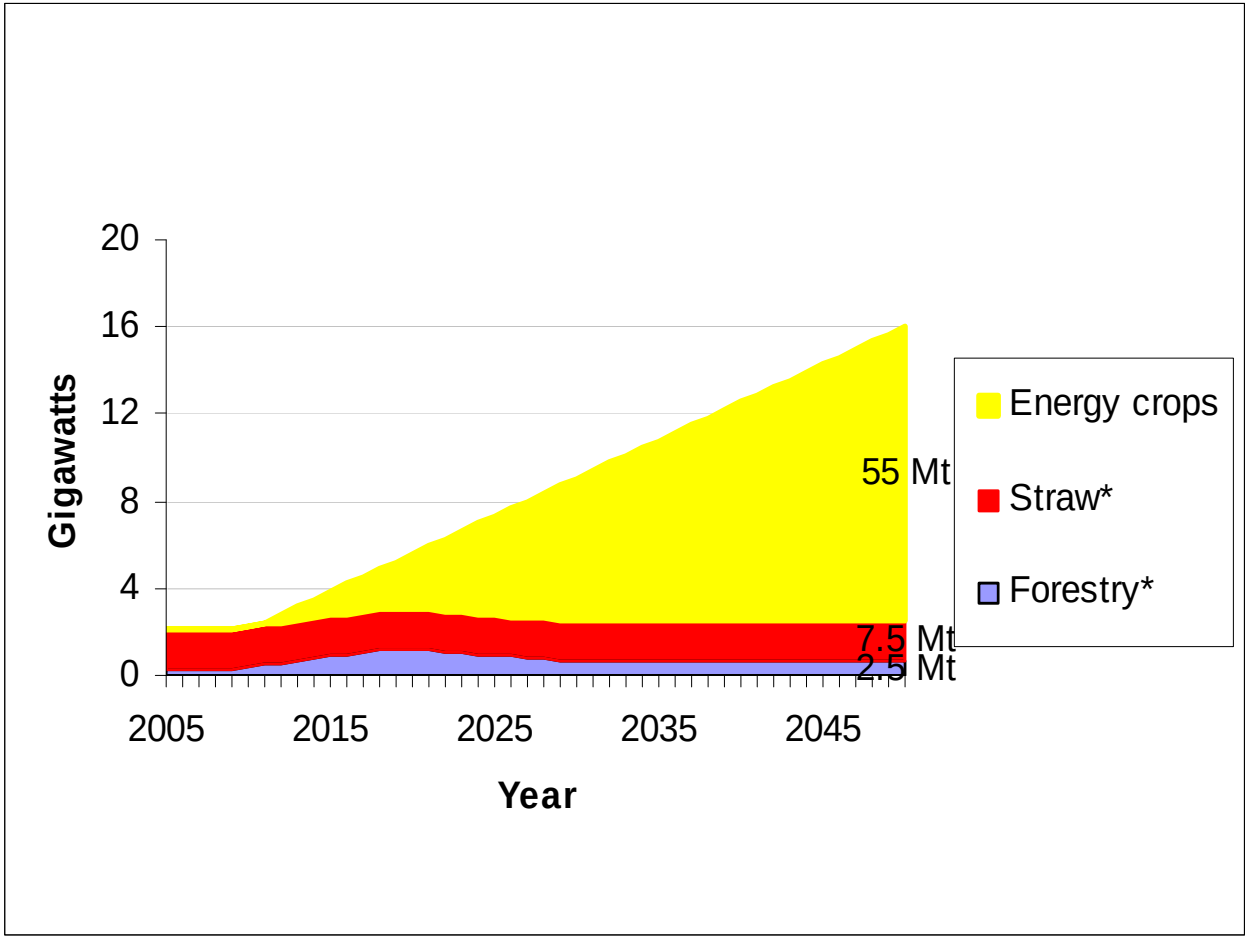
FOUR SCENARIOS FOR 2050

1. "Techno-fix" – final demand at 1998 level
2.,3. 36% reduction in demand
   - mainly through improved building performance
4. 47% reduction in demand below 1998 level

