



**NORTHAMPTON**  
BOROUGH COUNCIL

**Northampton Low Emissions Strategy  
(NLES)**

**2016 – 2021**

**Working Draft**

**May 2016**

## **About the LES**

The Northampton Low Emission Strategy (NLES) has been developed through collaboration between Northampton Borough Council (NBC) and Northamptonshire County Council (NCC), including Public Health with each organisation having an input and contributing to the content of the strategy.

The NLES project is funded by DEFRA and managed by Neil Polden, NBC, with technical support provided by Low Emissions Strategies Ltd.

The NLES is intended to influence and shape local and regional strategies, plans and policies to facilitate a reduction in emissions from vehicles, and improve air quality, resulting in a healthier place for people to live, work and visit.

The Strategy sets out specific aims and objectives to be achieved over the next five years, although it is recognised that further action will continue to be required beyond the timeframe of this Strategy. It is intended that the Strategy will be kept under review and will be renewed towards the end of the five year period to take into account changing needs, technologies and priorities.

The Strategy forms part of the Northampton Air Quality Action Plan (AQAP) and a *Task Group* will be set up to deliver the objectives within this Strategy and provide an annual progress report.

## **Consultation on the LES**

This draft NLES has been developed with input from technical experts from their respective fields, including air quality; transport policy, planning policy & development control, climate change, sustainability and public health, however for the NLES to be successfully delivered, wider stakeholder and public consultation is required to help shape the final version of the Strategy. We are therefore inviting responses from interested groups and the public on the NLES to be made by **[TO BE CONFIRMED]**.

# Contents

Foreword	3
Executive Summary	4
2. LES: Vision, Aims and Objectives	10
3 Introduction	12
Theme 1 – Evidence for Change:	
4 <i>Health Impact.</i>	14
5 <i>Legal Requirement.</i>	19
6 <i>Air Quality</i>	22
7 <i>Vehicle Emission Assessment</i>	23
Theme 2 – Creating a Low Emission Future:	
8 <i>Integrating Policies</i>	24
9 <i>Place-shaping</i>	26
10 <i>Changing Travel Behaviour</i>	29
11 <i>Leading by Example</i>	33
Theme 3 – Reducing Vehicle Emissions:	
12 <i>Cars</i>	37
13 <i>Buses</i>	42
14 <i>Commercial Vehicles &amp; Freight</i>	45
15 <i>Taxis &amp; Private Hire Vehicles</i>	46
16 <i>Local Authority Fleet</i>	47
Glossary of Terms	48
Appendix 1 – What is a Low Emission Vehicle?	50
LES Supporting Documents:	
Air Quality & Planning Technical Guide	
Public Sector Fleet Procurement Guide	

## Foreword

## 1. Executive Summary

- 1.1. Traffic in our urban centre and areas near busy roads are affecting concentrations of air pollution that can have a significant impact on the health of the general population, with those having underlying health conditions being most at risk. There are two pollutants of greatest concern: Nitrogen Dioxide (NO<sub>2</sub>) and Particulate Matter (PM), which have an adverse effect on health and are mainly a problem because of vehicle exhaust emissions, with diesel exhaust emissions contributing most to the air pollution problem.
- 1.2. Unlike the smoke and smog problems of the past, NO<sub>2</sub> and PM are invisible, leading to a perception that the air is “clean”. However, particulate matter is so fine that it is inhaled deep into the respiratory tract and, in the case of very fine particles and NO<sub>2</sub> may transfer into the blood stream. A range of health problems are attributed to exposure to high levels of nitrogen dioxide and particulate matter, the most obvious being respiratory conditions, asthma and coronary heart disease, but evidence is now also showing a strong association with cancer, strokes, low birth-weight babies and even childhood cognitive development. These health conditions impact both on quality of life and life expectancy. The Public Health Outcomes Indicator for air pollution points to as many as one in twenty deaths each year in Northampton being attributable to particulate air pollution.
- 1.3. NO<sub>2</sub> and particulates, together with other air pollutants, have been set an upper air quality limit value that the general population should not be exposed to in order to protect public health. These limits are legally binding through EU and UK law. The urban area of Northampton has been identified as having elevated levels of air pollution and Air Quality Management Areas (AQMA) have been designated where there is relevant exposure to NO<sub>2</sub>. Current projections indicate that concentrations of NO<sub>2</sub> may not fall below the limit value in some parts of the Borough until after 2020. Continued failure to meet the limit values will put the UK Government at risk of legal action being taken against it under European law, with the further risk of any fine imposed on the UK Government being passed down to local authorities if their action, or in-action, has contributed to the limit value being exceeded. Legal action has already been taken against the UK Government by Client Earth for the continued breach of the limit values in both the European Courts and UK Supreme Court. It is therefore important, not least for the protection of public health, that all public bodies work together to achieve compliance with the limit values by the earliest possible date.
- 1.4. Knowing that we have an air quality problem is one thing, but introducing effective actions to tackle the problem is another. We know that traffic-related emissions are the main reason why people are exposed to levels of air pollution which can damage health, but our society and economy is structured around

the effective and efficient movement of people and goods. The challenge is to reduce emissions, without adversely impacting on the economy and our need to travel. Conversely, this is also an opportunity for our society and economy to benefit from the innovation and activity that will lead us to a low emission future.

- 1.5. We already know a lot about the concentrations of air pollutants in the Borough and where air pollution is highest, however, we also need to build our air quality monitoring and modelling capability to inform evidence-based decision-making so that the most cost-effective and viable options to deliver air quality improvements are considered.
- 1.6. No single action will solve our air quality problems, but a range of actions and activity is required at a local, regional, national and European level in order to achieve the desired reduction in emissions. This Strategy considers the local and regional activity required to reduce emissions, having regard to the national and European context. The Strategy is a collaboration between the Borough and County Councils and recognises that the actions that will have greatest impact are ones which are implemented across the region, such as regional transport planning, developing electric vehicle charging infrastructure and spatial planning policies.
- 1.7. This Strategy has three main themes:
  - ***Evidence for Change***
  - ***Creating a Low Emission Future***
  - ***Reducing Vehicle Emissions***
- 1.8. The first theme: ***Evidence for Change***, explores the evidence which is driving the need for change, including the impact on health and the legal consequences of not taking action. Evidence arising from national LES feasibility studies and work by the Borough in its role in assessing local air quality has identified where air quality is poor and what causes the main air pollution problems. We know that older diesel vehicles cause the most significant air quality issues and exposure to poor air quality is highest in urban areas, and when people live near busy roads. Evidence suggests that action targeting the most polluting vehicles which operate mainly in urban areas, for example older diesel buses, will achieve the most significant air quality and health benefits. Action to improve air quality can, in most cases, deliver additional benefits by reducing carbon dioxide emissions and reducing environmental noise. This evidence will help inform what decision making to reduce emissions, but the evidence base needs to develop further to help inform decision making in the future and to ensure the aims and objectives of this Strategy are being achieved.

- 1.9. The second theme: ***Creating a Low Emission Future***, considers what needs to be done to shape the places where we live and work, how we travel and the choices we make so that low emission travel becomes part of normal everyday life. The NLES will help inform other strategies and policies to achieve this. Notable strategic plans include the Local Transport Plan and Strategic Economic Plans developed in partnership with Northamptonshire County Council and the Local Development Plan produced by the Borough, but other policies and plans, for example on Carbon Management, Procurement and Commissioning of Services can also influence how the low emission future is achieved and how the places where we work and live are shaped. An *Air Quality & Planning Technical Guide* has already been developed as part of the LES to be used to assess the air quality impact from new development and help quantify the level of mitigation required to make developments sustainable. We will use this Guide to help shape new developments, for example by creating electric charging point infrastructure, so that low emission choices are easy to make.
- 1.10. Low Emission Zones (LEZ) are one way in which local authorities can regulate emissions from vehicles in urban centres, by only allowing vehicles into zoned areas which emit a low level of exhaust emissions. Traffic management is not un-common in urban areas, for example bus-lanes and enforcement cameras are now an integral part of urban areas. However, very few traffic management areas are based on vehicle emissions and there are complexities around implementing such schemes. It would not be feasible at this stage to implement a LEZ in Northampton without either regional support or a national framework supported by the Government. Instead, we believe that we should achieve our aims through the delivery of this Strategy.
- 1.11. Changing behaviour is a key element of delivering a low emission future. The car has become an essential part of everyday life for most people, but increasingly people are interested in alternative travel options and travel planning, with active travel (walking and cycling) – the ultimate low emission vehicle – being increasingly important. The NLES can be used to compliment the travel planning and active travel strategies across Northamptonshire.
- 1.12. The Office for Low Emission Vehicles (OLEV) figures showed a four-fold increase in sales of ultra-low emission vehicles, such as plug-in electric cars, during the first months of 2015 compared to the same period in the previous year as people are seeing the benefits of lower running costs and environmental benefits. Pure battery electric vehicles (BEV) have zero exhaust emissions and represent a significant opportunity for improving air quality. However, ULEVs still represent a very small percentage of the cars on the roads in Northampton and more work needs to be done to promote ultra-low emission vehicles as a viable option for more people.

- 1.13. The NLES will also help raise awareness of the impact which emissions, particularly from vehicles, have on air quality on health. It can be a confusing picture, for many years diesel engines have been seen as better for the environment because of their lower CO<sub>2</sub> emissions compared to petrol, but we know that diesel engines emit higher levels of nitrogen dioxide than their petrol equivalents and so contribute more to air quality problems. This is not to say that petrol cars don't have issues, with new direct injection models reported to emit high numbers of particulates. The NLES will help to educate and inform so that everyone, from key decision makers to individuals considering their next vehicle purchase, will be better informed about the health and environmental consequences of the choice they make.
- 1.14. Finally, under Theme 2 – *Creating a Low Emission Future*, we will lead by example. Public sector organisations operate a large number of vehicles and employ many people across the region and therefore have the potential to influence the uptake of low emission vehicles, both as part of their business operations and in the wider population. We will carry out fleet reviews to see how low emission vehicles can be incorporated into the vehicle mix, and will promote the uptake of low emission vehicles for employees. Public authorities can influence others through the commissioning of services and the procurement of goods and services so consideration will be given to how this influence can be used to encourage providers to reduce their emissions.
- 1.15. Theme 3 – ***Reducing Transport Emissions***, considers each of the main vehicle sectors which contribute to local air pollution problems. The emphasis is on reducing overall emissions by moving to cleaner fuels and technologies, such as electric, hybrid-electric, natural gas & bio-methane, LPG and hydrogen, and also reducing emissions from conventional diesel and petrol driven vehicles. There are many factors to be taken into account when choosing a new vehicle, whether this be an individual, bus company, taxi driver or fleet manager. Decisions are heavily influenced by previous purchase choices and initial purchase price. Because alternative fuels and technologies are still emerging onto the market there is uncertainty about choosing something different. The NLES illustrates the potential for an increasing number of low and ultra low emission vehicle alternatives to save money. Further work is required to better understand the barriers to ULEV uptake and we will work with individuals and organisations to make low emission vehicles a viable and affordable alternative. The following vehicle sectors are considered in the NLES:
- **Private Cars** – Diesel car sales have risen three-fold in the last decade, and now exceed petrol car sales, with low emission alternatives continuing to represent less than 1% of privately owned vehicles on the roads of Northampton. As engine technology improves and new cars come onto the market, emissions will reduce, but this will take a long time and therefore the



LES will promote the accelerated uptake of ultra-low emission fuels and technologies.

- **Buses** – as a public transport option, buses are part of the solution, but, because they are mainly diesel powered, they also contribute to the air pollution problem; particularly in our urban centre and arterial routes where air quality is poorest. Bus companies typically operate buses for a long time and older buses produce higher emissions than modern equivalents. The LES will encourage and support bus operators to accelerate bus replacement programmes; operate newer, cleaner buses in urban areas; fit NOx and particulate abatement technology on buses; and consider low emission alternatives in order to reduce emissions from buses.
- **Commercial Vehicles and Freight** – Northampton has one of the busiest strategic motorway networks in the UK and is a hub for major logistics and distribution companies. Consequently the number of Heavy Goods Vehicles (HGVs) on the road network contributes significantly to overall air pollution. Recent years have also seen an increase in the number of light goods vehicles (LGVs), which may be attributed to an increase in internet sales, home deliveries and growth in the independent service sector and trades. The commercial sector can be difficult to influence, but they understand the need to reduce their carbon footprint and improve green credentials. The LES will aim to support the commercial sector to reduce emissions from fleet operations, for example by assisting companies to understand whole-life costs of vehicles and support alternative, low emission fuels such as electricity, natural and bio-methane gas, liquefied natural gas (LNG) and, potentially in the future, Hydrogen.
- **Taxis and Private Hire Vehicles** – 809 Hackney Carriage taxis and private hire vehicles operate in Northampton and most are diesel cars. The majority of journeys are short journeys in town and city centres and therefore contribute to overall air pollution. However, as well as being a contributor to the pollution problem, taxis and private hire can be part of the solution, by show-casing the potential for low-emission vehicles and “normalising” their use to the thousands of passengers they carry each year. The LES will encourage and support taxi and private hire operators to switch to low emission alternatives and consider what policy incentives will support taxi and private hire operators to make the change.
- **Public Sector Fleet** – public sector organisation operate many cars, vans and heavy goods vehicles, such as refuse disposal and highway maintenance vehicles. Public sector employees also use their own cars, the “grey fleet”, for business journeys. The LES will seek to increase the number of low emission vehicles in both the direct fleet and grey fleet in public sector organisations. A fleet procurement toolkit will be developed to assist with the

whole life costing of vehicles to balance potentially higher purchase costs, but lower running costs of low emission vehicles compared to traditional fuel types. Policy incentives, such as salary sacrifice schemes for low emission vehicles, will also be considered to incentivise uptake of privately owned low emission vehicles.

Additionally, we will investigate the production of renewable fuels, such as biomethane, to fuel our Council fleets, through the collection of organic waste for use in anaerobic digestion (AD) facilities. The potential for working in partnership with local businesses will be assessed.

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## 2. Low Emission Strategy Vision, Aims and Objectives 2016 – 2021

### 2.1 Vision & Aim

***A vibrant Northampton where clean air creates a healthy environment for people to live, work and invest***

***A town where air quality meets the Limit Values as set out in EC Directive 2008/50EC by 2021***

### 2.2 Objectives

The Borough and County Authorities will work together to achieve the above aims and will commit to the following strategic objectives:

<b>Theme 1: Evidence for Change</b>		<b>By When</b>	<b>By Who</b>
<b>1A</b>	We will review the Air Quality Management Areas (AQMA) across the Borough to ensure they provide an effective means of supporting decision-making and action planning.		
<b>1B</b>	We will monitor local air quality where necessary to do so		
<b>1C</b>	We will assess the potential impacts of accelerating the uptake of cleaner fuels and technologies, including impact that such measures will have on the health of residents		
<b>1D</b>	We will establish a clear performance monitoring framework in order to monitor progress towards achieving the aims of the NLES.		

<b>Theme 2: Creating a Low Emission Future</b>		<b>By When</b>	<b>By Who</b>
<b>2A</b>	We will work with our partners and stakeholders to ensure that regional and local strategies, policies and plans make provision, where appropriate, to support the Aims and Objectives of the NLES.		
<b>2B</b>	We will work in partnership to identify funding opportunities to deliver the aims and objectives of the NLES.		

