West Yorkshire Low Emission Strategy

(WYLES)

2016-2021

Draft_v2 for Public Consultation

October 2015

About the West Yorkshire Low Emission Strategy

The West Yorkshire Low Emission Strategy (WYLES) has been developed through collaboration between the West Yorkshire local authorities (Bradford MDC, Calderdale MBC, Kirklees MDC, Leeds CC and Wakefield MDC); West Yorkshire Combined Authority (WYCA) and Public Health England (PHE), with each organisation having an input and contributing to the content of the strategy.

With funding from the Department for the Environment and Rural Affairs (DEFRA) the WYLES project has been managed by Bradford MBC, with technical support provided by Low Emissions Strategies Ltd. and Public Health England and specific acknowledgements are given for their contribution to the development of this Strategy.

The WYLES is intended to influence and shape other local and regional strategies, plans and policies to facilitate a reduction in emissions, mainly 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. 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.

A West Yorkshire Task Group will be set up to deliver the objectives within this Strategy and provide annual progress reports to each of the West Yorkshire local authorities and to the West Yorkshire Combined Authority.

Consultation on the WYLES

This draft WYLES has been developed with input from technical experts from their respective fields, including air quality; transport policy and public health, however for the WYLES 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, initially from interested groups and subsequently through public consultation. This consultation phase is with key stakeholder groups with a closing date of 7th August 2015.

A consultation pro-forma is attached and responses can be made on-line: https://www.surveymonkey.com/r/WYLES-Stakeholder

For further information please contact your local authority representative:

Authority	Name	e-mail
Bradford Council	Sally Jones	sally.jones@bradford.gov.uk
Calderdale Council	John Riley	john.riley@calderdale.gov.uk
Kirklees Council	Wendy Blakeley	wendy.blakeley@kirklees.gov.uk
Leeds Council	Jon Tubby	jon.tubby@leeds.gov.uk
Wakefield Council	Gary Blenkinsop	gblenkinsop@wakefield.gov.uk
WYCA	Steve Heckley	steve.heckley@westyorks-ca.gov.uk

Contents

Foreword

City of Bradford MDC www.bradford.gov.uk	***Insert text here from relevant Member / Lead from each authority.***	Photo Signature Name Title
Calderdale Council	***Insert text here from relevant Member / Lead from each authority.***	Photo Signature Name Title
Kirklees COUNCIL 	***"The Strategy is an excellent opportunity to work with colleagues across West Yorkshire to reduce emissions and improve air quality whilst at the same time maintaining a strong economic growth, resulting in a healthier place for people to live, work and visit."*** Cllr Peter McBride Cabinet Member for Transportation, Skills, Jobs and Regional Affairs	
Leeds CITY COUNCIL	***Insert text here from relevant Member / Lead from each authority.***	Photo Signature Name Title
wakefield council working for you	***Insert text here from relevant Member / Lead from each authority.***	Photo Signature Name Title
WEST YORKSHIRE COMBINED AUTHORITY	***Insert text here from relevant Member / Lead from each authority.***	Photo Signature Name Title

Public Health England has collaborated on the development of the West Yorkshire Low Emissions Strategy and is fully supportive of it.

1. Executive Summary

1.1. Most of West Yorkshire benefits from very good air quality and, overall, air quality has improved relative to air pollution levels experienced by previous generations. However, traffic in our urban centres and on busy roads result in levels of air pollution which have a significant impact on the health of the population, with those having underlying health conditions being most at risk. There are two pollutants of greatest concern: Nitrogen Dioxide (NO_2) and Particulate Matter (PM_n), which have an adverse affect on health and are a 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, nitrogen dioxide and particulate matter 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 nitrogen dioxide 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 cardio-vascular disease, but evidence is now also showing an 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 the equivalent of one in twenty deaths in West Yorkshire each year being attributable to poor air quality.

1.3. Nitrogen dioxide 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 and are legally binding through EU and UK law. The urban areas of West Yorkshire have been identified as having some of highest levels of air pollution in the UK, with only London showing higher levels at a regional level. Current projections indicate that concentrations of nitrogen dioxide will not fall below the limit values in some parts of West Yorkshire until after 2030. 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. We know that traffic-related air pollution is 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 social expectations. 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 region and where air pollution is highest, however, we need to build on our existing knowledge to help inform decision-making so that the most cost-effective and viable options to deliver air quality improvements are made, which do not have unintended adverse economic, social or environmental impacts.

1.6. No single action will lead to improved air quality, 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 West Yorkshire authorities and recognises that the actions that will have greatest impact are ones which are implemented across the region, such as regional transport policy, economic growth, housing, spatial planning, infrastructure developments and behaviour change.