BIOMASS IS KEY

- **Close to carbon-neutral.**
- **Overlooked by Government policy on renewables.**
- **Output is predictable and controllable.**
- **Fuel for heat as well as electricity.**
- **Provides 15% of primary energy in Austria.**

AVAILABILITY

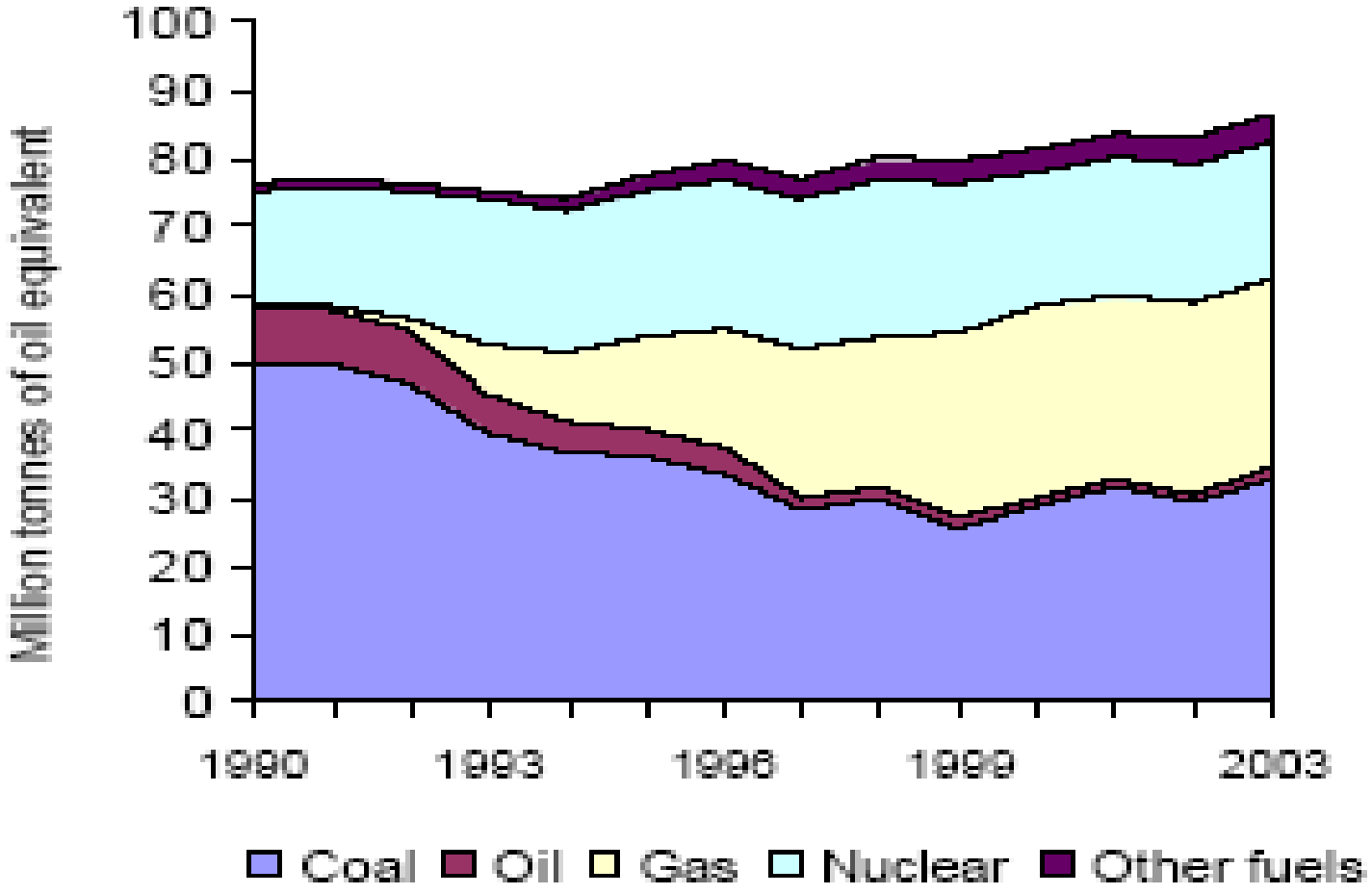


CONCLUSIONS SO FAR

The debate over nuclear power should not obscure the more significant and urgent issues of fixing the buildings and developing the biomass energy sector
(Clift, Sinclair and Johnsson, *Parliamentary Monitor,* July 2006)

The technology need is for small-scale biomass-fired combined-heat-and-power plants which are efficient and reliable.

FUEL USED IN ELECTRICITY GENERATION



ELECTRICITY GENERATION (GW avge)

RCEP scenario for 2050	1	2	3	4	1998
Wind	**17.9**	**14.7**	**11.6**	**9.0**	**0.1**
Energy crops & waste	**17.8**	**17.8**	**7.5**	**3.0**	**0.19**
Other renewables	**17.1**	**12.1**	**5.4**	**7.5**	**0.61**
TOTAL RENEWABLE	52.8	44.6	24.5	19.5	0.9
LARGE SCALE LOW-C	52	0	19	0	11.4

CONCLUSIONS FOR ELECTRICITY

- **Renewables alone are unlikely to be sufficient by 2050**

- **We will need some “dispatchable” low-carbon generation**

- **This could be nuclear or fossil with carbon capture and storage**

TRANSPORT FUELS

Crude oil is not the only fossil source of hydrocarbons for transport…

Coal-to-liquids technology can produce crude oil substitute at about $80-100/bbl.

BIOFUELS FOR TRANSPORT

- **<u>Premise 1</u>:**

  a) hydrocarbons will be available for the foreseeable future – use constrained by emissions not by supply

  b) Transport will be the priority user of hydrocarbons

<u>And note</u>: Kerosene will remain the only viable fuel for aircraft.

BIOFUELS FOR TRANSPORT

- **<u>Premise 2</u>:**

  Biofuels have low energy density.

  ∴ must be used or processed locally.

  e.g. small-scale fermentation of carbohydrates;

  small-scale pyrolysis of woody biomass

BIOFUELS FOR TRANSPORT

- **<u>Premise 3</u>:**

  Where there is a local demand for heat or CHP, biomass is the fuel of choice.

  ∴ biofuels should be considered for transport only where there is surplus availability once this demand has been met – not in the UK!

TECHNICAL ISSUES

- Need to look at energy use in total, not just electricity.
- Biomass, agricultural waste, etc. need to be used to fire CHP plants primarily for heat output, with electrical output used to “back up” intermittent renewable sources.
- Needs a fundamental review of how electricity networks can best be financed, managed and regulated to stimulate and accommodate large contributions to energy supplies from CHP and renewable sources.

