

# Example of low carbon transport systems essay

[Countries](#), [England](#)



## **Report: Low Carbon Transport Systems**

### Summary

Research sources selected for this paper include three strategy / policy approaches to achieving a low carbon transportation system. “Towards low carbon transport in Europe” describes the European Union (EU) policies and plans they have set in place to achieve the desired CO<sub>2</sub> emission reductions. “Low Carbon Transport: A Greener Future” is the UK’s strategy document. The United Kingdom, as a member country of the EU thus shares some of its plans and targets. A more locally-based research source is “Birmingham Low Carbon Transport Strategy 2011+” - a low carbon transportation system strategy from the perspective of an English city having a transport system needs upgrading.

All three documents proposed strategies arising from the widely accepted need to minimise harmful climate change by taking steps to reduce CO<sub>2</sub> emissions, considered a cause of global warming. Also, they emphasised the need for better communications, better management, and the need for greater efficiency in all areas of transportation.

Arising from agreement that research and development into alternative fuels and/or propulsion systems is essential, to move away from a global dependence on the finite resources of fossil fuels, this report also includes information from an HM government document entitled “Ultra-low Carbon Vehicles in the UK” (Nov 2008) which includes case studies on innovative vehicle design. There is also a section on the important issue of intellectual property rights (IPR) derived from a report entitled “Who Owns Our Low Carbon Future?” (Sep 2009), and a section describing fuel cell technology as

one of the more promising solutions for low-carbon transportation in the longer term.

### **Summary Word Count: 260 words.**

Report Word Count: 3676 words. (Excludes Summary, Title Page and References Page).

#### The Research

##### 1. Towards low carbon transport in Europe

Schoemaker, Scholtz and Enei (2012) produced this brochure under the auspices of the Transport Research and Innovation Portal (TRIP) consortium, on behalf of the European Commission's Directorate-General for Mobility and Transport (DG MOVE).

The brochure's preface informed the reader that the brochure links EU policy strategic targets with innovative research on decarbonising transportation and with the objective of ending the fossil fuels dependency inherent in the transport system, yet maintaining efficiency and mobility. The 2050 target of 60 percent reduction of CO<sub>2</sub> emissions requires transport to use less and cleaner energy, plus make more efficient utilisation of the transportation infrastructure, to reduce environmental impacts, especially CO<sub>2</sub> emissions. Because European transportation is complex, the desired reduction in CO<sub>2</sub> emissions requires a wide range of policies and research, including long-term planning at all levels, and individual transport choices made by citizens. The brochure described current innovative research to provide a sustainable European low carbon transportation system.

The brochure discussed the EC policies priorities for transport sector CO<sub>2</sub>

emissions reduction, and how current and future research affects those policies in respect of road, rail, air and sea transport, including long and medium distance and local (urban) transport systems. The EU has set itself so-called “ 20-20-20” targets for 2020, as shown below:

**20% greenhouse gas reduction (compared with 1990 levels), or 30% if other developed nations make similar commitments to reduce greenhouse gases;**

20% increase in the use of renewable energy in energy generation (i. e. wind and solar energy and biofuels). The current figure is 8. 5 percent;

**20% energy consumption reduction of the currently projected 2020 levels.**

Three policy priorities and associated research were: Transport Efficiency; Energy Efficiency; Alternative Fuels & Propulsion Systems. Increased traffic volumes have increased emissions, so the EU must reverse that trend, setting a 2050 target of 60 percent reduction in transportation CO2 emissions. Road transport accounts for some three quarters of EU transport sector greenhouse gas emissions. Research programmes in all transportation modes are key, particularly in urban transport, as most EU citizens live in urban locations.

There is no single solution; multiple policy initiatives, research projects, and innovative technology is needed if targets are to be met. EU planning and policies take into account the projected growth in both passenger and freight transport volumes. Improved infrastructure and management can reduce traffic volumes and therefore CO2 emissions, but expanding traffic management information technology, and creating user-friendly public

transportation systems that reduce use of private cars, can also make a valuable contribution.

