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Transport and climate change: Simulating the options for carbon reduction in London

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ABSTRACT

Transport is a major user of carbon-based fuels, and it is increasingly being highlighted as the sector which contributes least to CO_2 emission reduction targets. This paper reports on the findings of the VIBAT London study (www.vibat.org) which considers the role of the transport sector in reducing CO_2 emissions in London.

The analysis develops a transport and carbon simulation model (TC-SIM) for London. Within this, users are able to consider the implementation of a series of potential policy packages—low emission vehicles, alternative fuels, pricing regimes, public transport, walking and cycling, strategic and local urban planning, information and communication technologies, smarter choices, ecological driving and slower speeds, long distance travel substitution, freight transport and international air. They can select variable levels of application to help achieve headline CO_2 emission reduction targets. The roles of carbon rationing and oil prices are also considered. TC-SIM can be played in different user modes: as ‘free riders’, ‘techno-optimists’, ‘enviro-optimists’, ‘complacent car addicts’ and other typical travel market segments, including a ‘free role’. Game playing or scenario testing such as this helps to highlight perceived levels of homogeneity of views within certain cohorts, the development of entrenched positions and the likely success in achieving objectives.

The paper develops various policy packages, scenarios and pathways aimed at reducing transport CO_2 emissions. It argues that strategic CO_2 emission reduction targets are very ambitious relative to current progress, and that we need to act more effectively across a wide range of policy mechanisms, with a ‘high intensity application’ of many of the options, to get near to achieving these targets. A critical issue here will be in communicating and gaining greater ‘ownership’ of future lifestyle choices with stakeholders and the public, and participation tools such as TC-SIM could become increasingly important in this area.

1. Introduction

Climate change and projected rises in greenhouse gas (GHG) emissions pose a major challenge for the UK and the world. Population growth, increased average incomes and material consumption mean that reducing emissions becomes very difficult. The transport sector contributes around 25% carbon dioxide (CO_2) emissions in the UK, yet remains the major under-performing sector in contributing to emissions reductions. Trend-breaking futures are required to help mitigate and adapt to the potential impacts of global warming.

Many authors (the International Panel on Climate Change, IPCC, 2007a; Stern, 2009; and others) give stark warnings. An overwhelming body of scientific evidence now clearly indicates that climate change is a serious and urgent issue. The concentration of atmospheric CO_2 has increased from a pre-industrial value of around 280 parts per million (ppm) to 379 ppm in 2005, with levels of CO_2 emissions expected to rise to 550 ppm by 2050 without immediate intervention.[1] Atmospheric CO_2 concentration increased by only 20 ppm over the 8000 years prior to industrialisation, with multi-decadal to centennial-scale variations less than 10 ppm that were most likely due to natural processes. However, since 1750, CO_2 concentration has risen by nearly 100 ppm. The annual CO_2 growth rate was larger during the last 10 years (the 1995–2005 average is 1.9 ppm p.a.) than it has been since continuous direct atmospheric measurements began (the 1960–2005 average was 1.4 ppm p.a.). The rate of

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[1] The target levels in the EU for the stabilisation of emissions in 2050 are 550 ppm CO_2e or 450 ppm CO_2. The higher figure includes all greenhouse gas emissions, of which CO_2 emissions are the most important.

atmospheric CO_2 concentration growth (now 2–3 ppm p.a.) means that we are likely to hit the 400 ppm threshold within 10 years (from 2005) and the 450 ppm threshold within 35 years (2005–2040). Even the more conservative estimates of atmospheric CO_2 concentrations are likely to cause climatic difficulties. A rise of 2° or 3° in surface temperature resulting from an increase in CO_2 concentrations to 450 ppm will lead to fewer cold days and nights, more frequent hot days and nights (virtually certain); warm spells, heat waves, heavy precipitation events (very likely); areas affected by drought increase, intense tropical cyclone activity and increased incidence of extremely high sea levels (including tsunamis) (likely) (IPCC, 2007a).

The IPCC estimates that most (> 50%) of the observed increase in global average temperatures, since the mid-20th century, is *very likely* (defined as a 90% probability) to have been caused by anthropogenic activities. Eleven of the last 12 years (1995–2006), the exception being 1996, rank among the 12 warmest years on record since 1850. Within this global picture, transport is playing a major and increasing role. It relies largely on a single carbon source, petroleum, which supplies 95% of the energy used in world transport. In 2004, transport was responsible for 23% of world energy related greenhouse gas emissions and its rate of increase is faster than any other energy using sector (IPCC, 2007b). It seems essential that transport should contribute much more substantially to reduction targets for CO_2 emissions.