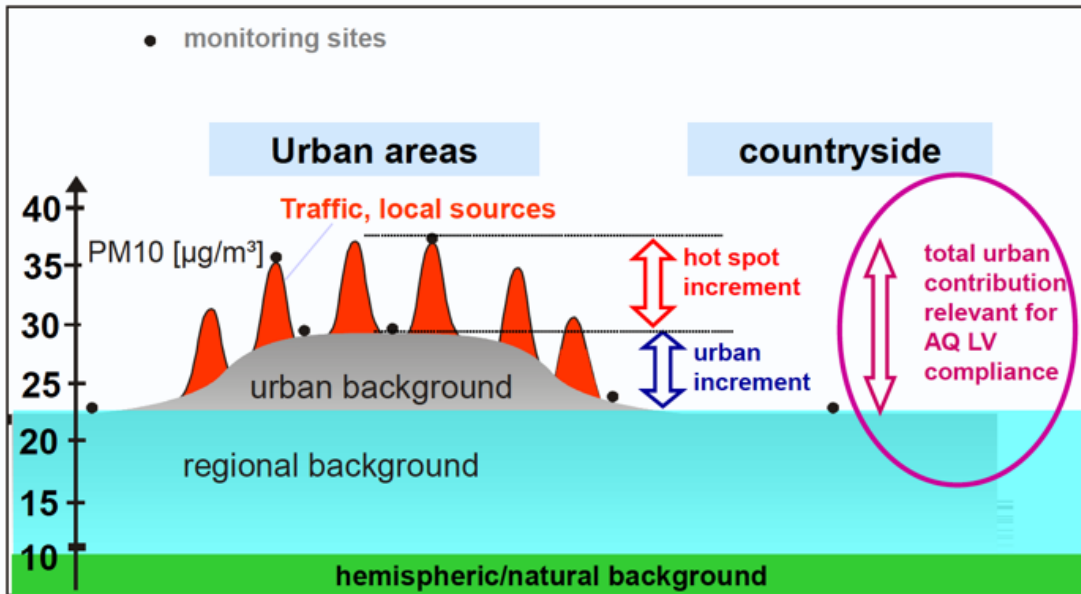
<b>2C</b>	We will continue to work with health professionals to raise awareness of air quality and the health impacts from emissions from transport to influence attitudes and encourage behaviour change to increase active and low emission travel.		
<b>2D</b>	We will use the Northampton Air Quality and Planning Technical Guide to help deliver sustainable developments in the Borough		
<b>2E</b>	We will promote the uptake of ultra-low emission vehicles with public sector employees, including the consideration of appropriate incentive packages.		
<b>2F</b>	We will use existing networks with key employers in the Borough to promote low emission vehicle alternatives in public and private fleet operations and vehicles used by employees.		
<b>2G</b>	We will, within the rules of procurement, use the commissioning and procurement process to integrate low emission criteria into contract awards.		
<b>Theme 3: Reducing Transport Emissions</b>		<b>By When</b>	<b>By Who</b>
<b>3A</b>	We will carry out research to better understand potential barriers to increasing the uptake of low emission vehicles by individuals and develop a package of measures that would overcome these.		
<b>3B</b>	We will work in partnership to implement the package of measures identified in objective T3A and seek funding opportunities and partnership arrangements to achieve this wherever possible.		
<b>3C</b>	We will engage with local bus operators to accelerate the investment in newer buses and/or emissions abatement technology to reduce bus emissions.		
<b>3D</b>	We will engage with the freight and logistics sector within the region to better understand how to support businesses to reduce emissions from their fleet operations and support fleet operators to switch to low emission alternatives, including developing the necessary refuelling infrastructure to support this.		

<b>3E</b>	We will engage with hackney carriage and private hire operators to determine how they may be supported to reduce emissions from taxi and private hire fleet, including demonstrating financial benefits; supporting funding bids and considering policy incentives to promote uptake of low emission taxis.		
<b>3F</b>	We will work with public sector partners to review our own fleets using the Northampton Fleet Procurement Guide to assess whole-life costs of vehicles to compare low emission alternatives to diesel, and switch to low emission vehicles where the business case supports this.		
<b>3G</b>	We will seek to identify options to develop AD to create our own bio-gas from food waste collection to create a cleaner fleet of vehicles.		

### 3. Introduction

- 3.1. Breathing clean air, which does not adversely affect health, should be a basic requirement of any modern society. Air quality has improved significantly over recent decades from the days when thick smogs and smoke which could be seen coming from chimneys in the region. However, we cannot yet say that the air which people breathe in some parts of Northampton does not have a negative impact on their health.
- 3.2. The “quality” of air describes its composition, and breathing clean air, without harmful pollutants, is something that we would all wish to achieve. Some pollutants occur naturally, while others are a result of human activities, which we have all become used to in today’s society, such as driving a car, heating our homes and businesses, generating electricity and power, industrial and manufacturing processes and transporting goods.
- 3.3. It is not possible to eliminate air pollution altogether, but steps can be taken to minimise the amount of pollution created and to control exposure to levels of pollution which negatively impact on people’s health. Figure 1 illustrates how air quality becomes a problem in urban areas, as local hot-spots of pollution from traffic or other localised emission sources adds to background pollution resulting in air pollution levels which start to have a negative impact on health.

**Figure 1 - Illustration of how air pollution builds up in urban areas**



Source: Lutz & Rauterberg-Wulff (2011)

- 3.4. In the busiest urban areas the overall urban background concentrations can exceed levels which impact on health and so all the population in that area can be exposed to high pollution levels. In other cases the background levels will be below threshold levels which impact on health and only the population near to busy roads or other localised hot-spot could be exposed to harmful levels of pollution.
- 3.5. We know that exhaust emissions from traffic, and particularly from diesel vehicles, contributes most to urban background and localised air pollution and, therefore, the focus for the Northampton Low Emission Strategy (NLES) is on reducing transport-related exhaust emissions over the next five years and beyond. The NLES will also look to shape regional and local policy to create a future where low emission technology becomes a normal part of everyday life for people and businesses in the region, and also considers other, non-transport emissions which may emerge as potential threats to air quality in the coming years.
- 3.6. Everyone in Northampton has a role to play in improving air quality, including individuals, businesses, public sector organisations and local and national Government. However, Northampton Borough Council (NBC), together with Northamptonshire County Council (NCC), recognise that together they play a key role in shaping how the region develops moving forward through the development of economic, social and environmental policy and the allocation of funding. The intention of the NLES is to provide the strategic commitment from NBC and NCC to implement a range of actions, both at a policy level and practical level, to improve air quality for the people of Northampton.

#### 4. Theme 1 – Evidence for Change: *The Health Impact*

- 4.1. Poor outdoor air quality is a contributing factor to many health problems as well as damaging ecosystems, biodiversity and valued habitats. The adverse health effects from short and long-term exposure to air pollution range from premature deaths caused by heart and lung disease to worsening of respiratory symptoms (i.e. asthma, chronic obstructive pulmonary disease (COPD, commonly known as chronic bronchitis), which lead to a reduced quality of life and increased health care costs. There is also evidence linking air pollution with a range of cancers<sup>1</sup> (lung and bladder in particular), low birth weight babies<sup>2</sup> and subsequent neurodevelopment problems in children<sup>3</sup>. In 2013, the World Health Organisation (WHO) classified diesel exhaust emissions as carcinogenic to humans<sup>4</sup>.
- 4.2. The two main pollutants of concern in urban areas are nitrogen dioxide (NO<sub>2</sub>) and particulate matter (PM<sub>n</sub>). Studies have shown an association between nitrogen dioxide in outdoor air with adverse health effects, including reduced life expectancy, however, it has not been clear if these effects were caused by NO<sub>2</sub> itself or other pollutants (such as particulate matter) emitted from the same source: for example traffic will produce both NO<sub>2</sub> and PM<sub>n</sub> emissions. The Government has recently stated<sup>5</sup> that NO<sub>2</sub> increases mortality by an average of 4.3% across the UK.

*There are 44,750 – 52,500 annual equivalent attributable deaths in the UK due to the impact of NO<sub>2</sub> and PM. This has an annual social cost of £25.3bn - £29.7bn<sup>5</sup>.*

- 4.3. Particulate matter is categorised by the particle diameter and three main descriptors are used:

PM<sub>10</sub> – particles smaller than 10 microns (0.01mm)

PM<sub>2.5</sub> – particles smaller than 2.5 microns (0.0025mm)

PM<sub>0.1</sub> – particles smaller than 0.1 microns (0.0001mm)

Figure 2 below illustrates the size of this particulate matter relative to a human hair.

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<sup>1</sup> [http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221\\_E.pdf](http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf)

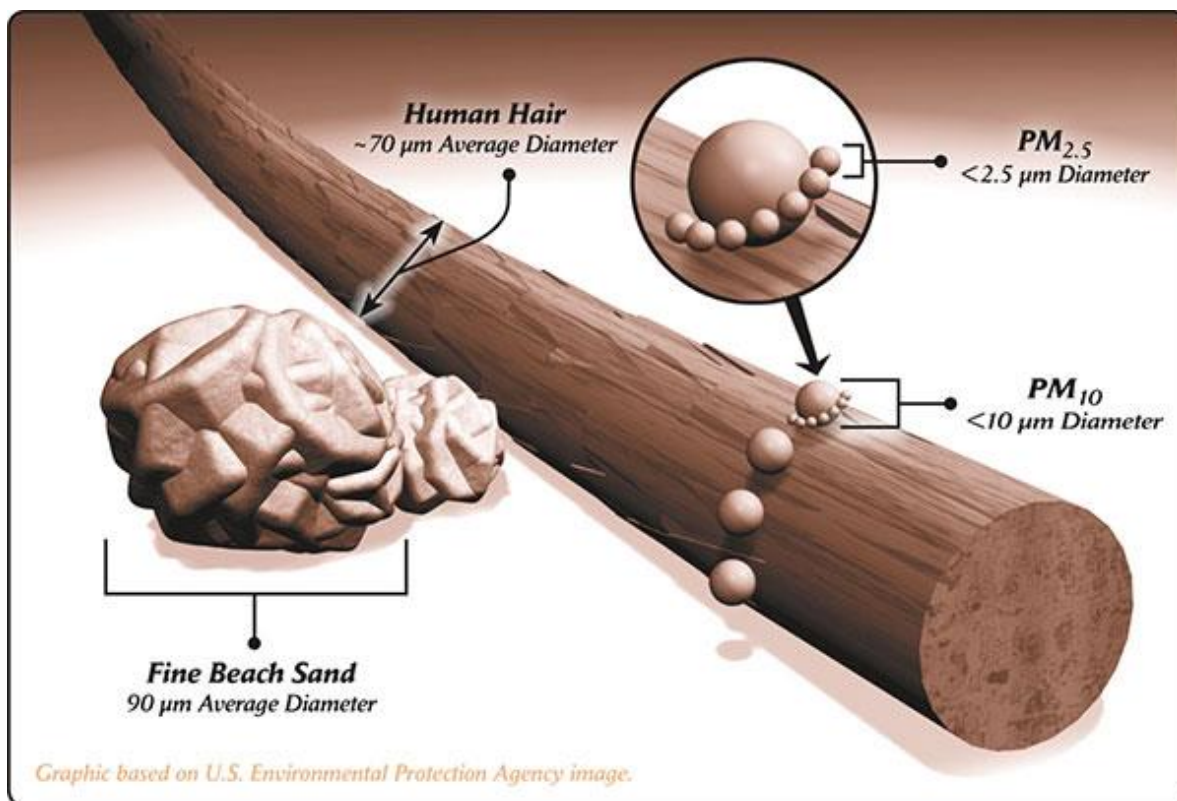
<sup>2</sup> [http://www.thelancet.com/journals/lanres/article/PIIS2213-2600\(13\)70192-9/abstract](http://www.thelancet.com/journals/lanres/article/PIIS2213-2600(13)70192-9/abstract)

<sup>3</sup> <http://www.ncbi.nlm.nih.gov/pubmed/25229653>

<sup>4</sup> [http://terrance.who.int/mediacentre/audio/press\\_briefings/](http://terrance.who.int/mediacentre/audio/press_briefings/)

<sup>5</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/460401/air-quality-econanalysis-nitrogen-interim-guidance.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/460401/air-quality-econanalysis-nitrogen-interim-guidance.pdf)

**Figure 2: Particle size relative to human hair.**



4.4. The small particle size means that that these pollutants are inhaled deep into the lung tissue and the smallest particles can pass into the bloodstream and be circulated around the body. Although much remains to be understood about the toxicity of different particle sizes, chemical composition and particle structure, the Government Committee on the Medical Effects of Air Pollutants (COMEAP)<sup>6</sup> has found a clear causal link between exposure to particulates and adverse impacts on health, with a clear recommendation that reducing the concentration of particulate matter in air will benefit public health.

4.5. Public Health England<sup>7</sup> use PM<sub>2.5</sub> as an indicator for mortality attributable to particulate air pollution. The Indicator suggests that in 2010, across Northampton, 6.1% of people aged over 25 will die prematurely each year because of particulate air pollution: equivalent to 102 deaths per year or 1168 associated life years lost. Table 1 shows the estimated fraction of mortality attributable to particulate air pollution for people aged over 25 years in Northamptonshire.

<sup>6</sup> Statement on the Evidence for Differential Health Effects of particulate Matter According to Source or Components, COMEAP (March 2015)

<sup>7</sup> Estimating Local Mortality Burdens Associated with Particulate Air Pollution, Public Health England, 2014



**Table 1: Estimated fraction of mortality attributable to particulate air pollution in Northamptonshire for people aged over 25 years (2010)<sup>7</sup>.**

	Percentage mortality attributable to PM <sub>2.5</sub>	Attributable Deaths aged 25+	Associated Life-Years lost
England	5.6%	25,002	264,749
<b>Northamptonshire</b>	<b>5.7%</b>	<b>323</b>	<b>3,513</b>
Corby	5.6%	29	330
Daventry	5.5%	33	349
East Northamptonshire	5.5%	42	390
Kettering	5.8%	47	493
<b>Northampton</b>	<b>6.1%</b>	<b>102</b>	<b>1168</b>
South Northamptonshire	5.4%	34	384
Wellingborough	5.9%	36	400

4.6. Premature death is the ultimate health impact associated with air pollution, but poor air quality particularly affects people with pre-existing respiratory and cardiac problems. It can be seen from Table 2 and 3 that the number of people affected by asthma and COPD in Northampton is higher than for England as a whole. These figures give an indication of the levels of ill health and the size of the 'high risk' population that will benefit most from improvements in air quality in the Borough.

**Table 2: Rates of Prevalence for Asthma 2012/13<sup>8</sup>**

	% Population with Asthma	Number of People with Asthma
Northampton	6.12%	13,800
England	5.9%	3,127,590

<sup>8</sup> Public Health Northampton

**Table 3: Mortality rates for COPD Northampton, East Midlands and England 2010<sup>9</sup>**

	All Cause Mortality (per 100,000)	COPD Mortality (per 100,000)
Northampton	589	29
East Midlands	545	24
England	538	25

4.7. In addition to the more predictable health impacts from exposure to air pollution such as those linked to respiratory and cardiac function, studies also suggest associations with other adverse health outcomes, including strokes<sup>10</sup>, which increase the risk of vascular dementia, low birth-weight babies<sup>11</sup> and cognitive development in schoolchildren<sup>12</sup>.

4.9 The evidence suggests there is a close link between air pollution and areas of high deprivation. Individuals living in areas of high deprivation often live in accommodation close to roads that have high levels of emissions. The Environment Agency estimates that people living in the most deprived areas have over five times the exposure to air pollutants as individuals living in the least deprived areas (Environment Agency, 2003). Individuals in more deprived areas have poorer health in general, so they suffer more adverse health effects than people experiencing the same level of emissions exposure in less deprived areas (BMA, 2012).