1.7. This Strategy has four main themes:

- ***Evidence for Change***
- ***Creating a Low Emission Future***
- ***Reducing Transport Emissions***
- ***Controlling Emissions from non-Transport Sources***

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 Low Emission Zone feasibility studies and work by local authorities in their 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 to busy roads areas of traffic congestion. 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, also deliver additional benefits by reducing carbon dioxide emissions and reducing environmental noise.

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 WYLES will help inform other strategies and policies to achieve this. Notable strategic plans include the Single Transport Plan and Strategic Economic Plans developed by WYCA, and Local Development Plans produced by Planning Authorities, 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 been developed as part of the WYLES to assess the air quality impact from new development and help quantify the level of mitigation required to make developments sustainable. The West Yorkshire Authorities will use this Guide to help shape new developments, for example by creating electric charging infrastructure, so that ulta-low emission vehicles become a realistic and viable alternative for more people.

1.10. Changing behaviour is a key element of delivering a low emission future. The car has become, and will continue to be, a part of everyday life for most people, but increasingly people are interested in alternative travel options and journey planning, with active travel (walking and cycling) – the ultimate low emission vehicle – being increasingly important. The WYLES can be used to compliment the travel planning and active travel strategies across West Yorkshire.

1.11. The WYLES will also help raise awareness of the impact that emissions, particularly from vehicles, have on air quality and health. It can be confusing picture: for many years diesel engines have been seen as better for the environment because of their lower CO_2 emissions compared to petrol, but we know that diesel engines emit higher levels of nitrogen dioxide and particulates than their petrol equivalent and so contribute more to air quality problems. The WYLES 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 choices and decisions they make.

1.12. 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. Most modern towns and cities benefit from some form of traffic management, for example pedestrianised areas, cycle-only routes, bus-lanes and bus-gates are now an integral part of town and city centres. However, outside London, there are very few traffic management areas based on vehicle emission standards and there are complexities around implementing such schemes. Low Emission Zone feasibility studies have been carried out for Leeds and Bradford and these are considered in the WYLES. Although LEZs can reduce vehicle emissions within a defined area, more work needs to be undertaken in terms of the practical implementation and economic impact of implementing Low Emission Zones, but

remain an option for regulatory control if voluntary measures fail to achieve the aims of this Strategy.

1.13. Creating a Low Emission Future will also require public authorities to lead by example. Local authorities operate over 3,000 fleet vehicles and employ over 30,000 thousand people across the region which provides the potential to influence the uptake of low emission vehicles, both as part of their business operations and in the wider population. Local authorities will carry out fleet reviews to see how low emission vehicles can be incorporated into the vehicle mix, and will promote the uptake of ulta-low emission vehicles with their own employees. Public authorities can also influence others through the commissioning of services and the procurement of goods and so consideration will be given to how this influence can be used to encourage contractors and service providers to reduce their emissions when awarding contracts.

1.14. Theme 3 – ***Reducing Transport Emissions,*** considers each of the main transport modes 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, 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 affordability – particularly initial purchase price. Because alternative fuels and technologies are relatively new to the market there is greater uncertainty about choosing something different and initial purchase costs can seem prohibitive. Work is required to better understand the barriers to ULEV uptake and work with individuals and companies to make low emission vehicles a viable and affordable alternative. The following transport modes are considered in the WYLES:

- **Private Cars** – Car use is a part of everyday life for most people, but with nearly one million cars in the region, accounting for 78% of the 9.8 billion miles driven on West Yorkshire roads each year, they are a significant contributor to overall emissions which impact on air quality. Diesel cars have also grown in popularity, with a three-fold increase in the last decade, however diesel cars can produce 22 times more particulate exhaust emissions and four times more NOx emissions than petrol cars, which is one of the reasons why air quality targets have not been achieved across the UK. Ultra-low emission vehicles, such as plug-in electric cars, are becoming increasingly popular as more people are seeing the benefits that ULEVs can bring, including: lower running costs, zero road tax, Government “plug-in grant” towards purchase costs as well as the environmental benefits. However, ULEVs still represent less than 0.05% of cars in West Yorkshire and more work needs to be done to promote ultra-low emission vehicles as a

viable option for more people. Emissions from traditional (diesel and petrol) engine technology will reduce as new cars come into the market, but this will take a long time and therefore the WYLES will support the growth of ultra-low emission fuels and technologies in the region.

- **Buses** – as a public transport option, buses are part of the solution, but, because they are mainly diesel powered, also contribute to the air pollution problem; particularly in towns and cities where air quality is poorest. Bus companies typically operate buses for a long time and older buses produce higher emissions than modern equivalents. The majority of bus services are operated by private companies on a commercial basis, however, the WYLES will be used to 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.