TRANSPORT FUELS

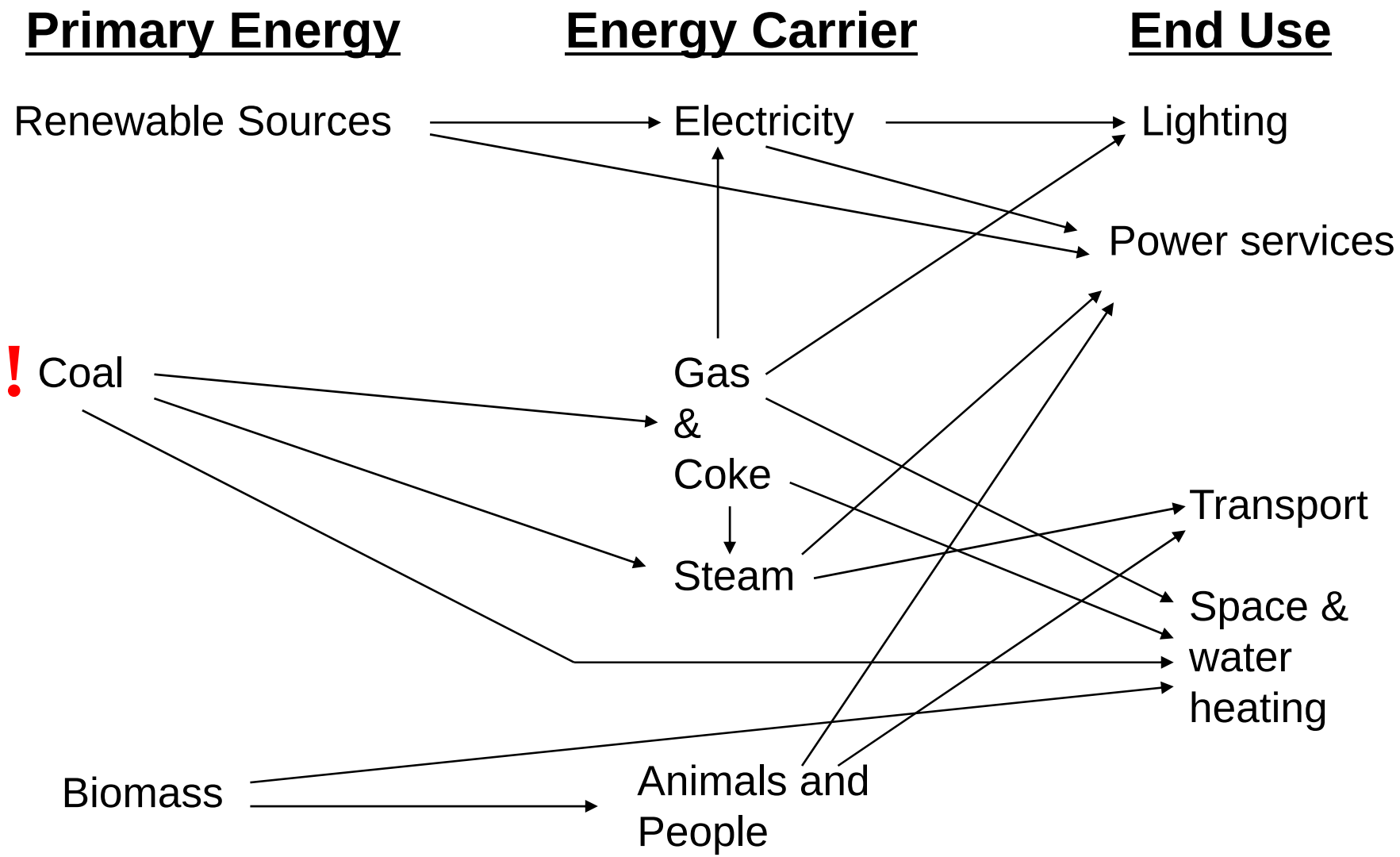
Crude oil is not the only fossil source of hydrocarbons for transport…

Coal-to-liquids technology can produce crude oil substitute at about $80-100/bbl.

<u>Personal view</u>: the "car of the future" is a plug-in hybrid with a hydrocarbon-fuelled engine