The proportion of children living in high traffic density areas has been found to increase with decreasing median family income for all ethnicities except white (Gunter, 2003). Minority children are about three times more likely to live in high traffic areas compared to white children. Therefore minority children have a higher potential of exposure to vehicle emissions, and this is of particular concern considering the previously discussed vulnerability of children to air pollution and emissions. Figure 3 shows the spatial distribution of deprivation in Northampton.

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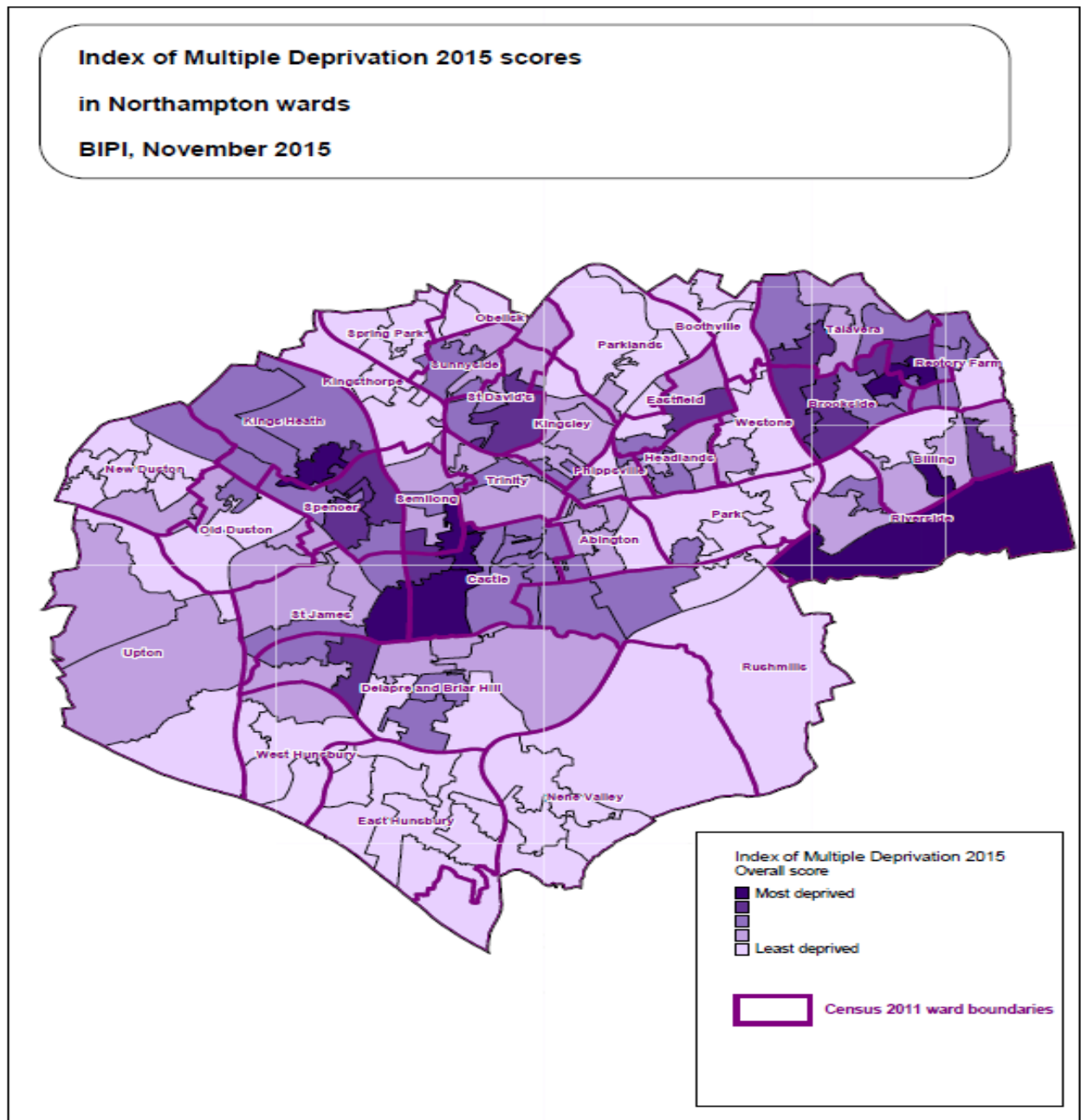
<sup>9</sup> NHS Information Centre for Health and Social Care

<sup>10</sup> Short term exposure to air pollution and stroke: systematic review and meta-analysis, *BMJ* March 2015; 350:h1295

<sup>11</sup> Maternal Exposure to Particulate Air Pollution and Term Birth Weight: A Multi-Country Evaluation of Effect and Heterogeneity, *Environmental Health Perspectives*, (March 2013)

<sup>12</sup> Association between Traffic-Related Air Pollution in Schools and Cognitive Development in Primary School Children: A Prospective Cohort Study, *PLOS Medicine* (March 2015)

**Figure 3 – Spatial Distribution of Deprivation in Northampton**



## 5. Theme 1 – Evidence for Change: *The Legal Requirements*

5.1. Although improving public health is the main driver for the NLES, there is also a legal requirement to improve and maintain air quality standards. Air Quality Directive 2008/50/EC<sup>13</sup> sets out the obligations for Member States in terms of assessing ambient air quality and ensuring Limit Values (LV) for certain pollutants are not exceeded. The requirements of the Directive have been transposed into domestic law through the Environment Act 1995 and subordinate regulation<sup>14,15</sup>.

5.2. The UK Government is responsible for assessing ambient air quality and for meeting the Limit Values and targets set out in the Air Quality Directive. In addition, NBC is required to carry out a Local Air Quality Management (LAQM) function to review and assess air quality within the Borough. The LAQM function requires us to determine whether national Air Quality Objectives (AQO) are being achieved; declare Air Quality Management Areas (AQMA) where AQOs are being exceeded, and to work towards achieving compliance with the AQOs by implementing an Air Quality Action Plan (AQAP). The Air Quality Objectives which we are required to work towards are very similar as the Limit Values which the UK Government is required to achieve. Table 4 summarises the Limit Values and Air Quality Objectives for the two most relevant pollutants: nitrogen dioxide and particulate matter.

**Table 4: Summary of Air Quality Objectives, Limit Values and Targets**

Pollutant	Air Quality Objectives	Date to be achieved / retained	EU Limit Value	Date to be achieved / retained
<b>NO2 (annual mean)</b>	40µgm <sup>-3</sup>	31 <sup>st</sup> December 2005	40µgm <sup>-3</sup>	1 <sup>st</sup> January 2010
<b>PM<sub>10</sub> (annual mean)</b>	40µgm <sup>-3</sup>	31 <sup>st</sup> December 2004	40µgm <sup>-3</sup>	1 <sup>st</sup> January 2005
<b>PM<sub>2.5</sub> (annual mean)</b>	N/A	<b>Stage 1:</b>	25µgm <sup>-3</sup>	1 <sup>st</sup> January 2015
		<b>Stage 2:</b>	20µgm <sup>-3</sup>	1 <sup>st</sup> January 2020

5.3. The relevant targets for PM<sub>2.5</sub> are more complex because it is recognised that there is no safe exposure level for these fine particulates. In addition to the limit values shown in Table 3, the Directive also requires Member States to achieve a reduction in PM<sub>2.5</sub> exposure relevant to the 2010 baseline Average Exposure Indicator (AEI). In the case of the UK this is a 15% reduction from the 2010 AEI

<sup>13</sup> DIRECTIVE 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, 21 May 2008

<sup>14</sup> Air Quality Standards Regulations 2010

<sup>15</sup> Air Quality (England) Regulations 2000

calculated to be  $13\mu\text{g}\text{m}^{-3}$ , to be achieved by 2015, with a further reduction by 2020.

- 5.4. The European Commission has commenced infraction proceedings against the UK Government for failing to meet the Limit Value for nitrogen dioxide and has indicated that it would like [the UK Government] “*to achieve full compliance with existing air quality standards by 2020 at the latest*”. More recently, in a case brought by Client Earth<sup>16</sup>, the Supreme Court ruled that the UK Government should submit new Air Quality Plans to the European Commission by the 31<sup>st</sup> December 2015 on how it intends to achieve compliance with the limit value for nitrogen dioxide in the shortest possible time. The implication being that continued failure to meet the limit value beyond 2020, would result in further legal action and possible infraction fines against the UK Government.
- 5.5. Meeting air quality obligations is not the role for Government alone. As outlined above, we have a role in relation to local air quality management. We have designated 7 Air Quality Management Areas (AQMAs) in Northampton due to elevated levels of nitrogen dioxide with the most significant contributor in every case being emissions from road traffic. Achieving air quality improvements will require input from a range of stakeholders including: transport planning, land-use planning, economic development, public health as well engagement and support from private and other public sector organisations.
- 5.6. DEFRA recently wrote to all local authorities seeking their co-operation in achieving compliance with the air quality limit values, adding: “***we feel we ought to remind you of the discretionary powers in Part 2 of the Localism Act under which the Government could require responsible authorities to pay all or part of an infraction fine***”. There are no silver bullets when it comes to resolving the air quality issues facing the UK, but there is an urgent need to ensure that we are doing all that we can to achieve compliance with the limit value by 2020 as any further delay in achieving the air quality limits could lead to EU fines being passed to NBC and NCC, as the Transport Authority.
- 5.7. Any EU fine may be a lump sum amount and further on-going penalty for continued non-compliance. A complex methodology applies to determining the level of fine and is affected by the relevant Member States’ GDP, the seriousness of the breach and the length of time the breach has been ongoing. The UK Government has, to date, never been fined under infraction proceedings and so there is no UK precedent, although examples cited in guidance by the Government include the case of the French Government being fined €20m lump sum and a further €58m every six months until compliance was achieved in relation to a fishing case.
- 5.8 In September 2015, DEFRA launched consultation on draft plans to improve Air Quality. The draft plans set out the action planned, being implemented and

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<sup>16</sup> R (on the application of ClientEarth) (Appellant) v Secretary of State for the Environment, Food and Rural Affairs (Respondent) [2015] UKSC 28, 29 April 2015

already taken at local, regional and national level to meet the annual and hourly EU nitrogen dioxide (NO<sub>2</sub>) limit values in the shortest possible time<sup>17</sup>. At the same time, DEFRA has published plans for each of the Zones where levels of NO<sub>2</sub> will continue to exceed the EU Limit Value beyond 2015<sup>18</sup>.

Northampton is part of the East Midlands Zone and the Northampton Low Emission Strategy is included within the Zone Plan for Northampton as a key measure to improve concentrations of NO<sub>2</sub>.

We will continue to work in partnership with DEFRA to develop and implement appropriate measures to improve air quality.

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<sup>17</sup> <https://consult.defra.gov.uk/airquality/draft-aq-plans>

<sup>18</sup> <http://uk-air.defra.gov.uk/library/no2-consultation-documents-2015>

## 6. Theme 1 – Evidence for Change: *Where is Air Quality a Problem?*

6.1 Northampton Borough Council has designated 7 Air Quality Management Areas (AQMA) due to elevated concentrations of NO<sub>2</sub> – see Figure 5. The predominant cause of these elevated levels is road transport emissions. While NBC are reviewing the status of 2 AQMA designations, levels of NO<sub>2</sub> in the other AQMAs remain stubbornly elevated, with the possibility that further AQMA may be designated. The emissions of NO<sub>x</sub> (the pre-cursor for NO<sub>2</sub>) from different vehicle types have a varying significance, depending on location. For example, buses are a significant contributor in the inner urban area and on arterial routes, while heavy and light goods vehicles are a significant contributor on trunk roads. Passenger cars, particularly diesel, play a significant role in all areas.

Further information on air quality, including the Air Quality Further Assessment 2011 and monitoring data can be found on the NBC website<sup>19</sup>

**Figure 4 – Northampton Air Quality Management Areas (AQMA)**



<sup>19</sup> <http://www.northampton.gov.uk/info/200075/pollution/1083/air-quality-review>

## 7. Theme 1 – Evidence for Change: *Vehicle Emission Assessments*

7.1 As part of the development of the NLES, the Borough has modelled predicted emissions and concentrations of NO<sub>x</sub>, NO<sub>2</sub> and particulate matter (PM<sub>10</sub>) in 2018 under the 'do nothing' scenario. Against this base case, selected low emission scenarios have been assessed for effectiveness if introduced in 2018. The scenarios modelled include

- \* All vehicles are Euro 6/VI
- \* All buses are Euro VI
- \* All cars are Euro 6
- \* All Heavy Goods Vehicles (HGV) are Euro VI
- \* All Light Goods Vehicles (LGV) are Euro VI
- \* All cars are petrol

For further information on low emission vehicles and the relative performance of European Emission Standards (Euro Standards) please see *Appendix 1 – What is a Low Emission Vehicle*.

It is acknowledged that modelling has its limitations as it assumes that certain road conditions are homogenous. Currently there are a limited emission factors for certain technologies e.g. natural gas. However the selected scenarios still provide a useful yardstick for playing out different scenarios, recognising that some technologies are likely to provide emission improvements beyond the Euro 6/VI Standard. Similarly, it is possible that real world vehicle emissions may under-perform the Euro 6/VI Standard

The scenario modelling data will continue to provide an evidence base to support the further development of specific vehicle type measures which are discussed in the NLES.