- **Trains** – trains, like buses, are part of the public transport solution, however, a considerable number of train routes in the region have not been electrified and therefore diesel engines continue to be used and contribute to the overall air pollution problem, particularly in urban stations, such as Leeds and Bradford. The WYLES supports the move to electrify more train routes in the region and reduce the reliance on diesel engine trains.

- **Commercial Vehicles and Freight** – West Yorkshire has some of the busiest strategic motorway networks in the UK and is a hub for major logistics and distribution companies. Consequently, the number of HGVs on the road network contribute 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, improve their "green" credentials and be socially responsible for the impact they have on the environment. The WYLES will aim to support the commercial sector to reduce emissions from their fleet operations, for example by supporting driver training programmes to reduce fuel costs and assisting companies to understand whole-life costs of vehicles and support alternative, low emission fuels and technologies such as compressed natural gas (CNG), liquefied natural gas (LNG), dual fuel, electric and plug-in electric and hydrogen fuel options.

- **Taxis and Private Hire Vehicles** – Nearly 11,000 thousand taxis and private hire vehicles operate West Yorkshire region and most are diesel cars or vans. 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 WYLES 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.

- **Local Authority Fleet** – local authorities operate over 3,000 cars, vans and heavy goods vehicles, such as refuse disposal and highway maintenance vehicles as part of their fleet operations. Local authority employees also use their own cars, the so-called "grey fleet", for business journeys. The WYLES will seek to increase the number of low emission vehicles and ultra-low emission vehicles in both the local authority fleet and grey fleet. The West Yorkshire Low Emissions Procurement Guide has been developed in support of the WYLES 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 and help inform procurement decisions. Policy incentives, such as salary sacrifice schemes for low emission vehicles, will also be considered to incentivise uptake of privately owned ultra-low emission vehicles.

1.15. Theme 4 – ***Controlling Emissions from non-Transport Sources***, considers the other contributing factors to air quality problems in West Yorkshire. The focus of this Strategy is predominantly around reducing emissions from transport, but there are also other sources which contribute to air pollution. Some emerging initiatives intended to reduce CO_2 emissions, including Combined Heat & Power and District Heating schemes and the trend for biomass or wood burning, may have unintended consequences in terms of making air quality worse. The WYLES will raise awareness of these potential conflicts and promote sustainable energy and heat production which do not have an adverse impact on air quality.

2. WYLES Vision, Aims and Objectives 2016 – 2021

2.1 Vision

A vibrant West Yorkshire economy, where people use transport and power and heat their homes and businesses in a way which improves air quality to create a safer and healthier environment for people to live, work and invest.

2.2 Aims

In working towards achieving the above vision the West Yorkshire local authorities and West Yorkshire Combined Authority will use this Strategy to achieve the following aims:

Aim 1	Air quality in West Yorkshire will meet the air quality limit values as set out in EC Directive 2008/50/EC by 2020.
Aim 2	Contribute significantly to a reduction in emissions across the region and at locations where concentrations are known to be especially high.
Aim 3	To avoid activity which has an adverse impact on air quality and to prioritise activity which delivers co-benefits of cutting carbon emissions and reducing environmental noise.

2.3 Objectives

The West Yorkshire local authorities (WYLA) and West Yorkshire Combined Authority (WYCA) will work together to achieve the above aims and will commit to the following strategic objectives:

Objectives - Theme 1: Evidence for Change		**By When**	**By Who**
T1A	We will use the best available evidence, or develop new evidence where any gaps exist, to support policy making, funding decisions, and action planning to reduce transport and other emissions in the region in order to deliver the WYLES aims.		
T1B	We will carry out relevant assessments to ensure actions to deliver the WYLES aims do not result in any unintended adverse economic, social or environmental impact.		

T1C	We will build on the work undertaken as part of the Low Emission Zone Feasibility Studies to improve transport and air quality modelling capability for the region.		
T1D	We will review local air quality management arrangements across the region to ensure they provide an effective means of supporting decision-making and action planning.		
T1E	We will establish a clear performance monitoring framework in order to review progress towards achieving the aims of the WYLES.		