Passengers travelling long distance within the EU can plan complex (multi-mode) journeys online, thus minimising unnecessary travel and thereby reducing CO2 emissions. Similar techniques and technologies in freight transportation, where freight consolidation can reduce individual truck journeys, have the same objective.

EU policy is to shift passenger and freight traffic where possible into other transport modes, such as moving freight from road to water and persuading passengers to either share car journeys or to use bicycles not cars for short distances. Urban passenger transport causes a quarter of all passenger transport CO2 emissions, so potential savings are significant.

Greater fuel efficiency equates to travelling further per unit of fuel. The Europe 2020 initiative entitled “ Resource-Efficient Europe” is about new technologies to update and decarbonise the transportation sector. There are voluntary agreements with manufacturers that set maximum permissible emission levels for cars and light goods vehicles.

Comparing cars built from 1995 to 2010, new cars now available in Europe have more than halved CO2 emissions. Also, EU-funded technology research targets a 40 percent reduction in new cars or light goods vehicles by 2020 (10 percent for heavy goods vehicles).

Research into vehicle design is ongoing, plus research is underway on ships, rail locomotives, and aircraft, all with the goal of reduced CO2 emissions by increased energy efficiency. Pilot research and development projects are underway to replace road vehicles driven by fossil fuels, with others driven

by alternative fuels and other forms of motive power such as biofuels, fuel cells (hydrogen), electric and hybrid systems.

For rail transport, electricity will remain the major form of motive power, but with the objective of using sustainable fuels for its generation. For water transportation, there is a 40 percent emissions reduction target. As well as research on ship and engine design, alternative fuels like hydrogen, LPG and LNG are being considered for shorter or inland waterway journeys, or nuclear power for long sea voyages. Civilian air transport contributes just two to three percent of all transport sector CO<sub>2</sub> emissions. The target is to reduce air transport emissions by 50 percent (per passenger-kilometre) by the year 2020. There is also a secondary target that 40 percent of all aircraft will be using low carbon fuels by 2050.

The concluding brochure section entitled “ Policy and Research outlook” emphasised the need for continuing research and innovation to reduce the dependency on fossil fuels, to limit their social and environmental effects, and to achieve a modern Europe-wide low carbon transport system that is also safe and resource-efficient. To that end the European Commission is preparing a Strategic Transport Technology Plan (STTP) that will cover policies for the years 2035 to 2050. Although the brochure did not mention the need for intellectual property protection for the results obtained from the EU-funded research discussed, such protection will doubtless be provided where needed on a per project basis.

## 2. Low Carbon Transport: A Greener Future

This strategy document published by the Department of Transport for the UK government (July 2009) set out the UK’s approach to reducing CO<sub>2</sub>

emissions, to avoid climate change by meeting an overall global target of a 50 percent reduction by the year 2050. However, the document stated that as a developed nation, the UK must go further, so has instead set a target of an 80 percent reduction. Because transport sector emissions represent 21 percent of all UK emissions, decarbonising transport is a primary objective, which will affect all modes of transport: road, rail, shipping, and civil aviation.

The document considered two distinct stages in the efforts to reduce UK emissions. Firstly, meeting the UK's obligations for carbon budgets by 2022, then achieving longer-term objectives up to the year 2050. The document claimed that by 2022 road vehicles will be "vastly more fuel efficient", primarily from improvements in efficient engine design, but also due to the increasing use of vehicles using low-emission fuels and new technologies.

**Cars:** In 2008 the UK agreed the EU's New Car CO<sub>2</sub> Regulation, which establishes long-term industry guidelines for developing low-emission vehicles. The government is providing financial incentives for the purchase of new low-emission cars ranging from £2,000 to £5,000, and will use up to £30 million to establish an "electric car cities" network.

**Vans:** Because vans are the fastest growing area in road vehicles, the UK government is supporting a specific EU-wide initiative for vans CO<sub>2</sub> emissions reduction by 2020.

**Road Freight:** For this transport sector (heavy goods vehicles) the UK will coordinate with the EU to determine the most effective way to reduce HGV CO<sub>2</sub> emissions.