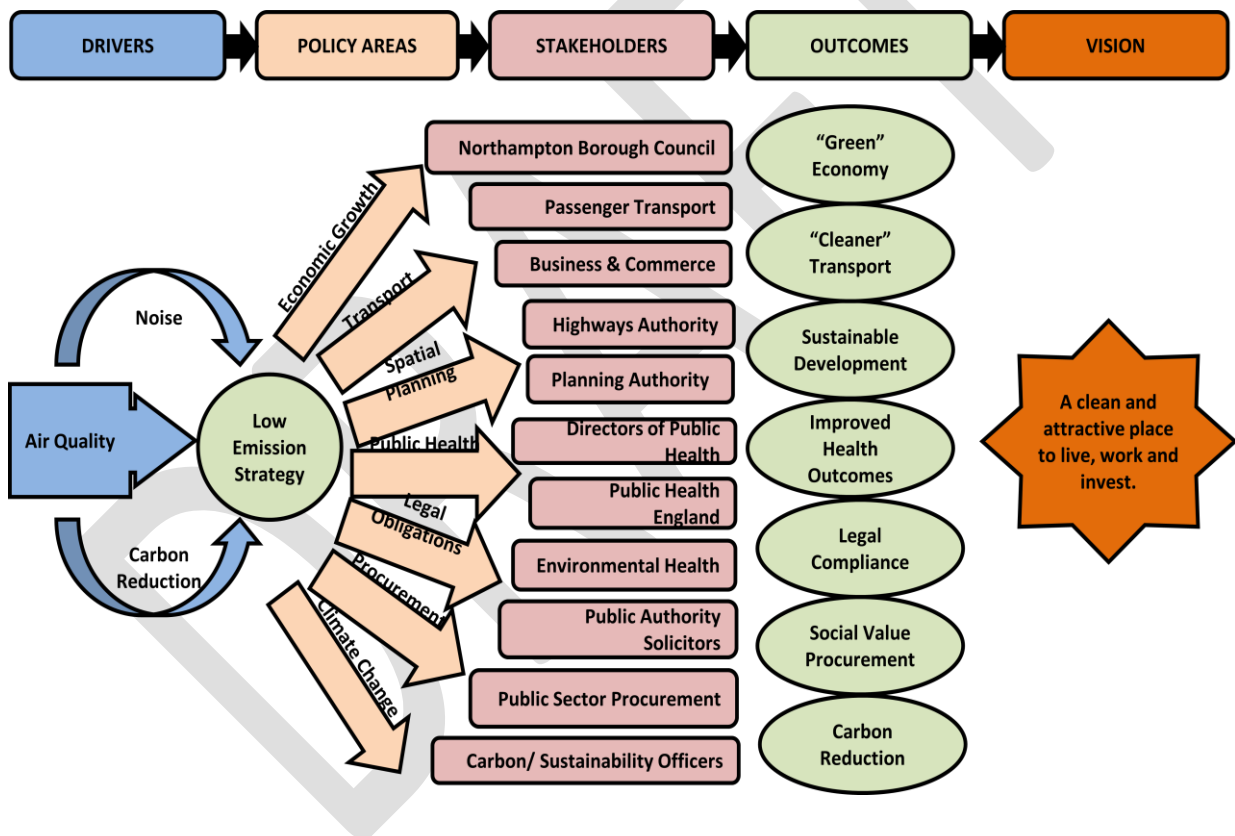
## **8. Theme 2 – Creating a Low Emission Future: *Influencing Policy, Strategies and Plans***

- 8.1. The NLES should be used to help inform and influence other relevant strategies and policies, both at a local and regional level. Figure 7 illustrates how the NLES cuts across and can be used to inform a range of strategies, policies and plans that different public bodies are engaged in delivering. Some of the key policy areas which the Strategy can inform and influence are discussed below, but these are by no means exhaustive.
- 8.2. Transport is fundamentally linked to economic growth through the movement of people and goods and the delivery of services. Economic growth and employment delivers significant benefits, not least the benefits to health, and the aim of the NLES is to support sustainable economic growth by providing the context for what is needed to improve air quality moving forward. Decision-makers at all levels should use the NLES to influence their own strategies, policies and plans, providing a real opportunity to translate the objectives of the NLES into positive action.
- 8.3. NBC is required to produce Local Plans and policies which determine where development, such as housing and employment, is required. The underlying theme of development is that it should be sustainable, having regard to the relevant economic, social and environmental factors. This Strategy will be used to inform the development of local plans and taking planning decisions: Theme 2 – Creating a Low Emission Future: *Place Shaping* discusses this in further detail.
- 8.4. The NLES focuses on air quality, with a primary focus on transport emissions, because this has the most direct and significant impact on health. The number of deaths attributable to poor air quality is one of a number of relevant public health indicators that Directors of Public Health and other health professionals are focussed on improving. The NLES should therefore be used to help inform health professionals working across the Borough in what they can do to contribute to the objectives contained within the Strategy and ultimately improve health outcomes.
- 8.5. The aims and objectives within this Strategy look to improve air quality, but emissions from transport also make a significant contribution to carbon dioxide emissions and climate change. Policy makers, businesses and individuals are aware of the need to reduce their carbon footprint and this strategy can be used to deliver co-benefits of improving air quality and helping to tackle climate change. Policy decisions should be taken which maximise these co-benefits,

but where there is a potential for policy conflict, the option which has the greatest benefit, or least impact, on public health should be chosen.

8.6 In the way that the LES can deliver improvements to the climate change agenda, the same can also be said of the potential co-benefits for reducing environmental noise, for which there is a growing evidence-base as having an adverse impact on health<sup>20</sup> Highways Authorities are required to take action in areas where people are exposed to high noise levels from road traffic and this Strategy can be used to help deliver co-benefits of improved air quality and reduced noise exposure.

**Figure 5: Northampton Low Emission Strategy and links to other key Policy Areas**



<sup>20</sup> Public Health Outcomes Framework – Indicator 1.14: Noise Complaints and Exposure to Noise, Public Health England

## 9. Theme 2 – Creating a Low Emission Future: *Place-Shaping*

### Land-Use Planning

9.1 Sustainability is at the heart of national planning policy, whereby the environmental, social and economic impact of development must be taken into account when making Local Plans and when taking planning decisions. The National Planning Policy Framework (NPPF)<sup>21</sup> recognises the importance of air quality and sustainable transport when deciding where new development is needed and when determining individual planning applications.

9.2 Paragraph 124 of the NPPF states that planning policies should:

*“Sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with local air quality action plans”.*

9.3 National Planning Practice Guidance (NPPG)<sup>22</sup> provides further detailed guidance and states Local Plans should:

- Consider the potential cumulative impact on air quality from developments.
- Consider the impact of point-sources of air pollution, for example industrial emissions.
- Where air quality may be unacceptable, identifying measures for offsetting the impact including supporting measures in an air quality action plan or **low emissions strategy**.

9.4 As well as considering air quality impact when making Local Plans, it is also a material consideration when determining individual planning applications. The National Planning Guidance further states:

- If a proposed development will lead to an unacceptable risk of air pollution or prevent sustained compliance with EU Limit values or national objectives then Planning Authorities should consider refusing permission
- Authorities should consider how the development can be made acceptable (for example through mitigation) or whether permission should be refused.

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<sup>21</sup> <https://www.gov.uk/government/publications/national-planning-policy-framework--2>

<sup>22</sup> <http://planningguidance.planningportal.gov.uk/>

9.5 Examples of mitigation are suggested in the Guidance, including:

- Infrastructure to promote modes of transport with low impact on air quality;
- Contributing funding to measures, including those identified in air quality action plans and **low emission strategies**, designed to offset the impact on air quality.

9.6 Given that Northampton is failing to meet the EU obligations on air quality it is clear that, as the planning authorities, the Borough Council has a significant role to play in ensuring future development will not make air quality worse and will also make a positive contribution to meeting the air quality objectives moving forward. The Planning system can also be used very effectively to implement a more joined up and holistic approach to air quality management and implementation of transport policy such as alternatives to the car with improved public transport, opportunities for walking and cycling and development of electrical vehicle recharging infrastructure which goes beyond just that of the development. Therefore this policy is intended to apply to any relevant development in Northampton regardless of whether it is located in an AQMA or not.

9.7 One key strand of the NLES has been the development of an Air Quality & Planning Technical Guide to assist developers, consultants, air quality officers and planning authorities to ensure that the principles of sustainable development, with particular reference to air quality, are satisfied when making planning decisions.

9.8 The Guide has the following key elements:

- It takes account of the cumulative impact from developments.
- It provides guidance on appropriate mitigation having regard to the scale and kind of development.
- For major developments it provides a systematic way of assessing the health damage costs arising from increased air pollution and uses this to determine the level of mitigation required to make the development sustainable in air quality terms.
- It focuses effort on practical measures to protect and improve air quality

9.9 The approach taken provides clarity and certainty to developers and planners so that it is easy to understand how air quality will be considered during the planning application process. The Guide also encourages developers to consider appropriate mitigation at the design stage so that mitigation becomes an integral part of the development and not an after-thought.

9.10 Making appropriate land-use decisions includes:

- Separating sources of air pollution away from those who could be affected by air pollution.
- Making active travel choices the easiest option wherever possible.
- Connecting the places where people live, work, shop and relax by sustainable transport modes.
- Building the necessary infrastructure to enable ultra-low emission vehicles to become a normal part of everyday life.

9.11 The Technical Guide uses evidence from HM Treasury to quantify the damage cost attributable to air quality impact from increases in air pollution (NO<sub>2</sub> and PM<sub>2.5</sub>) and provides a notional cost to this impact in monetary terms. This figure is then used to determine the scale and kind of mitigation that would be required to mitigate or off-set the increase in air pollution.

9.12 Using the Guide, only developments categorised as “large” or where air quality is already known to be poor would strongly encouraged to produce a full air quality impact assessment. Smaller developments, which may introduce only moderate increases in traffic would not require a full assessment, but, in recognition of the cumulative air quality impact from such development, standard mitigation would be required including features such as EV Charge Points, Cycling provision and Travel Planning schemes. The type of mitigation required will vary from development to development in discussion with the Local Planning Authority, Environmental Health, Highways Authority and Transport Authority. Two mitigation requirements will usually be required are: the provision of electric vehicle (EV) charging points (See Table 5 below) and the control of particulate (dust) emissions during demolition and construction.

**Table 5 – EV Charge Point Provision for New Developments**

<b>Development Type</b>	<b>EV Charge Points required</b>
<b>Residential</b>	1EV charge point per unit (dwelling with dedicated parking) or 1 EV charge point per 10 spaces (unallocated parking)
<b>Commercial / Retail</b>	EV charging for 10% of car parking spaces. Initial provision may be less than 10% with cabling and triggers for increased provision in the future

9.13 The Council will use the Air Quality & Planning Technical Guide to mitigate against adverse impacts on air quality from new developments in order to ensure sustainable development across the region. The Air Quality & Planning Technical Guide is supporting document to the NLES.

## 10. Theme 2 – Creating a Low Emission Future: *Changing Travel Behaviour*

### Travel Choice and Promoting Active Travel

10.1. Active travel is an approach to travel and transport that focuses on physical activity (walking and cycling) as opposed to motorised and carbon-dependent means. Active travel is cheap, inclusive and accessible, but is also the ultimate “low emission vehicle”. Choosing to walk or cycle over motorised transport will not only reduce air pollutants, congestion and climate change impacts (20% of car-related CO<sub>2</sub> emissions are from journeys <5km), it will also:

- Improve health and well-being for the individual - Inactivity has a health effect comparable in scale to that of air quality. Eliminating inactivity in the UK would cut mortality rates by 7.5%<sup>23</sup>.
- Promote a vibrant local economy
- Benefit community cohesion

10.2. Figure 6 below shows the economic benefits each year of getting just one child to walk or cycle to school<sup>24</sup>.

**Figure 6 – Illustration of the health benefits from walking and cycling**



<sup>23</sup> [http://www.panorama.am/en/current\\_topics/2015/01/15/inactivity-deaths/](http://www.panorama.am/en/current_topics/2015/01/15/inactivity-deaths/)

<sup>24</sup> Kings Fund infographic 2014

- 10.3. Active travel offers excellent opportunities for health improvement for the individual and will go some way to reduce the number of vehicles on the road and therefore emissions. It is also relevant that individuals undertaking active travel can reduce their own exposure to pollutants (exposure is around 5 times higher in a vehicle than on the pavement). This Strategy recognises the importance of active travel, but acknowledges that it is unlikely that enough people will switch from using motorised transport to walking and cycling to make the difference to air quality that is required to protect health and achieve air quality targets. The NLES is supportive of any action which promotes active travel, but, in order to achieve the scale of change necessary to improve air quality, the NLES focus will be on reducing vehicle emissions.

## **Travel Planning**

- 10.4. A Travel Plan is a long-term management strategy for integrating proposals to promote and encourage sustainable travel. Travel Plans are a tool particularly aimed at reducing the need to travel, gaining economic efficiencies, reducing the impact of car travel and encouraging greater use of public transport, cycling and walking.
- 10.5. In addition to general travel planning guidance produced by NCC in partnership with NBC, specific Area Travel Planning (ATP) Strategies have been produced for Brackmills and Telford Way Industrial Estates. The measures included are outlined below:

### **Brackmills Area Travel Plan Strategy**

#### *Car Travel*

- Develop, implement and promote car share scheme.
- Provide guidance and advice to employers on introducing car sharing and dedicated car share spaces.

#### *Cycling*

- Prepare a case for the improvement and maintenance of off-road cycle ways around the Estate.
- Update the existing cycle map.

#### *Pedestrians*

- Prepare a case for the improvement of off-road walk ways around the Estate.
- Provide 'Healthy Walking' maps.

### *Public Transport*

- Collate evidence for improved bus services, upgrade bus stops and real-time information displays.
- Discuss findings with council and bus operators.

### *Freight*

- Ensure that details of official lorry parks are made available to drivers.
- Design a freight preferred route map and promote to logistics companies.

### *Marketing and Promotion*

- Design, organise and implement an ATP launch event incorporating a car share scheme launch event.
- Provide a leaflet on travel directions to the Estate.
- Produce and distribute promotional material on, car sharing, walking, cycling and public transport.

## **Telford Way Area Travel Plan Strategy**

### *Public Transport*

- Collate evidence for improved bus services to / from Telford Way Estate and discuss with operators.
- Collate evidence to upgrade bus stop flag poles to shelters and provide real-time information.

### *Walking*

- Prepare a case for the maintenance and improvement of footpaths and the installation of CCTV.
- Collate evidence for the installation of pedestrian crossings and sign-posting within / around the Estate.

### *Cycling*

- Develop a case for the improvement of the safety and accessibility of cycle routes to Telford Way.
- Update the existing cycle map and distribute electronic copies.
- Collate evidence for the installation of cycle route sign-posting within the Estate.

### *Motorcycling*

- Promote motorcycle parking provision and the installation of lockers and drying facilities to employers.



- Engage employers with the national 'Bike Safe' initiative.

#### *Car Travel*

- Develop, implement and promote a car share scheme.
- Support the implementation of double yellow lines to address parking issues across Telford Way Estate.

#### *Marketing and Promotion*

- Design, organise and implement an ATP launch event, including a car share launch event.
  - Produce dedicated travel pages for the Telford Way Industrial Estate website.
  - Produce and distribute promotional material on car sharing, walking, cycling and public transport.
- 10.6. Employers are also encouraged to employ smart working practices to reduce the need for journeys altogether, for example: flexible working, home working and using remote tele/video conferencing facilities.
- 10.7. The current travel-planning model focuses on reducing journeys by car, however, the approach can also be used to encourage emission reductions. The NLES will use the existing Travel Planning Networks to engage with key employers, providing access to thousands of employees in the Borough to promote the uptake low emission vehicles when developing travel plans.
- 10.8. Travel planning is also important when new housing and business developments are taking place because people are considering new ways of travel and are more likely to consider alternative travel options. Travel Planning is already a key feature of the development management process and developers are often required to produce travel plans for new developments. The Air Quality and Planning Technical Guide will add further weight to travel planning as a tool to offset and mitigate against the impact of air quality from new developments.

## 11. Theme 2 - Creating a Low Emission Future – *Leading by Example*

11.1. In order to create change it is important that key organisations, including the Borough and County and other public sectors organisations who promote health and environmental improvements, lead by example. Public sector organisations operate fleets of vehicles and are significant employers in the area, generating thousands of business miles each year, and are responsible for spending public money when procuring goods and services. These represent significant opportunities for influencing change, both within the public sector, but also beyond, including employees and the many private and voluntary sector organisations who engage with the public sector on a daily basis.

### **Local Authority Fleet**

11.2. Although many factors need to be taken into account when deciding what type of vehicle is most suitable for a particular job, it is also a legal requirement<sup>25</sup> that public bodies must consider the energy and environmental impact that a vehicle will have during the length of its operational life, which include taking into account emissions which impact on air quality. Initial purchase costs for low emission vehicles and associated infrastructure can be expensive relative to conventional vehicles and fuels, however over the life of a vehicle, because running costs are typically much lower for low emission vehicles than conventional equivalents, the whole-life costs can be lower and therefore represent good value to the taxpayer. The Department for Transport has produced guidance<sup>26</sup> on what authorities need to do in order to comply with the Regulations and, as part the NLES, this Guidance has been used to develop a Northampton Fleet Procurement Guide to assist fleet managers to purchase or lease vehicles having regard to the environmental impacts for the whole life of the vehicle. This Guidance is available as a supporting document to the NLES.