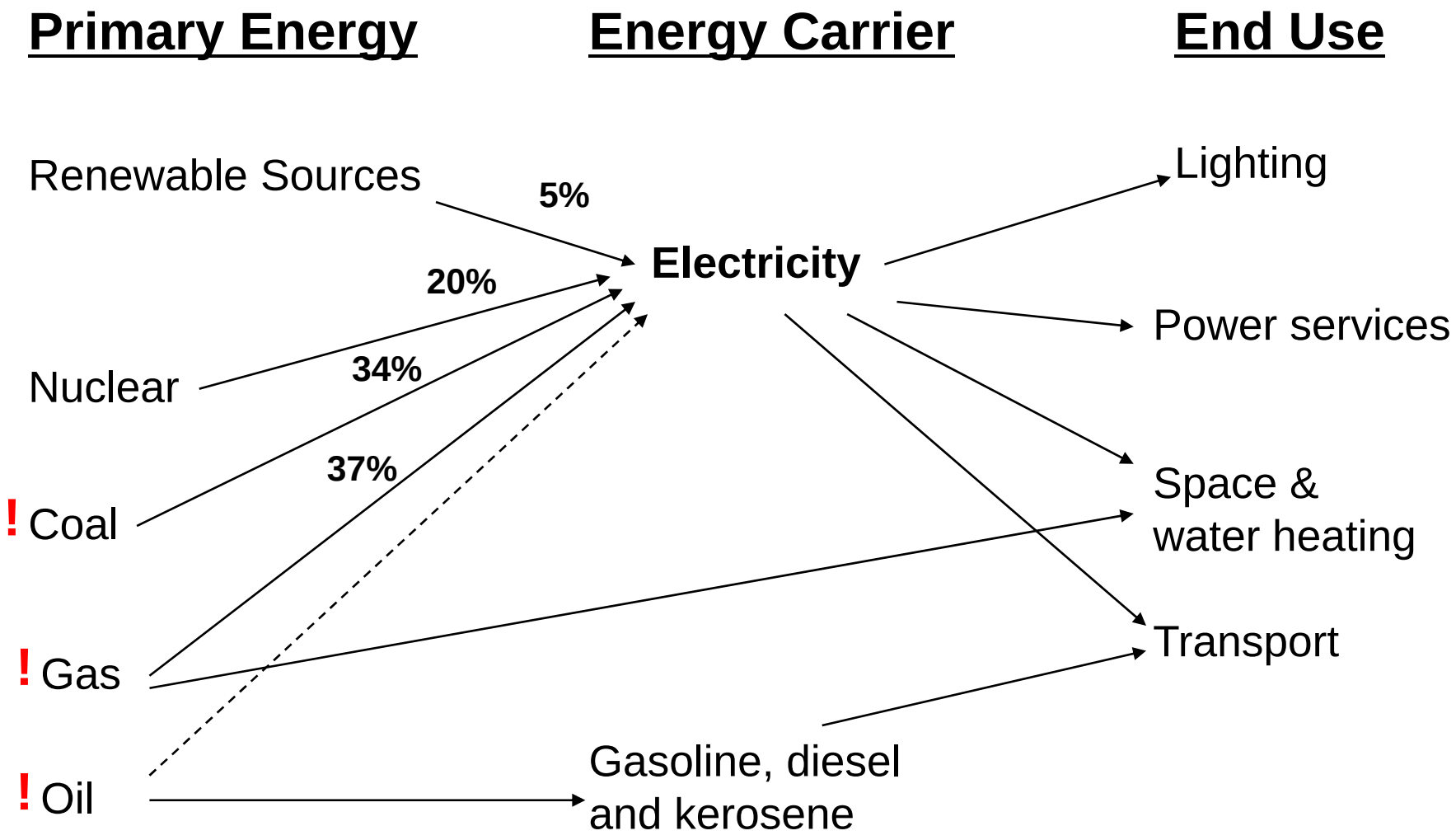
This use of fossil fuels for transport is compatible with targets for reducing fossil carbon emissions (see RCEP, 2000)