**Buses:** To incentivise the take up of low-emissions technology by bus

operators, the government will provide up to £30 million in grants over the periods 2009/10 and 2010/11.

**Rail Transport:** More of the rail network is being electrified, plus the government is supporting rail industry initiatives to improve the energy efficiency of rail operation.

**Civil Aviation:** The UK government's focus is to make aircraft more fuel-efficient, and to aim for emissions from aircraft by 2050 to be below 2005 levels.

**Shipping:** The UK government expect industry to find ways to reduce CO2 emissions / improve fuel efficiency, but is also working with the International Maritime Organisation.

**Biofuels:** As well as implementing and supporting regulations to promote use of these fuels, both in the UK and the EU, the UK government is supporting biofuels research efforts.

The document stated that in addition to the technological advances discussed to bring about emissions reductions, it is also important that individuals and businesses consider the daily choices made about when, where and how we travel or transport goods and products.

**Low Carbon Public Transport:** The government's stated aim is to make public transport not only low carbon but also accessible, attractive, and easy for all of us to use. Rail – already a low carbon mode of transport – is attracting more passengers. Also, bus use has increased by over 17 percent in the last decade, and the government provides £2.5 billion annual support for bus services, including off-peak free travel for the elderly and disabled.

**Integration of Transport Modes:** “ Smart ticketing” – where passengers can



transfer seamlessly between transport modes - is one strategy in this area, as is making it easier for people to cycle. Although about 60 percent live within 15 minutes cycling of the nearest train station, only about two percent cycle there. Station bicycle storage will be enhanced, and to encourage bicycle use "sustainable travel cities" and a National Cycle Plan are proposed.

Providing Better Information: To help car owners make better choices in buying and running their cars, the government is providing information and are integrating "eco-driving" techniques into the driving test, to help drivers learn how to drive economically.

Business and Freight Travel CO<sub>2</sub> Reduction: The Energy Saving Trust reviews and advises operators of fleets, to help fleet users reduce costs and cut emissions. There is also a "Safe and Fuel Efficient Driving" programme available to drivers of vans and HGVs that is being extended to bus drivers, too. There is help available for companies to take their freight off the road and transfer it to rail or the waterways, and encouragement for people to avoid unnecessary travel by increasing the use of information technology in journey planning.

Summarising the impacts of the strategies set out in this document, it is claimed that a total of 85 million tonnes of CO<sub>2</sub> will be saved in the period 2018 to 2022.

### 3. Birmingham Low Carbon Transport Strategy 2011+

This consultation document described the measures proposed to achieve a 60 percent emissions reduction for the city's transportation systems from the

year 1990 to 2026. The proposed measures were based on four primary themes:

### **Smarter Choices;**

Smarter Infrastructure;

Smarter Technology;

Effective Carbon Management Planning.

The document cited the known links between carbon emissions and climate change and in particular referred to the “ 2007 Stern Review of the Economics of Climate Change.” In terms of carbon emissions from transportation, it stated that the total CO<sub>2</sub> emissions for Birmingham in 2008 were 6. 183 million tonnes. Of that total, road transport accounted for 24 percent. The Figure below (reproduced from the Birmingham document) illustrates that:

### **Figure: Estimated Birmingham Carbon Emissions 2008**

(Reproduced from “ Birmingham Low Carbon Transport Strategy 2011+”)

Of the total CO<sub>2</sub> emissions from transportation, private cars generated 67 percent, goods vehicles contributed 27 percent, and buses the remaining six percent.

The remainder of this Birmingham strategy document provided specific details of local measures and policies proposed to achieve the targeted emissions reductions.