11.3. The NBC Fleet is managed under contract hire through Specialist Fleet Services (SFS) and comprises refuse collection vehicles and around 85 car derived vans. The vans are a minimum Euro 5 Standard. Fleet operation contracts are reviewed regularly and provide an opportunity to specify vehicle emission standards and also assess the potential for introducing ultra low emission vehicles. Public sector fleet procurement is discussed in more detail under Theme 2: *Reducing Vehicle Emissions*.

### **Local Authority Employees**

11.4. The public sector is a major employer in the region and most of those employees will drive vehicles of their own, in their personal life, but also on business carried out on behalf of their public sector employers – the so-called grey fleet. The role

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<sup>25</sup> The Cleaner Road Transport Vehicles Regulations 2011

<sup>26</sup> <https://www.gov.uk/government/publications/guidelines-for-the-directive-on-the-promotion-of-clean-and-energy-efficient-road-transport-vehicles-2009-33-ec>

of NLES will seek to make recommendations that encourage the Council to implement policies which will incentivise employees to consider low emission and ultra-low emission vehicles in the future. Opportunities to support and incentivise the uptake of low emission vehicles could include:

- Salary Sacrifice and Car Lease schemes for LEVs and ULEVs.
- Providing ULEV pool cars so that employees become familiar with “new” technology.
- Providing electric vehicle charge-points in workplaces.

**Figure 7 – Northampton EV Recharging**



### **Local Authority Spending**

11.5. The purchasing power of the public sector is significant across Northampton and the County, which is an opportunity to influence the providers of goods and services to ensure the vehicles used by the providers emit the lowest possible emissions

11.6. Public Sector organisations must follow strict procurement rules, but included within those rules is a duty<sup>27</sup> to consider “social value” as part of the procurement process. This means that when procuring goods and services authorities must

<sup>27</sup> The Public Services (Social Value) Act 2012

take into account social and environmental considerations and can set criteria when awarding contracts and procuring service how these may be improved. For example this could include incorporating minimum vehicle emission standards when awarding contracts.

11.7. It is recommended that the following standards are integrated into tendering and contract award evaluation:

- All contracting of goods and services where vehicles will be required to access urban areas should include provision for meeting the current and previous European Emission Standard.
- Additional weight should be given in award criteria to tenders that can demonstrate best practice in minimising vehicle emissions and the use of low and ultra-low emission vehicles. See table 6 below:

**Table 6 – Emission Reduction Criteria for Tender Evaluation**

<b>SCORE</b>	<b>SCORE STANDARDS</b>	
5	Excellent answer	Can evidence vehicle emission reduction activity, considering NOx, NO2, PM & CO2, and, using reasonable endeavours, will use vehicles (including NRMM) that comply with the latest European Emission Standard (Euro Standard) and include some vehicles that are classified as low or ultra low emission vehicles to deliver the contract
4	Good answer	Can evidence vehicle emission reduction activity, considering NOx, NO2, PM & CO2, and, using reasonable endeavours, will use vehicles (including NRMM) that comply with the latest Euro Standard to deliver the contract
3	Acceptable answer	Can evidence vehicle emission reduction activity, considering NOx, NO2, PM & CO2, and, using reasonable endeavours, will use a mix of vehicles (including NRMM), some that comply with the latest Euro Standard with the remainder complying with the previous Euro Standard, to deliver the contract
2	Poor answer	Can provide a commitment to vehicle emission standards for NOx, NO2, PM & CO2 (including NRMM) but may fall below the current or previous Euro Standard to deliver the contract
1	Very poor answer	Information may be provided but cannot commit to a reasonable vehicle emission standard to deliver the contract
0	No answer given	No information provided

### **Local Sourcing**

11.8. Local sourcing is practised widely by local authorities, whereby local suppliers are encouraged to bid for Council contracts. Such initiatives have the potential to support the local economy while helping reduce overall mileage. Local sourcing offers the potential for lighter goods vehicles to be used in delivery. Helping local

suppliers develop emission strategies can provide competitive advantage in procurement decisions.

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## 12. Theme 3 – Reducing Vehicle Emissions: *Private Cars*

### What are the issues?

12.1 Car ownership for many is a necessity for everyday life, however, the number of cars on our streets continues to increase and their impact on pollution levels is significant. Our modelling shows that cars contribute significant NO<sub>x</sub> emissions at key locations within the AQMA and it also demonstrates the impact that the increasing take up of diesel cars is having on air quality levels

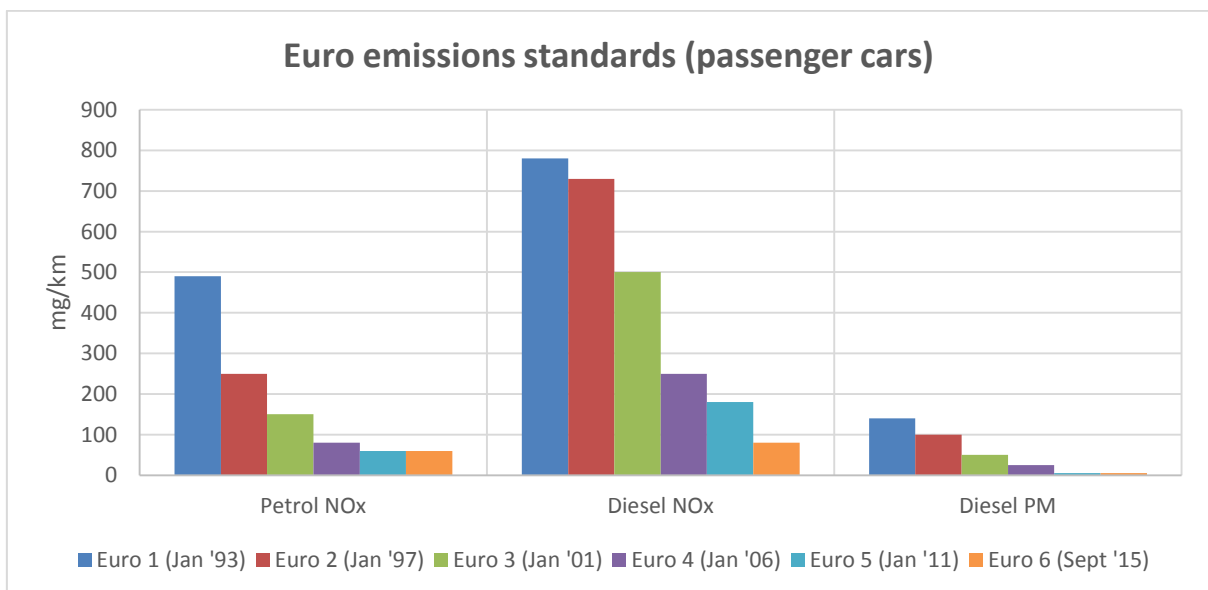
A key issue is the significant increase in diesel cars, rising from under 20% of the car fleet in 2000 to over 50% in 2014. Europe has the highest proportion in the world of diesel cars in the fleet mix (ICCT 2014<sup>3</sup>).

Many people have bought diesel cars assuming that they are environmentally friendly and the Government provides a reduced Vehicle Excise Duty (VED) to support take up. While diesel cars may be generally more fuel efficient than petrol cars, which is beneficial on long journeys, we must question the suitability of diesel cars for use in the urban areas. Studies by Which<sup>28</sup> show that unless diesel car owners are travelling more than 12,000 miles a year then they are unlikely to recover the increased cost of purchasing and maintaining a diesel vehicle over a petrol car

### 12.2 European Emission Standards (Euro Standards)

In order for manufactures to sell vehicles within EU Member States they must limit exhaust emissions to a level dictated by the latest Euro Standard, assessed during a standardised test cycle – see Figure 7.

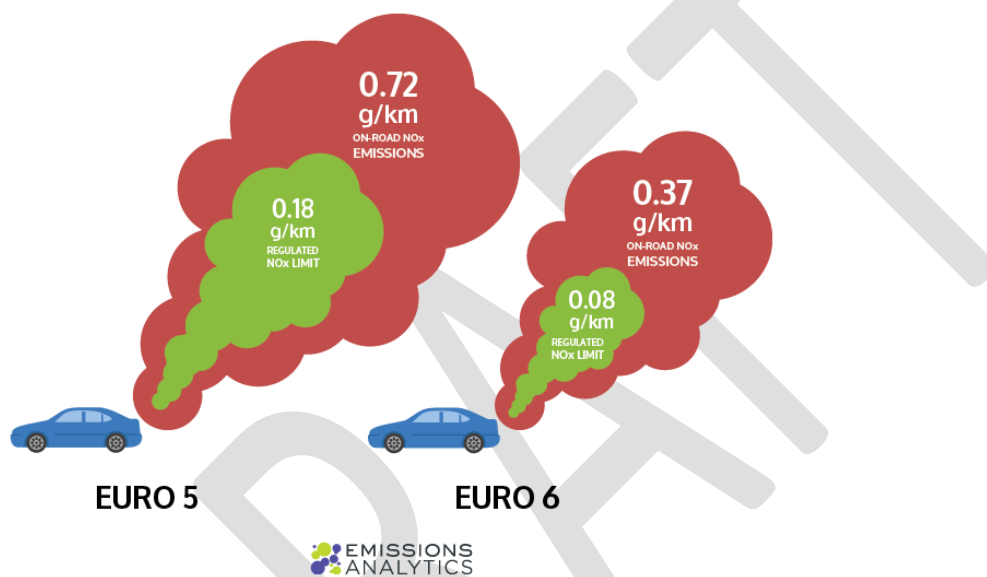
**Figure 8 – European Emission Standards for Diesel and Petrol Cars**



<sup>28</sup> <http://www.which.co.uk/cars/driving/driver-tools/petrol-vs-diesel/choosing-between-petrol-and-diesel/>

The mandatory standardised test to assess a vehicle compliance is often criticised for not being representative of real world emissions. Emissions projections assume the Standards will not be met, there is currently a push to amend the Euro 6 regulations to use real world testing in the vehicle approval process with the introduction of Euro 6c in 2017 (ICCT 2014<sup>29</sup>). Euro 6 and 5 diesel cars have had compliance issues especially with the NO<sub>x</sub> requirements. Figure 8 illustrates the difference between the test cycle emissions of Euro 5 and 6 diesel cars and their respective real world emissions.

**Figure 9 – Real World NO<sub>x</sub> Emissions from Diesel Cars compared with Regulated Limits**



Even if Euro 6 diesel cars were to achieve their regulated emission limits in real world driving, the business as usual projections in Northampton indicate that additional measures are likely to be required to improve air quality including the promotion and take-up of low and ultra low emission vehicles.

**What can be done?**

12.3 It is apparent that many car owners are unaware of the impact their vehicle has on urban air quality and there has been mixed messages from Government. The NLES includes information to raise awareness of passenger vehicle emissions and their impact on health. Additionally, information is provided on the Total Cost of Ownership (TCO) of cars, including emissions, to help the public make informed purchasing decisions. Figure 9 shows the TCO of a selection of cars after 3 years of ownership.

<sup>29</sup> <http://www.theicct.org/real-world-exhaust-emissions-modern-diesel-cars>

**Figure 10 – Total Cost of Ownership (TCO) of selected diesel, petrol, hybrid and electric cars**

Vehicle	Leaf (hatchback)	Octavia (hatchback)	Octavia (hatchback)	Prius (hatchback)
Manufacturer	Nissan	Skoda	Skoda	Toyota
Model details	80kw Visia 5dr	1.4TSI 140 SE 5dr	1.6TDI 105 S 5dr	1.8 VVT-I T3 5dr
Fuel type	Electric	Petrol injection	Diesel turbo	Petrol hybrid
Power (kw)	80	102.12	76.96	99.16
0-60mph (sec)	11.5	8.4	10.8	10.4
Euro std	NA	6	6	6
Price	£ 21,490	£ 18,860	£ 18,360	£ 21,995
3yr RV	£ 7,820	£ 7,075	£ 8,185	£ 12,665
New/used	New	New	New	New
Miles pa	25,000	25,000	25,000	25,000
mpg	NA	35	47	52.2
litres/km (kwh/km)	0.173	0.081	0.060	0.054
Tax band	A	D	A	A
Depreciation 3yrs	£ 13,670	£ 11,785	£ 10,175	£ 9,330
Tax £pa	£ -	£ 110	£ -	£ -
Fuel £pa	£ 519.00	£ 3,959	£ 3,054	£ 2,654
Servicing £pa	£ 0	£ 185	£ 179	£ 202
Nox damage £/yr	£ 0	£ 11.06	£ 80.93	£ 7.41
PM damage £/yr	£ 0	£ 17.54	£ 17.54	£ 17.54
CO2 damage £/yr	£ 144.94	£ 308.95	£ 268.16	£ 207.15
TCO for 1 yr (no depr)	£ 664	£ 4,591	£ 3,599	£ 3,089
TCO for 3 yrs inc depr	£ 15,661.82	£ 25,558.99	£ 20,973.21	£ 18,596.38

It can be seen that although the electric and hybrid models incur a higher purchase cost, their TCO over 3 years is considerably less than the diesel and petrol models.

The NLES will also seek to encourage the take-up of low and ultra low emission vehicles through the provision of information and incentives. While still at a relatively low base, there has been an observed increase in the numbers of hybrid cars in Northampton and, although we are yet to see the 5% ownership levels of plug-in cars seen in Norway and the Netherlands, there has been a significant increase in sales of plug-in electric vehicles across Northamptonshire over the last 2 years. Figure 10 shows the registrations of new ultra low emission vehicles in the UK over the last 5 years.

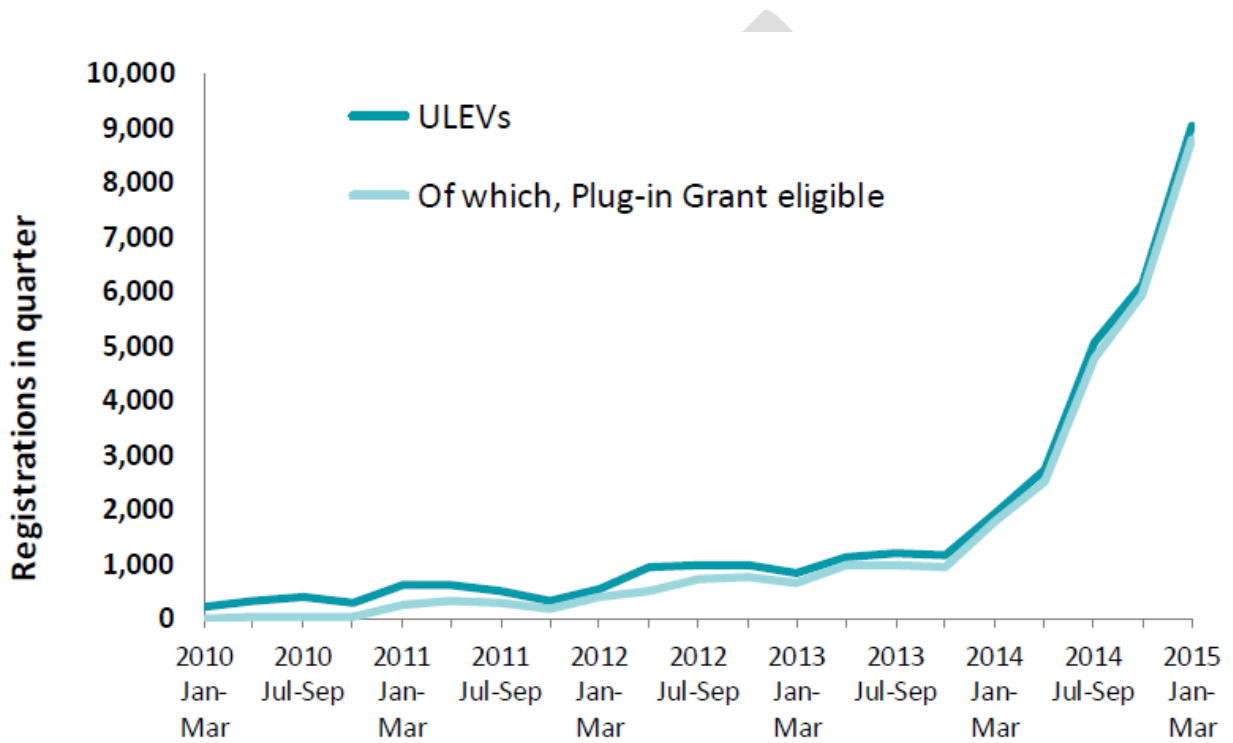
12.4 If Northampton and the region is to play a part in meeting EU obligations in relation to air quality and carbon reduction commitments then steps must be taken to reduce emissions from car exhausts. The Government's strategy: *Driving the Future Today*, has set a target that by 2050 nearly all cars and vans in the UK will be an ultra-low emission vehicles. This will mean a shift-change in the traditional internal combustion engine (ICE) as the predominant power source for vehicles, and although the ICE is likely to remain a feature of the vehicle market for many years to come, other alternative powered vehicles, such as Battery Electric Vehicles (BEV), Fuel Cell



Electric Vehicles (FCEV) and Plug-in Hybrid Electric Vehicles (PHEV), are likely to play a much more significant role if the ULEV target is to be achieved.