A number of authors have examined the potential role of transport in a carbon constrained future through global analysis (Ewing et al., 2008; Schäfer et al., 2009; Sperling and Gordon, 2009; Yang et al., 2009). Others have considered transport as part of wider energy reduction futures (Mackay, 2009), and there is an earlier literature on achieving sustainable transport, for example, the OECD EST study (OECD, 2000) and the EU-POSSUM project. Hickman and Banister (2007) consider policy pathways at the UK level. All suggest the need for radical trend-breaks in terms of moving towards sustainable transport futures.

London provides a complementary case study to this analysis. Per capita transport emissions, particularly in inner London, are low relative to many western industrialised international city standards, and are lowest of all urban areas in the UK. There are already impressive efforts to fund and develop public transport, walking and cycling, and integrate urban and transport planning.

This paper draws on findings from the VIBAT London[2] study (Visioning and Backcasting for Transport in London). It uses London as a case study and develops a simulation model of the city to test potential future scenarios for different levels of application of different policy packages. The analysis adds to the developing debate on low carbon transport pathways at the city level by quantifying the likely impacts of a wide range of interventions, and outlining potential future scenarios of application. The baseline and projections are considered with respect to CO_2 reductions and transport, before outlining the range of policy measures available. These are assembled into packages to ensure consistency and effectiveness so that the potential benefits can be made complementary. Various role or game playing options are then presented so that a range of different potential stakeholder viewpoints can be compared in terms of their involvement and concern over achieving the overall reduction targets for transport in London. It is noted that these different 'player roles' are likely to select different options according to their own set of perceptions and rules. Two other critical issues are raised: how to deal with aviation, and the role of oil prices and carbon credits. Finally, some conclusions are drawn on optimised packaging and the need for the development of simulation tools that can effectively engage a wider cohort of the population in the debate over achieving sustainable mobility.

2. The role of the transport sector

London is aiming to become a 'model' sustainable city that can combine population growth with economic prosperity and a fair society, but at the same time reduce its carbon emissions. Current levels of emissions (2006) in London are around 44 $MtCO_2$ (million tonnes of carbon dioxide). Achieving large reductions in carbon emissions, whilst retaining economic and quality of life goals, is likely to be difficult, even with a static population and employment base. Add in large population and economic growth and the task to reduce aggregate emissions becomes considerable. London's population is expected to grow by 23% to 9 million in 2050 from 2006 levels, and the economy by between 100% and 150% over the same period (GLA, 2009).

A large amount of strategic forward planning and analysis has already been carried out by the public agencies in London. Transport for London has produced Transport 2025 (T2025) (TfL, 2006) and the Mayor's Transport Strategy (TfL (Transport for London), 2009). The Greater London Authority has produced the London Plan (GLA, 2009) and Climate Change Action Plan (CCAP) (GLA, 2007). The headline target adopted for London is a 60% reduction in CO_2 emissions by 2025 across all sectors on 1990 levels (CCAP, 2007)—this is a very ambitious target (Table 1 and Fig. 1).

Within London, the transport sector accounts for 22% of ground-based transport CO_2 emissions (9.6 $MtCO_2$). This figure rises dramatically if aviation is included—the methodology used within CCAP is that half of emissions from all flights landing at London airports (Heathrow and City Airport) are allocated to London residents' emissions. This results in aggregate transport emissions rising to 48% (Fig. 2). Within the transport sector, car-based CO_2 emissions dominate (at 49%) and road freight (23%) (Fig. 3).

There are interesting comparisons to be made between areas in London and in the UK. The transport sector, for London as a whole, performs well because of the high usage of public transport. There are, however, large differentials within London. The highest emitters are found in the more car-dependent suburbs—Bromley, Bexley, Barnet and Hillingdon. Even here, CO_2 emissions perform well relative to the rest of the country, on a par with a mid-ranking smaller town in the UK, such as Stockport or York.

The lowest emitters in London are found in the City of London and the boroughs with good public transport links (Islington, Camden, Hammersmith and Fulham, Ealing) and in East London

Table 1
CO_2 Projections and Targets for London, excluding aviation ($MtCO_2$).

Scenario	1990	2006	2025	2050
BAU projection (cross sectoral)	45.1	44.3	51.0	
BAU projection (ground transport)	9.9	9.6	11.7	
CCAP target (cross sectoral)			31.6	
60% reduction against a BAU projection				
VIBAT London target (ground transport)				
60% reduction by 2025 against a BAU projection			4.0	
80% reduction by 2050 against a BAU projection				2.0

From Hickman et al. (2009b)

[2] More detailed papers from the VIBAT London study (Hickman et al., 2009b) can be found at www.vibat.org. The study was funded under the UrbanBuzz Programme, www.urbanbuzz.org.