THE UK ENERGY SYSTEM 1881



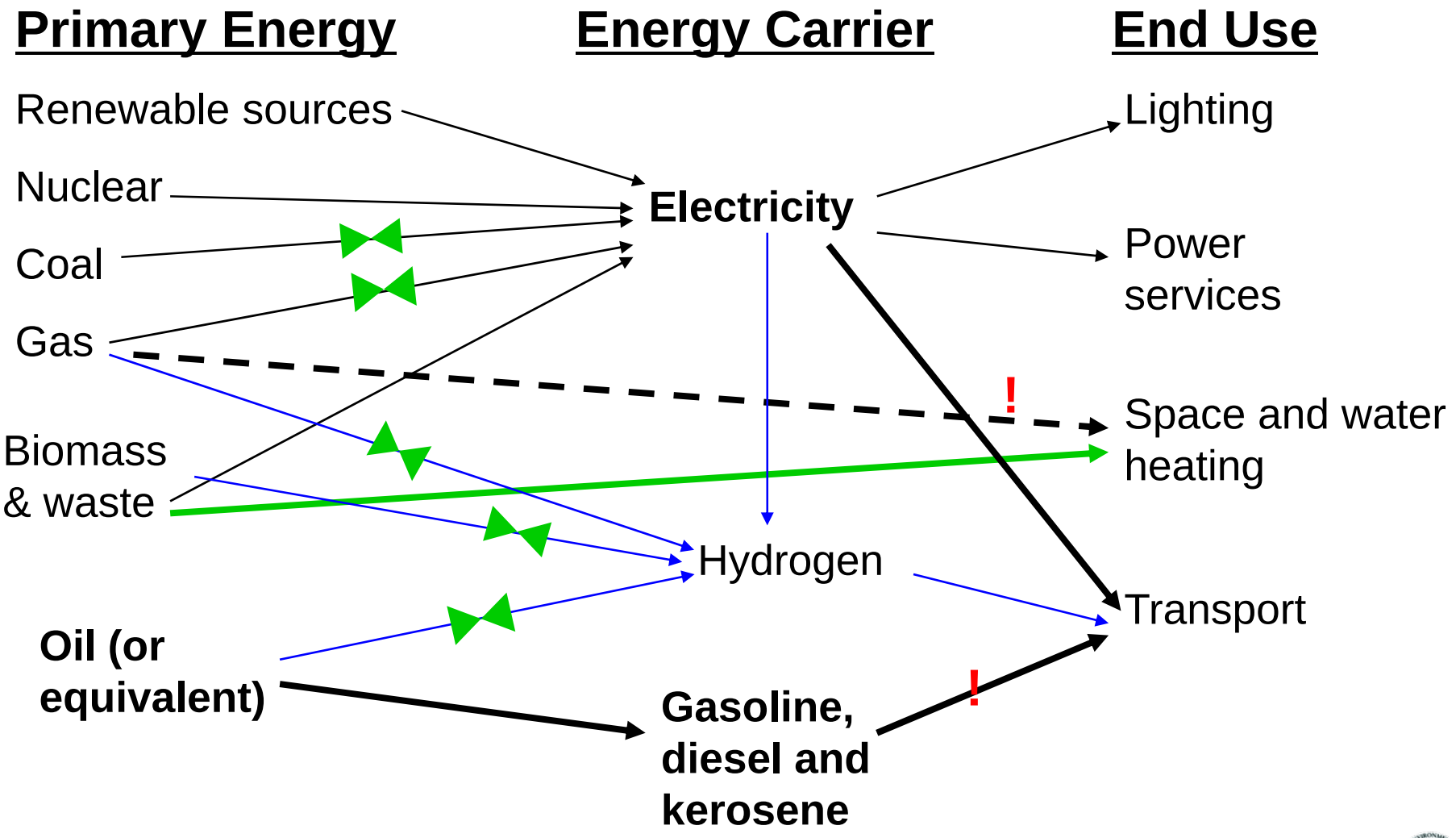
! **Source of net carbon dioxide emissions**

THE UK ENERGY SYSTEM 2004



! Sources of net carbon dioxide emissions

A LOW-CARBON ENERGY SYSTEM 2050



Carbon capture and storage

! Sources of net carbon dioxide emissions