12.5 Considerable effort will be required to change the way people think when choosing a car, how cars fit into overall journey-planning, and developing the necessary infrastructure to re-charge / refuel with alternative powers sources, such as electricity or hydrogen fuel cell technology.

**Figure 11 – New Ultra Low Emission & Electric Vehicles: UK 2010 – Q1 2015<sup>30</sup>**



12.6 The Government has announced £500m funding between 2015 and 2020 to support a range of initiatives to further stimulate the ULEV market. This is an opportunity to increase the number of ultra-low emission cars on the roads of Northamptonshire and we will work together to promote the uptake of ULEV in the region and access Government funding to support initiatives to achieve this, including:

- Developing the necessary re-charging / refuelling infrastructure to support ULEVs.
- Raising awareness of the environmental, health and financial benefits from driving a ULEV.

<sup>30</sup> Vehicle Licensing Statistics: Quarter 1 (Jan – Mar) 2015, DfT (June 2015)

- Policy initiatives, such as preferential parking, to promote uptake of ULEVs.
- Support employers to promote ULEV uptake, for example through car leasing, salary sacrifice and access to pool cars.

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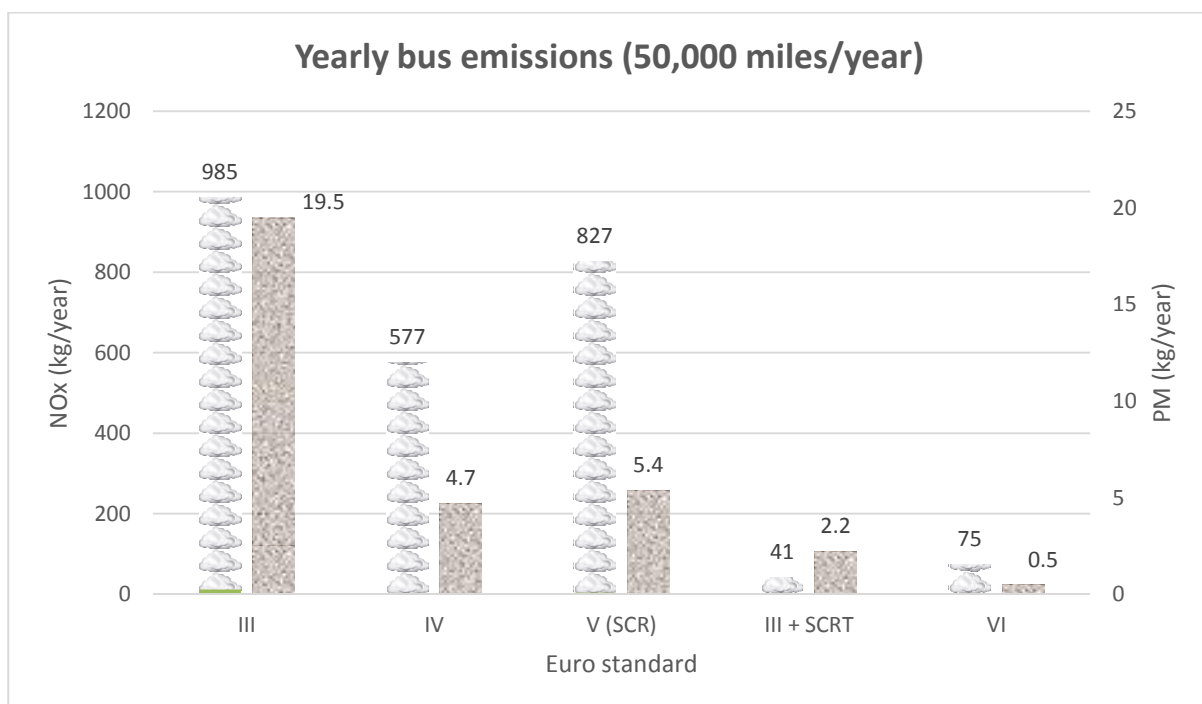
### 13. Theme 3 – Reducing Vehicle Emissions: *Buses*

13.1 Good provision of public transport is critical to improving air quality by providing a viable alternative to car use, reducing the number of individual car journeys. However, to achieve the greatest benefits overall, the public transport fleet should contribute to improving air quality in line with the objectives of the strategy.

#### Buses - What are the issues?

13.2 Monitoring and modelling show that diesel buses are a significant contributor of NO<sub>x</sub> and airborne particulates in the town centre and along certain arterial roads.

**Figure 12 – Relative Emissions of Selected European Emission Standards for Buses**



13.3 European Emission Standards for buses are designed to progressively reduce emissions of NO<sub>x</sub> and PM with the introduction of each new Standard. Unfortunately, some Standards have not resulted in emission improvements when buses operate under real-world driving conditions. Figure 11 shows the relative mass emissions for buses of differing Euro Standards based on Government approved emission factors<sup>31</sup> at typical urban speeds<sup>32</sup>. The data shows that the emissions performance of Euro V buses (with SCR) do not appear to be performing well in the real world. However, Euro VI buses appear to be providing significant emissions improvements over previous Euro Standard.

<sup>31</sup> Copert 4.10

<sup>32</sup> Euro III + SCRT taken from Millbrook testing undertaken by Eminox

While it may not be feasible to replace all buses with Euro VI or Low Emission<sup>33</sup> (see Appendix 1 – What is a Low Emission Vehicle) buses, operators can retrofit older Euro III/IV buses with selective catalytic reduction (SCR) technology at a cost of around £13,000 per bus. Thermal Management Units can be fitted to Euro V buses to improve their emissions performance at a cost of around £8,000 - £11,000 per bus.

### ***Setting a Bus Emissions Standard***

- 13.4 Under the business as usual scenario it is assumed that bus operators will replace 6.7% of their fleet every year (normal investment practice in the bus industry) and when doing so will replace the oldest, poorest emissions buses within their fleet.
- 13.5 While the Borough reserves the right to implement a Low Emission Zone (LEZ) to regulate the emissions of buses accessing the town centre, it is believed that bus emissions can be improved through a partnership agreement with bus operators. Figure 12 outlines a proposed standard that could be implemented by 2018.
- 13.6 The Government has announced £30m of funding for Low Emission Buses<sup>33</sup>. The Fund is most applicable where air quality is an issue. Technologies such as electric, natural gas and hybrid are included. Through Partnership Agreements the Borough will actively encourage and support bus operators in Northampton to make applications to this and other funding opportunities to improve air quality.
- 13.7 The Government has announced £5m of funding under the Clean Bus Technology Fund (CBTF, DfT)<sup>34</sup> to retrofit Euro III, IV & V buses with technology to improve emissions

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<sup>33</sup> <https://www.gov.uk/government/publications/low-emission-bus-scheme>

<sup>34</sup> <https://www.gov.uk/government/news/5-million-greener-bus-fund-announced-to-tackle-air-pollution>

**Figure 13 – Suggested Bus Emission Standard for Northampton**

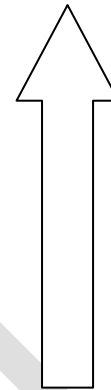
**Buses to be replaced by technologies outlined in green (in increasing order of preference)**

Electric or Fuel Cell

Natural Gas (CNG or bio-CNG)

Euro VI Diesel Electric Hybrid

Euro VI Diesel



**Existing buses to be retrofitted as outlined in orange**

Euro V Diesel with thermally effective NO<sub>x</sub> catalyst if needed

Euro IV Diesel with DPF and NO<sub>x</sub> catalyst

Euro III Diesel with DPF and NO<sub>x</sub> catalyst

Euro II Diesel with DPF and NO<sub>x</sub> catalyst

**Bus technologies not considered suitable for use in the AQMAs**

Euro IV Diesel (without SCR or DPF)

Euro III Standard Diesel

Euro II Standard Diesel

## 14. Theme 3 – Reducing Vehicle Emissions: *Commercial Vehicles & Freight*

### What are the issues?

14.1. Northamptonshire is a prime location for the distribution of goods - many distribution centres and logistics operators are located within the region, with the freight & logistics sector being a major contributor to the region's economy. Road freight is the most used mode for freight movements in Northampton.

Heavy and light goods vehicles are a significant contributor to elevated pollution concentrations in the urban centre and along arterial routes.

### What can be done?

14.2. Freight and commercial activity is potentially one of the most difficult for the Borough to directly influence, given that decisions in relation to the procurement of fleet vehicles is entirely a commercial decision. However, commercial organisations are required to report on CO<sub>2</sub> emissions and are encouraged to reduce their emissions, and from this we will seek to support from commercial operators to reduce transport emissions.

14.3. Examples of what can be done include:

- Seeking opportunities to increase the take-up of alternative fuels and technologies by HGV and LGV operators, for example natural and bio gas refuelling stations could be supported at key locations near to the strategic road network (possibly in conjunction with bus operators).
- Working with commercial fleet operators to use whole-life costing during vehicle procurement to promote the economic as well as environmental and health benefits from low emission HGVs and LGVs.
- Using the Northampton Air Quality & Planning Technical Guide (see Theme 2 – Creating a Low Emission Future) to ensure that new commercial developments incorporate facilities for low emissions vehicles, such as electric charging points and minimum Euro emission standards for fleet vehicles.
- Encourage more freight to be transported by rail for long-haul journeys.
- Using sustainable procurement criteria to reward those businesses which have a lesser impact on the environment.
- Minimising emissions in urban areas from HGVs and LGVs – the so-called “last mile” of deliveries – for example through the use of freight consolidation centres and consideration of Low Emission Service Delivery Plans.

## 15. Theme 3 – Reducing Vehicle Emissions: *Taxis and Private Hire Vehicles*

### What are the Issues?

- 15.1. There are 809 taxis (hackney carriages and private hire vehicles) currently operating in Northampton, with the majority being diesel cars. Most taxi journeys take place within the urban centre with some high-use taxis covering in excess of 30,000 miles each year. Although they make up only a small proportion of the overall vehicle numbers in the region, taxis do emit a higher proportion of NO<sub>x</sub> and particulate emissions in key areas so contribute disproportionately to poor urban air quality.
- 15.2. Taxis and private hire vehicles are also used by many people, which provides an opportunity for them to be used to expose passengers to new alternative fuels and technologies, such as electric vehicles.

### What can be done?

- 15.3. As with other commercial operations, we have a limited influence over the types of car which taxi and private hire operators buy. However, there are opportunities to influence taxi and private hire operators to reduce emissions from the vehicles they operate. Areas that could include the following:
- Investigate the potential for setting vehicle emission standards for taxis through the licensing system
  - Work with taxi and private hire companies to apply for Government funding (for example the £20m ULEV Taxi Grant Scheme announced in 2015<sup>35</sup>) to support ULEV taxis and private hire vehicles.
  - Using our taxi licensing function to promote incentivise the uptake of ultra-low emission taxis and private hire vehicles, for example by designating ULEV taxi ranks in high demand areas.
  - Demonstrating the potential fuel savings and financial benefits from operating ULEV taxis and private hire vehicles
  - Working with taxi and private hire operators to develop rapid electric charge-point network in suitable locations.
  - Using public sector transport contracts to promote low emission taxis.
- 15.4. If encouragement is not effective or widely supported, the option remains for us to specify the type of vehicle entering the fleet which could result in a speedier uptake of cleaner vehicles.

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<sup>35</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/382190/taxis-preliminary-guidance.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/382190/taxis-preliminary-guidance.pdf)

## 16. Theme 3 – Reducing Vehicle Emissions: *Local Authority Fleet*

- 16.1. Local authority fleet operations are an ideal opportunity to ‘lead by example’ and influence public vehicle purchasing decisions.
- 16.2. The NBC Fleet is managed under contract hire through Specialist Fleet Services (SFS) and comprises refuse collection vehicles and around 85 car derived vans. The vans are a minimum Euro 5 Standard. Fleet operation contracts are reviewed regularly and provide an opportunity to specify vehicle emission standards and also assess the potential for introducing ultra low emission vehicles.
- 16.2. The Cleaner Road Transport Vehicles Regulations 2011 require public sector organisations to consider the energy use and environmental impact of vehicles they buy or lease. A key concept of the Regulations is the consideration of **whole life costs** whereby the operational costs over a vehicle life, including pollution damage costs, are taken into account rather than just the purchase price. This helps to redress the issue of low emission vehicles costing more than conventional vehicles, while potentially having lower operating costs that outweigh the purchase increment.
- 16.3. In order to achieve compliance with the above Regulations and to public sector procurement teams a Public Sector Vehicle Procurement Guide has been produced as a supporting document to the NLES.