#### 4. Ultra-Low Carbon Vehicles in the UK

This UK government publication saw the challenge facing the UK as two-fold: to reduce the impact of carbon emissions on the environment and in so

doing to benefit the UK business community. In the opening paragraphs of this report, it pointed out that whilst internal combustion engines have for the last 100 years been the dominant source of motive power for road transport, massive changes lie ahead for the automotive industry. In the wake of financial and oil crises, and facing an ongoing crisis of climate change, environmental and economic factors require new approaches. Noting that the automotive sector is important to UK manufacturing, contributing almost £10 billion to the economy and providing employment (directly or indirectly) to almost 400, 000, the report stated that it is important that the UK leads in the design and manufacture of low carbon vehicles and technology such as “ hydrogen powered, plug-in hybrid and fully electric vehicles.” For that to happen, government must support the industry and its workers in moving swiftly to low carbon vehicles. As part of that, the UK government has supported the EU regulation for emissions from new cars, which sets targets of 130gm CO<sub>2</sub>/km by 2015, reducing to 95gm CO<sub>2</sub>/km by 2020. The report also noted that the UK is the first country in the world to set legally binding emission reduction targets: 26 percent by 2020 and 80 percent by 2050. In the shorter term, the report suggested that reductions in emissions can be secured through such measures as higher efficiency of internal combustion engines, better fuel injection, weight and drag reductions.

The report described one example of improved engine design: the Ford ECOnetic turbo diesel engines being built at Ford’s Dagenham, Essex plant, to power the Fiesta, Focus and Mondeo models. Combined with other technological advances such as tyres with low rolling resistance, better

aerodynamic shapes, lower friction oil types and a dashboard “ green shift” indicator to optimise gear-changing, these engines deliver emission levels ranging between 95 and 115gm CO<sub>2</sub>/km.

Regarding electric and plug-in hybrid cars, the report stated that the government is aiming to decarbonise electricity generation, in order to maximise the reduction of CO<sub>2</sub> emissions by using such vehicles. To be a leader - at home and overseas - in the next generation ultra-low carbon (ULC) vehicles, the report saw the following as the needed short term (five years) movement towards ULC vehicles:

### **Continuing improvement in the efficiency of new cars;**

Greater take-up of the new hybrid models;

Development of an infrastructure for electric vehicle battery charging by interested cities - so-called “ electric car cities”;

Progressive emergence of ULC vehicles on the market.

Similar strategies have been set for the medium term (5-10 years) and longer term (10+ years), culminating in the mass production of ULC vehicles.

Regarding a charging stations infrastructure for electric vehicles, a British company called Elektromotive intended, by the end of 2009, to have 100 charging stations operational in London and 68 more in other UK locations, plus systems in several other countries.

Because these lower carbon alternatives to conventional internal combustion-engined cars are presently more expensive to purchase, the government provides incentives to buyers in the form of purchase subsidies of between £2000 and £5000.

Included in the report was a case study of cutting edge development in electric vehicle power units. Zytek - a company the report described as a "globally leading, innovative SME" - designed and built an electric engine for Mercedes. The report described the unit as follows: "The Zytek electric engine is a complex assembly of many high technology products tightly packaged into a single unit."

The report included a research and development roadmap for the future, in which the government sees continual advances in the development and use of electric and hybrid vehicles, plus, by the 2020's onwards, the emergence of fuel-cell (hydrogen) powered vehicles onto the market and on the road. The expectation is that ULC vehicles will be a common sight on our roads by 2020. (See section later on fuel cell cars).

#### 5. Intellectual Property Rights Issues

"Who Owns Our Low Carbon Future?" (Lee, B., Iliev, I., & Preston, F. Sep 2009) is the title of a report published by The Royal Institute of International Affairs. Ownership of innovative technologies in the areas of low carbon developments to ameliorate climate change is reported as a crucial issue. In normal circumstances, according to this report, "inventions in the energy sector have generally taken two to three decades to reach the mass market." That delay is to a great extent associated with the time taken for the process of patenting inventions to protect ownership. Even greater delays can result from litigation between companies on patent issues. If we are to meet the carbon emission reduction targets set for 2050, it is clear that the entire patenting process must be dramatically accelerated. Key to accelerating the process is greater commercial and international

cooperation. Whilst protecting ownership of inventions and innovative technology is a perfectly understandable commercial motive, in the interests of halting global climate change it is imperative that new ideas and technology be disseminated as widely and as quickly as possible.