### **Funding for Low Emission Vehicles**

- 16.4. The Government recognises that public sector organisations are leaders within their communities and funding streams do become available to assist with the capital funding of low emission vehicles, for example under the Governments Plugged-in-Fleets initiative<sup>36</sup>. Northampton will use these available funding streams as a means of reducing emissions from their fleet operations and will support other fleet operators to secure funding where appropriate
- 16.5 NBC will look at innovative approaches to securing funding for accelerating the uptake of cleaner fuels and technologies, including partnerships with the private sector and funding through developer section 106 contributions

### **Producing Renewable Transport Fuels from Waste**

- 16.6 NBC will look at the potential for using organic waste in the Borough to produce biomethane through anaerobic digestion (AD). Biomethane is a renewable low emission fuel for heavy vehicles, including lorries<sup>37</sup> and buses with the potential to achieve operational cost savings. Further information on local AD facilities and natural gas/biomethane refuelling facilities can be found on the Gas Vehicle Hub<sup>38</sup>

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<sup>36</sup> <https://www.gov.uk/government/publications/ultra-low-emission-vehicles-getting-wider-public-sector-fleets-ready>

<sup>37</sup> <https://www.gov.uk/government/publications/low-carbon-truck-trial-first-year-executive-summary>

<sup>38</sup> <http://www.gasvehiclehub.com/>



## Glossary of Terms

AQMA	-	Air Quality Management Area
AQAP	-	Air Quality Action Plan
CDV	-	Car derived van
CO <sub>2</sub>	-	Carbon Dioxide
CVTF	-	Clean Vehicle Technology Fund
DEFRA	-	Department for the Environment, Food and Rural Affairs
DfT	-	Department for Transport
DPF	-	Diesel Particulate Filter
EEV	-	Environmentally Enhanced Vehicle
Euro Standard	-	European Emission Standard
FTA	-	Freight Transport Association
HDV	-	Heavy Duty Vehicle ie bus or lorry
HGV	-	Heavy Goods Vehicle ie lorry
LES	-	Low Emission Strategy
NHS	-	National Health Service
NO <sub>2</sub>	-	Nitrogen Dioxide
NO <sub>x</sub>	-	Oxides of Nitrogen ie a mixture of Nitrogen Dioxide, Nitric Oxide and Nitrous Oxide
OLEV	-	Office for Low Emission Vehicles
PHE	-	Public Health England
PM	-	Particulate Matter
PM <sub>10</sub>	-	Particulate Matter less than 10 microns in size
PM <sub>2.5</sub>	-	Particulate Matter less than 2.5 microns in size
RCV	-	Refuse Collection Vehicle
RHA	-	Road Haulage Association
SCR	-	Selective Catalytic Reduction

- TCO - Total Cost of Ownership
- ug/m<sup>3</sup> - micrograms per metre cubed
- ULEV - Ultra Low Emission Vehicle ie below 75 g/km CO2
- WHO - World Health Organisation
- WLC - Whole Life Costs

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## Appendix 1 – What is a Low Emission Vehicle

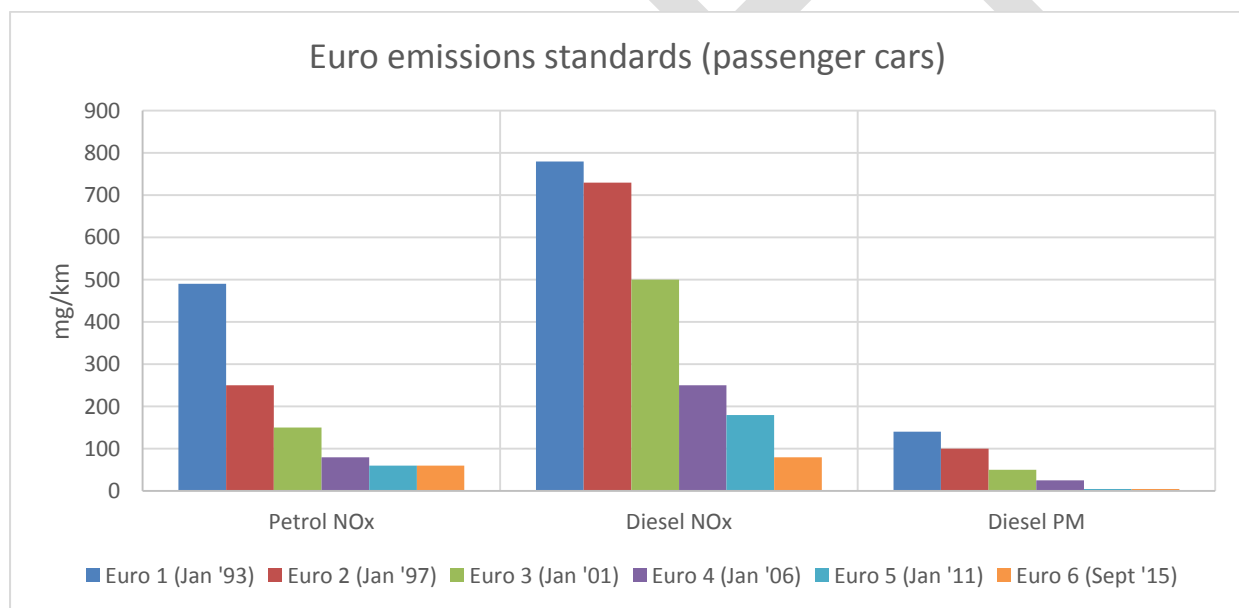
In considering what a low emission vehicle is, it is necessary to first consider what 'emissions' should be considered, and then how low counts as 'low'.

In the context of vehicles, emissions fall into two types. The first is emissions affecting air quality – currently<sup>39</sup> these are the oxides of nitrogen (NO<sub>x</sub>) and particulate matter (PM). The second is greenhouse gas (GHG) emissions, mainly carbon dioxide (CO<sub>2</sub>) but also methane, nitrous oxide and some others, usually measured together with CO<sub>2</sub> as overall CO<sub>2</sub>e (equivalent).

### Air quality

The emerging definition of 'low' emissions, in terms of NO<sub>x</sub> and PM, is the Euro 6/VI<sup>40</sup> standard. Figures 1 and 2 below show how the European statutory standards have progressed over time, for cars and heavy duty vehicles (trucks and buses) respectively<sup>41</sup>.

**Figure 1: Evolution of Euro emissions standards for passenger cars**



Three key points can be noted from the graph above. First, diesel cars have far higher NO<sub>x</sub> emissions than petrol cars, although the latest Euro 6 standard is only slightly higher for diesel than petrol. Second, there is no PM standard for **petrol**

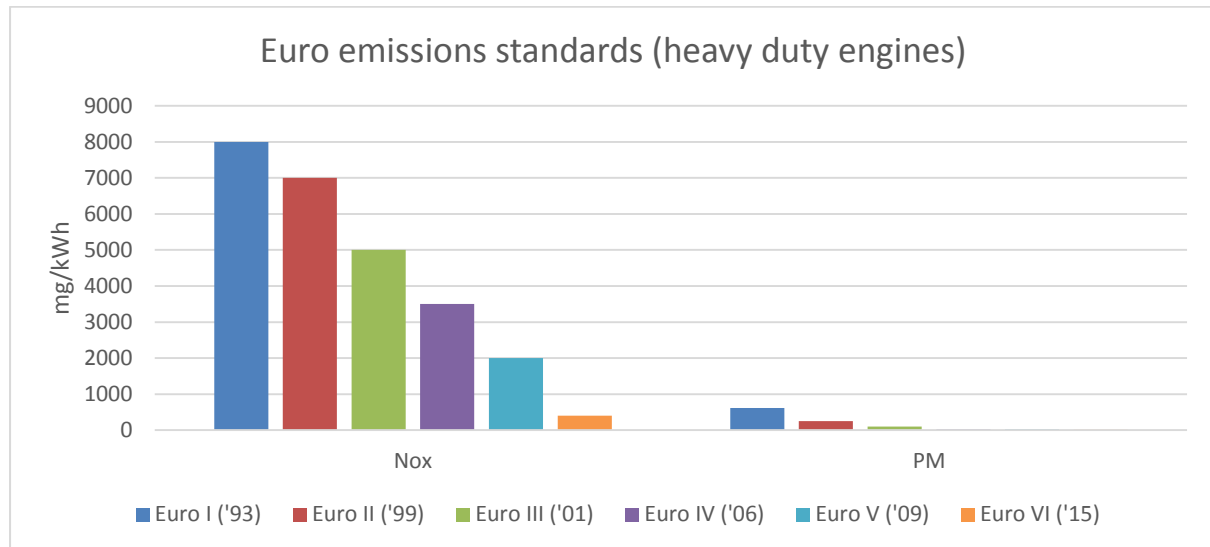
<sup>39</sup> There are several other types of exhaust emission that are regulated because of air quality concerns, especially carbon monoxide (CO) and unburned hydrocarbons (HC). However, effective technologies to control these have been in place for many years, and so they are not a current policy/technology issue.

<sup>40</sup> Euro emissions standards for cars and vans are represented by numbers 1-6, whereas for heavier vehicles they are designated by Roman numerals I-VI.

<sup>41</sup> There are separate standards for vans at various GVW, but these are similar to those for cars and are not shown for the sake of clarity. It should be noted that for heavy duty vehicles, only the engine is tested, and pollutants are measured in terms of mg per unit of power (mg/kWh) rather than per km in the case of cars/vans.

engines – this is because PM emissions from petrol engines are inherently very low. Finally, the Euro 6 standard for NO<sub>x</sub> for diesel cars is less than half the Euro 5 standard.

**Figure 2: European emissions standards for heavy duty engines (mg/kWh).**



*These will mostly be diesel, but the same standards would apply to larger engines running on other fuels such as gas or biofuels.*

The key thing to note from Figure 2 above is that the standard for NO<sub>x</sub> has been lowered even more from Euro V to Euro VI than was the case for passenger cars.

The standards shown above are those that vehicle and engine manufacturers are required to meet over a standard test cycle. It has always been acknowledged that these standard cycles were not a perfect representation of real world driving, but the full effect of this has only recently become apparent, as the introduction of Euro 4 and 5 vehicles failed to improve air quality as expected. More recently still, portable emissions monitoring (PEMS) has become easier and cheaper, and so several studies have tested vehicles in real world driving to assess the true difference between the test cycle and on-road performance.

**Figure 3: Real world NO<sub>x</sub> emissions of passenger cars (g/km) vs Euro standards**

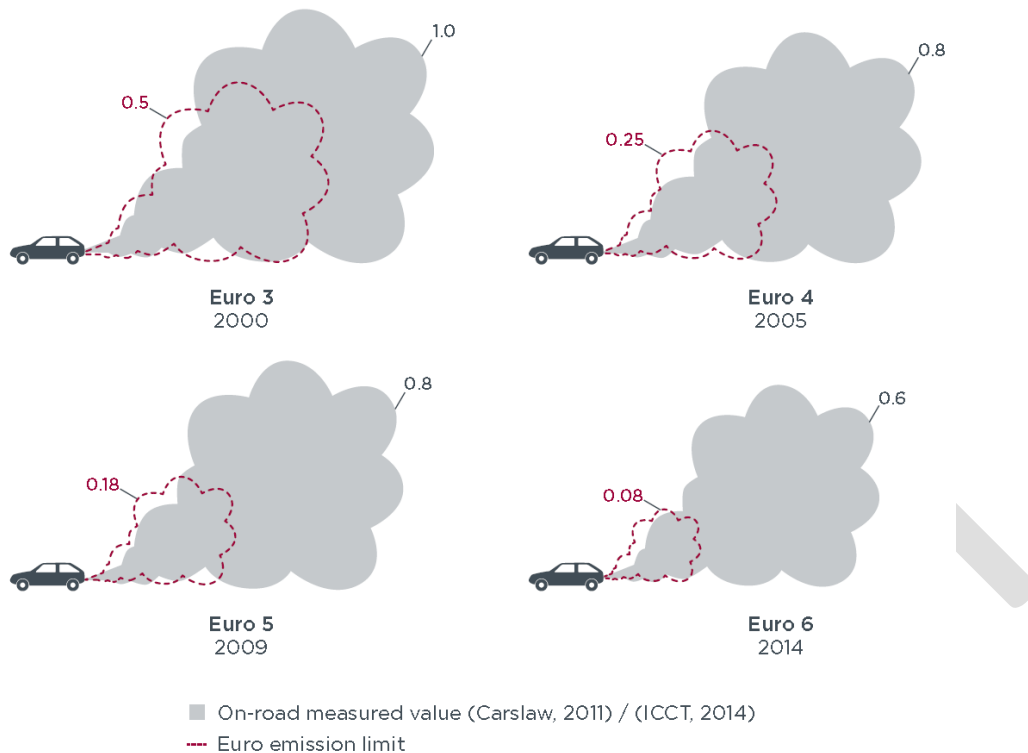


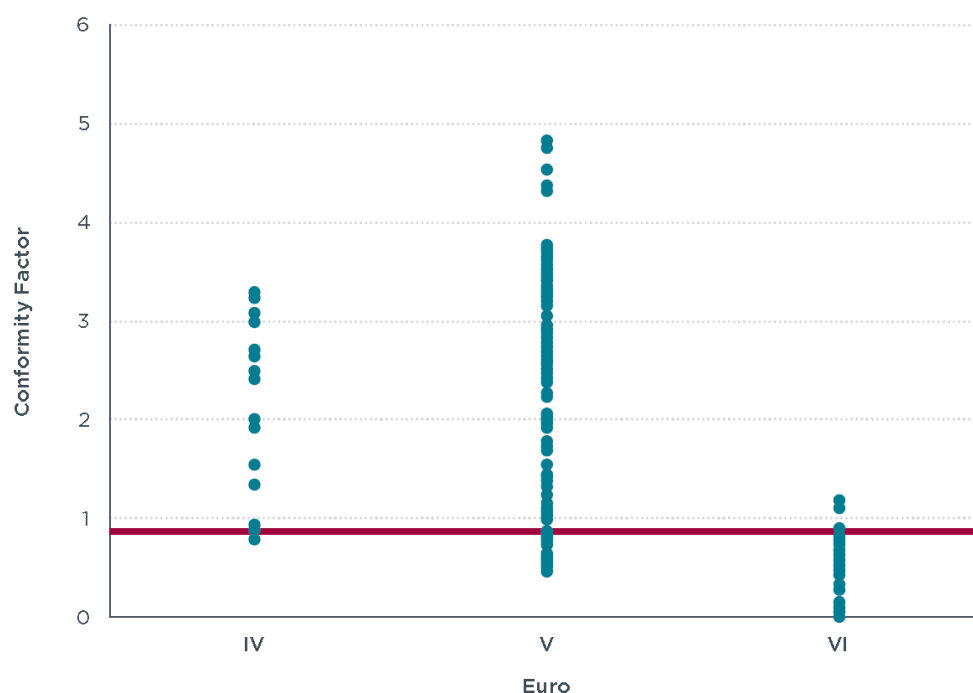
Figure 3 above shows the results of two studies on the real world performance of diesel cars. It can be seen that from Euro 3 to Euro 6, the emissions limits for NO<sub>x</sub> were lowered by 85%, and yet the actual NO<sub>x</sub> emitted in real world driving has only decreased by about 40%. The graphic above was taken from an ICCT study<sup>42</sup>, in which 15 new Euro 6 cars were tested. Although most of the vehicles failed to meet the standard in real world driving, one of them did achieve it, showing that the technology does exist. There are plans to introduce an element of PEMs into the Euro 6 test process from 2017, and this will hopefully force all manufacturers to improve their approach.

The picture for heavy duty vehicles is more optimistic, as can be seen in Figure 4 below. Taken from a separate report by the ICCT<sup>43</sup>, this shows the results of 210 tests on 38 different vehicles, including buses, rigid trucks and articulated trucks. Each dot represents a test, with 22 tests of Euro IV, 133 of Euro V and 55 of Euro VI. The 'conformity factor' is the ratio of the result to the standard limit, so a value of '2' means the vehicle was emitting double what it should for its Euro standard, and any value under '1' would mean it was cleaner than its Euro standard would require.

<sup>42</sup> "Fact sheet: Real-world emissions from modern diesel cars", October 2014, [www.theicct.org](http://www.theicct.org)

<sup>43</sup> "Briefing: Comparison of real-world off-cycle NO<sub>x</sub> emissions control in Euro IV, V, and VI", March 2015, [www.theicct.org](http://www.theicct.org)

**Figure 4: Performance of heavy duty engines against Euro standards**



The figure clearly illustrates the problem with Euro IV and V – these vehicles are typically emitting several times what they should, with Euro V particularly bad. Research suggests the reason for this is that the standard test cycle includes very little driving with the engine at low temperatures or idling, where the catalysts used are less effective, despite this being common in real world urban use.