## 6. Fuel Cell Cars

Because cars powered by fuel cells are seen by many – in the longer term – as one of the best solutions for ULC transportation, this section of the paper provides some insight into the technology. An article “Fuel cell cars” (updated Nov 2012) stated that rather like a battery-powered electric vehicle, a fuel cell car has no internal combustion power unit. A fuel cell is a device that converts energy stored in chemical form into electricity, with water and heat as the two by-products of the process. Note that in contrast to battery power, in order to produce electricity the fuel cell requires a continuous supply of oxygen and fuel (probably hydrogen – see later) to produce an electric current.

A major problem with the choice of hydrogen as the fuel source is that because it is a low-density substance, storage on-board the vehicle is problematic. Although other methods are possible, the most practical way of storing it in sufficient quantity is by compression. Hence, the vehicle must carry a tank of hydrogen, pressurized to around 5000 lb/sq. inch, in order to provide the vehicle with an acceptable range between refuelling stops.

Special refuelling stations and equipment are required to refuel those high pressure tanks with hydrogen – which is a highly inflammable gas. There are already numbers in existence in various European cities, though many more will be needed as vehicles powered by fuel cells become more widely

available and used on the roads.

According to the referenced article, the fuel cell-powered car offers similar advantages to battery electric-powered vehicles, in that it uses virtually no energy whilst stationary, and by employing regenerative braking techniques (generating electricity as the car is decelerated), efficiency can be increased even further. It is also a fuel system that does not depend on overseas sources of oil, and does not emit CO<sub>2</sub> as a by-product.

## **Timeline**

This timeline provides a quick reference to significant dates mentioned in this paper:

1990: the “baseline” year used to reference CO<sub>2</sub> emissions reductions against.

2005: Kyoto Protocol comes into force. Also the baseline date for the UK aviation emissions reduction target.

2007: Stern Review of the Economics of Climate Change.

2008: UK agreed the EU’s New Car CO<sub>2</sub> Regulation.

2009: G8 summit agrees 80 percent emissions reduction target by 2050.

2011: Transport White Paper (European Union).

2012: Kyoto Protocol expires; “replaced” by Copenhagen Accord.

2015: Target of 130gm CO<sub>2</sub>/km emission level for cars (EU), (reducing to 95gm CO<sub>2</sub>/km by 2020).

2020: EU target date for 20 percent emissions reductions. Also the UK target date for a 34 percent interim emissions reduction.

2020: ULC vehicles expected to be a common sight on the UK roads.

2022: Date of UK meeting first stage carbon budgets.

2026: Birmingham City's target date for 60 percent emissions reduction.

2035: EU Strategic Transport Technology Plan (STTP) start year.

2050: Emissions reduction "longer-term" target date for the EU and for the UK.

## Conclusions

As might be expected, the strategy documents used as research resources shared a number of common policies, plans and goals. They all outlined strategies to achieve defined CO<sub>2</sub> emissions reductions, in order to avoid or minimise the likelihood of harmful climate change, which could - if unchecked - affect the quality of life of everyone on the planet. Also as expected, the scope and perspective differed between them, reflecting the difference between the EU as an international organisation, the UK as one member country of the EU, and Birmingham as one city authority within the UK.

All of them described highly organised and comprehensive packages of plans and policies that in combination will strive to achieve the emissions reduction targets set out in each document. To some extent the measures described depend on the cooperation of individuals to succeed. For example, if people can be persuaded to use bicycles instead of cars for short journeys, and to make small but significant lifestyle changes to save energy.

However, the major factor affecting the success or failure of those strategies will be the capability and the cooperative will of the authorities and other organisations and bodies involved, in pressing ahead in a timely way with the needed policies and plans. As stated in the paper, there must also be real commercial and international co-operation in respect of patenting the



associated innovative technologies and products, otherwise the inevitable delays in those processes will mean that the emissions reduction targets will not be met in the timescales, due to the delays caused by protecting and preserving intellectual property rights.

The paper section describing cars powered by fuel cells provided an insight into one of the more promising solutions in the longer term in moving to low-carbon transportation. Fuel cells may be the best answer – not just in reducing carbon emissions from transportation, but also in reducing our dependence on the dwindling reserves of imported fossil fuels.

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