The picture for Euro VI is much more optimistic. For Euro VI, changes were made in the test cycle, and manufacturers were also required to include monitoring equipment that would constantly monitor exhaust gases in use, and put the engine into partial shut-down if limits were exceeded. It would appear from the results in Figure 4 that this has been effective, and indeed that at Euro VI level heavy duty vehicles may for the first time be less polluting than passenger cars and vans.

For the fleet manager or policy maker looking to promote ‘low emission vehicles’ with a view to improving air quality, there are the following take-away messages:

- Diesel cars, even brand new models, probably still have poor emissions performance (although this is likely to improve after 2017).
- Petrol cars are a better option. Emissions will be broadly related to fuel consumption, so more efficient cars, and hybrids, will be better. ‘Zero emissions’ vehicles, i.e. electric (or hydrogen), emit nothing during driving so are the best choice for urban areas.

- In the case of buses and trucks, Euro VI is very clean in practice. As with cars, emissions will be related to fuel consumption, so more efficient vehicles will further improve emissions performance.

### Greenhouse Gas (GHG) emissions

The definition of ‘low’ GHG emissions is more difficult to pin down. Air quality is a local problem, so emissions control is mainly a concern on the vehicle itself, at point of use. Climate change is a global problem, so GHG emissions need to consider the whole lifecycle of the fuel – an electric car can’t have ‘low’ emissions if the GHG emissions at the power plant are more than an equivalent car would have generated running on petrol.

A low GHG emissions technology needs to offer a significant reduction in emissions compared to the best available ‘conventional’ technology, which is usually a modern diesel engine. For several recent funding opportunities, the UK government has required a minimum GHG saving of 15% vs diesel to qualify, on a ‘well-to-wheels’ basis (i.e. taking the whole lifecycle of the fuel/energy into account). Some technologies just manage about 15%, whereas others can achieve considerably more, which is why the latest round of funding for low emission buses has moved to a sliding scale.

A wide range of technology approaches are available to lower GHG emissions, most of which lower energy use and therefore running costs as well. The principles of the main technologies are explained in the table below, followed by a table that summarises the technology options by vehicle type, along with their main costs and benefits.

### Low emission technologies

<p>Parallel hybrid  (Hybrid Electric Vehicle or HEV)</p>	<p>This is the type of vehicle most synonymous with the term ‘hybrid’, with the Toyota Prius the most well-known example. This type of hybrid has a conventional engine drive-train driving the wheels, but has a separate, parallel, electric drivetrain (battery and motor(s)) also helping to drive the wheels. Commonly one set of wheels is driven by the conventional engine and the other by the electric motor. All of the energy used by the electric drivetrain is gathered from regenerative braking – i.e. allowing the wheels to push the electric motor, generating electricity while using the electrical resistance of the motor to slow the car.</p> <p>The electric motor will generally operate at times of peak load, such as acceleration. The biggest benefit in terms of fuel economy is to allow the vehicle to have a downsized conventional engine, thus</p>
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	<p>saving fuel all the time while still having the performance of a vehicle with a larger engine.</p> <p>This type of hybrid is best suited to urban driving, with frequent acceleration and deceleration. For this reason the Toyota Prius is one of the most popular taxis in the UK. In motorway conditions however, there is little opportunity to collect electrical energy, and the downsized engine may be less efficient than a larger equivalent.</p>
<p>Plug in hybrid (PHEV)</p>	<p>The term plug-in hybrid normally refers to a parallel hybrid fitted with a larger battery pack, and the ability to charge from an external source of electricity. The 'plug-in' Prius, for example, has a battery about four times larger than the non-plug-in Prius, meaning it can be driven just by the electric motor for 12.5 miles.</p> <p>Since most journeys, especially in urban areas, are quite short, this type of vehicle can operate in pure electric mode for much of the time. However, if necessary it can be used for longer journeys, operating in the same way as a parallel hybrid once it's all electric range is used up.</p>
<p>Series hybrid (or Range Extended Electric Vehicle - REEV)</p>	<p>Like a parallel hybrid, a series hybrid has an electric drivetrain and a 'conventional' engine. However, in a series hybrid the conventional engine is only used to generate electricity to extend the range of the battery, not to directly drive the wheels. The Vauxhall Ampera and BMW i3 are the best known series hybrids in the UK market.</p> <p>The advantage of the series approach is that in theory the conventional engine can be redesigned once it no longer has to drive the wheels. As it is only generating electricity, it can be made smaller, lighter, and more efficient at a single power output. Meanwhile only the very efficient electric motor(s) are actually used to drive the wheels.</p> <p>In practice, series hybrids tend to have larger batteries than plug-in (parallel) hybrids, hence they are seen as Range Extended Electric Vehicles (REEVs). Charged from the mains, the Ampera has a range of around 50 miles before the range extender needs to kick in. This type of vehicle offers more opportunity to redesign the chassis and the conventional engine, and manufacturers are only just starting to exploit these possibilities fully, particularly BMW with the i3.</p>
<p>Battery electric</p>	<p>A Battery Electric Vehicle (BEV) is a straightforward electric vehicle with only electric motors driving the wheels and a battery to store energy. Typical range on one charge is around 100 miles, but the</p>



(BEV)	<p>top of the range Tesla S can achieve 270 miles (with a £90,000 price tag).</p> <p>The battery of a BEV is charged from an external source. Most BEVs (cars) can charge from a standard plug socket, but this usually takes 6- 8 hours, and a heavy duty (blue) plug is recommended for regular use. Dedicated charging posts are able to deliver a 'fast' charge in 3-4 hours. 'Rapid' chargers can deliver an 80% charge in around 30 minutes, but not all BEVs can accept this level of charge, and installing rapid chargers is expensive as they draw so much current that local electricity grids often need upgrading to support them.</p>
Gas	<p>Internal combustion engines can run on natural gas from the UK gas grid. A modern gas engine is very similar to the latest petrol engines, using spark plugs to ignite the gas, and a 3-way catalyst to remove CO, hydrocarbons and NOx from the exhaust. The efficiency is also similar to a petrol engine.</p> <p>Natural gas, or methane, is the cleanest burning fossil fuel in terms of carbon emissions. 'Biomethane' is methane produced through anaerobic digestion of organic material, and so is a renewable fuel with very low lifecycle greenhouse gas emissions.</p> <p>Gas can be stored on a vehicle either in compressed or liquefied form. Compressed gas needs to be stored in pressurised tanks, and takes up over three times as much volume as petrol or diesel (for the same amount of energy), which will limit the practical range of the vehicle on a single fill. Liquefied gas has double the energy density of compressed gas, giving longer vehicle range, but must be stored in a special tank at -162°C. Over a period of days, the gas will warm up and 'boil off' so such vehicles need to be in constant regular use.</p>
Hydrogen fuel cell	<p>A hydrogen fuel cell vehicle is driven by electric motors, but uses a fuel cell in place of a battery. A fuel cell is a device which can create electricity continuously through the chemical reaction of a fuel. A hydrogen fuel cell reacts hydrogen with oxygen in a controlled way, to create a stream of electrons (rather than an explosion and lots of heat, as usually happens when hydrogen reacts with oxygen).</p> <p>The advantage of a fuel cell vehicle is that it is essentially an electric vehicle that can be refuelled at a filling station.</p> <p>There are still several major obstacles to fuel cell vehicles. The most immediate is the cost of fuel cells themselves, which is still</p>



	<p>very high. The second is the ability to store hydrogen – compressed hydrogen has a very low energy density, so several tanks are needed to achieve the same range as a conventional fuel tank. This need not be a huge problem if fuelling stations are common, but as yet there are very few they are quite expensive. Finally, hydrogen is only really an energy ‘carrier’ – the well-to-wheel emissions reductions achieved by a hydrogen vehicle depend on the way the hydrogen is created.</p>
<p>Novel hybrid (flywheel, air, hydrogen)</p>	<p>While most hybrid vehicles use an electric drivetrain, this does require a battery, which is both heavy and expensive. For this reason many engineers have looked at alternative ways of harvesting braking energy and re-using it to improve overall vehicle performance.</p> <p>Flywheels store kinetic energy by accelerating a spinning wheel to tens of thousands of RPM. Although automotive flywheels have been considered theoretically for a long time, they were first made a practical reality with the KERS (Kinetic Energy Recovery System) developed for Formula 1. Since proving the concept in racing, they have been further developed for buses, which have a continuous stop-start drive-cycle well suited to the technology. Two different manufacturers are in the process of bringing these buses to market.</p> <p>Another way of storing braking energy is to use it to compress air in a small pressurised tank. This air can then be used to give a moderate engine efficiency boost by driving a supercharger. A more ambitious system, soon to be put into production by Peugeot, is a full parallel hybrid with a larger compressed air tank and a hydraulic motor which can drive the wheels. Similar to an electric plug-in hybrid, the compressed air tank can be charged/filled from an external source, and the vehicle can drive for short distances on air alone.</p> <p>One novel system uses electrical energy from regenerative braking to generate hydrogen using a small electrolyser. This hydrogen is then fed back into the engine along with the fuel, boosting engine performance and thus reducing fuel consumption.</p>




Other technologies that don't quite count as 'low emission':




<p>LPG (liquid petroleum gas)</p>	<p>Liquid Petroleum Gas is a mixture of propane and butane, and is a co-product of the production of refined petrol and/or natural gas (methane). Like natural gas it can be used in an engine very similar to a petrol engine – in fact since manufacturers no longer produce LPG-specific vehicles, all LPG vehicles are now converted from petrol. LPG attracts a lower rate of fuel duty than petrol and diesel, and there is a national network of filling stations, so there are still a significant number of people choosing it on cost grounds.</p> <p>LPG offers around a 15% GHG saving vs petrol, and was supported as a low emissions option by the government. Given that diesel engines are inherently more efficient than petrol, the rise of diesel in the car market has wiped out most of the benefit from using LPG. However, new sources of renewable LPG have become available recently, as a by-product of some biofuel production processes, which could offer significant extra GHG reductions.</p>
<p>Mild hybrid</p>	<p>'Mild' hybrids capture energy from regenerative braking, and feed it back into the electrical systems of the vehicle. This recovered electrical energy is not therefore used to directly power the wheels, but will increase fuel economy by reducing the work the engine has to do to recharge the battery via the alternator.</p> <p>In vehicles where the engine has to support a high auxiliary electrical load, mild hybridisation can have a big impact on fuel consumption. This would be true for passenger cars in hot countries where the air conditioning is in constant use. This approach is increasingly being used in larger vehicles, switching refrigeration units to run on batteries for example, and switching refuse truck compactors and bin lifts from hydraulic systems powered by the engine, to electrical operation with much of the energy coming from the continuous stopping and starting of this type of vehicle.</p> <p>The advantage of this approach is that the energy collected from braking can be used without fitting a second, expensive, electric drivetrain. However, the benefits to be gained are limited unless there are significant demands for electricity in the vehicle.</p>
<p>Dual fuel</p>	<p>One drawback of both gas and LPG is that although they are cheaper and cleaner than diesel, they require an ignition source. Diesel engines are more efficient than petrol engines because diesel can be made to ignite when compressed, whereas petrol requires a spark. Due to the different thermodynamics of the processes involved, 'compression ignition' engines are about 25%</p>

	<p>more efficient than 'spark ignition' engines, which is why diesel vehicles are cheaper to run even though diesel is more expensive than petrol.</p> <p>'Dual fuel' engines attempt to burn gas or LPG with diesel efficiency, by injecting a mixture of diesel and gas into the cylinder. The droplets of diesel ignite under compression, thereby also igniting the gas.</p> <p>Dual fuel engines can only substitute gas for diesel effectively when operating at a high, steady load, such as motorway driving. Dual fuel systems for modern engines are only coming onto the market in small numbers as yet, and the effect of the systems on emissions, especially NOx and methane, is still poorly understood.</p>
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Low emission vehicles – suitability and availability by vehicle type

Cars	 <p>[BMW i3]</p>	<ul style="list-style-type: none"> <li>• Passenger cars are available in a full range of hybrid and electric models.</li> <li>• From an urban air quality point of view, vehicles that can run in full electric mode in urban areas (BEV, PHEV, REEV) are the surest option until Euro 6 tests are improved, but any small petrol car will be very clean.</li> <li>• For fleets running vehicles every day in urban environments, BEVs already offer a good economic payback.</li> </ul>
Taxis		<ul style="list-style-type: none"> <li>• [See notes for cars above, which also apply to taxis.]</li> <li>• Due to their mostly urban use, the Toyota Prius has already become one the most popular choices for taxis.</li> </ul>

	<p>[Toyota Prius]</p>	<ul style="list-style-type: none"> <li>• While gas is not really an option for private cars, due to a lack of fuelling infrastructure, black cabs with gas engines are available and being used where access to a fuelling station can be arranged. (As in Reading, where taxis have been given access to the bus company's fuelling station.)</li> </ul>
<p>Small vans</p>	 <p>[ENV200]</p>	<ul style="list-style-type: none"> <li>• There are several all electric small vans available from Nissan, Renault and Peugeot, but no hybrids.</li> <li>• The VW Caddy is available in the UK in a gas variant.</li> <li>• There are currently no factory production hybrid or electric vans in the 2.5-3.5t GVW range (Transit size).</li> </ul>
<p>Large vans and minibuses</p>	 <p>[Fuso Canter hybrid]</p>	<ul style="list-style-type: none"> <li>• In the 3.5-7.5t GVW range there are a small number of hybrid options, notably the Fuso Canter (pictured).</li> <li>• Gas versions of the Mercedes Sprinter and Iveco Daily are available and can offer cost savings vs diesel.</li> </ul>
<p>Rigid trucks (15-26t)</p>	 <p>[Eurocargo CNG]</p>	<ul style="list-style-type: none"> <li>• Gas is the only low emissions technology available for this type of vehicle – the Iveco Eurocargo is the only readily available model.</li> <li>• Typical mileages for this type of truck are too low to offer economic payback on this type of gas truck if the cost of a fuelling station is included. However, it may be economic for a mixed fleet, where</li> </ul>

		<p>more of the cost of refuelling infrastructure is recovered from other vehicle types using more fuel.</p>
<p>Refuse collection vehicles</p>	 <p>[Econic CNG]</p>	<ul style="list-style-type: none"> <li>• Mercedes and Scania make gas fuelled RCVs. The high fuel consumption of these vehicles makes economic payback relatively quick, even with the cost of refuelling infrastructure.</li> <li>• Some manufacturers, including Volvo, are developing hybrid options, as this is suited to the stop-start nature of their use. Recovered braking energy may also be used to power bin-lifts and compactors, rather than the vehicle.</li> </ul>
<p>Buses</p>	 <p>[Optare Solo Flybus]</p>	<ul style="list-style-type: none"> <li>• A full range of low emission technologies are available for buses – hybrid, plug-in-hybrid, electric, flywheel hybrid, gas and hydrogen.</li> <li>• The stop-start drive-cycle and high mileage make all options suitable for buses – the best fit needs to be assessed on a case-by-case basis.</li> </ul>
<p>HGVs</p>	 <p>[Volvo FM methane-diesel]</p>	<ul style="list-style-type: none"> <li>• Electric and hybrid are not suitable technologies for long-haul trucks as the batteries required would be too heavy, and there is little opportunity to recover braking energy.</li> <li>• Gas is a viable option, but is limited as most hauliers require engines of 400+ bhp, and the most powerful gas engines currently available are around 330</li> </ul>

		<p>bhp.</p> <ul style="list-style-type: none"><li>• Several hauliers are switching to dual fuel vehicles, as these offer cost and emissions savings while still providing the safety net that they can run on diesel if the gas runs out.</li></ul>
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