Objectives - Theme 2: Creating a Low Emission Future		**By When**	**By Who**
T2A	We will raise awareness of the WYLES with key stakeholders in order to influence other key strategies, polices and plans that have an impact on air quality.		
T2B	We will work together to identify funding opportunities and set out an annual spending plan to deliver the aims and objectives of the WYLES.		
T2C	Working with health professional and academics, we will raise awareness of air quality and the other environmental and health impacts from emissions from transport and other sources to influence perceptions and encourage behaviour change to increase active travel and low emission travel.		
T2D	We will use the West Yorkshire Air Quality and Planning Technical Guide to help deliver sustainable developments in the West Yorkshire area.		
T2E	We will lead by example by promoting the uptake of ultra-low emission vehicles within local authority fleets and by local authority employees.		
T2F	We will use existing networks with key employers in the region to promote low emission vehicle alternatives in public and private fleet operations and vehicles used by employees.		

T2G	When commissioning and procuring goods and services we will promote the use of low emissions criteria when awarding contracts under the principles of social value and sustainable procurement.		
T2H	We will review the need to implement one or more Low Emission Zones within urban areas of the region.		

Objectives - Theme 3: Reducing Transport Emissions		**By When**	**By Who**
T3A	We will carry out research to better understand potential barriers to the uptake of ultra-low emission vehicles by individuals and develop a package of measures that would overcome these.		
T3B	We will work together implement the package of measures identified in objective T3A and seek funding opportunities and partnership arrangements to achieve this wherever possible.		
T3C	We will work with West Yorkshire bus operators to accelerate the investment in newer buses and/or emissions abatement technology to reduce bus emissions in line with option 2 or 3 as outlined in this Strategy.		
T3D	We will work with Rail North to promote electrification of key railway routes within the West Yorkshire region and engage with train operating companies to replace older diesel trains operating within urban areas of the region.		
T3E	We will work 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.		
T3F	We will work with the freight and logistics sector to review how more goods may be transported by alternatives to road transport, including rail and water transport for long-haul journeys and urban “last-mile” deliveries.		
T3G	We will work 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.		

T3H	We will use the West Yorkshire Low Emissions Procurement Guide to review our fleets and 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.		

Objectives - Theme 4: Controlling Non-transport Emissions		**By When**	**By Who**
T4A	We will raise awareness with key stakeholders of potential air quality impacts from the introduction of urban combined heat and power (CHP) plants, and biomass and wood-burning to ensure that these do not adversely compromise local air quality.		
T4B	We will work with industry and regulators to reduce emissions from industrial processes in the region and ensure emissions do not result in any exceedance of air quality limit values.		

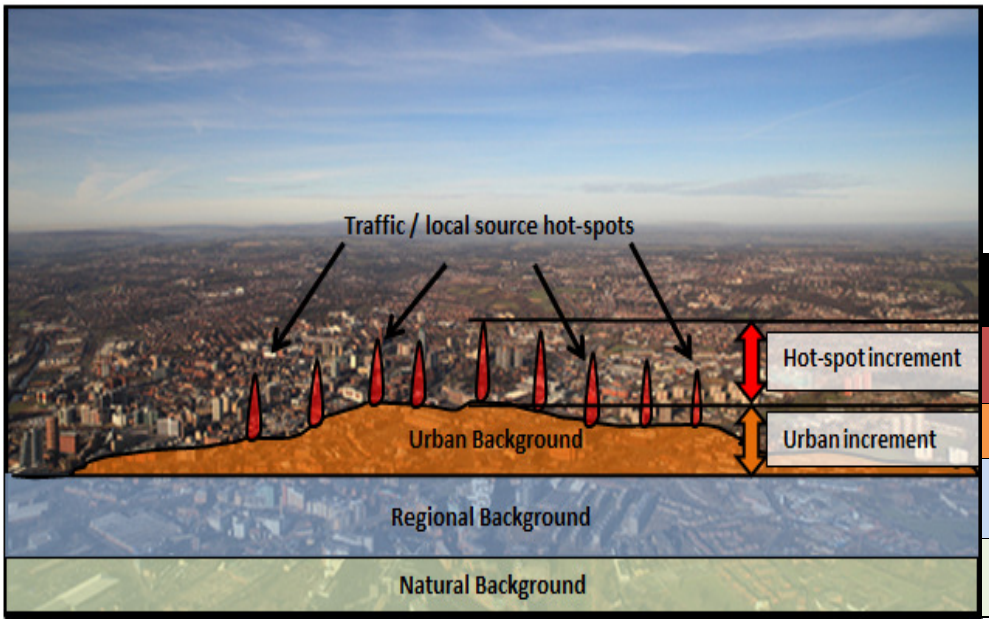
3. Introduction

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 could be seen coming from chimneys in the region, however, we cannot yet say that the air which people breath in some part of West Yorkshire 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 overall air pollution levels which have a negative impact on health.

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



3.4. In busy town and city centres 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 urban background levels will be below threshold levels which impact on health and only the population near to busy roads or other localised hot-spot will be exposed to harmful levels of pollution.

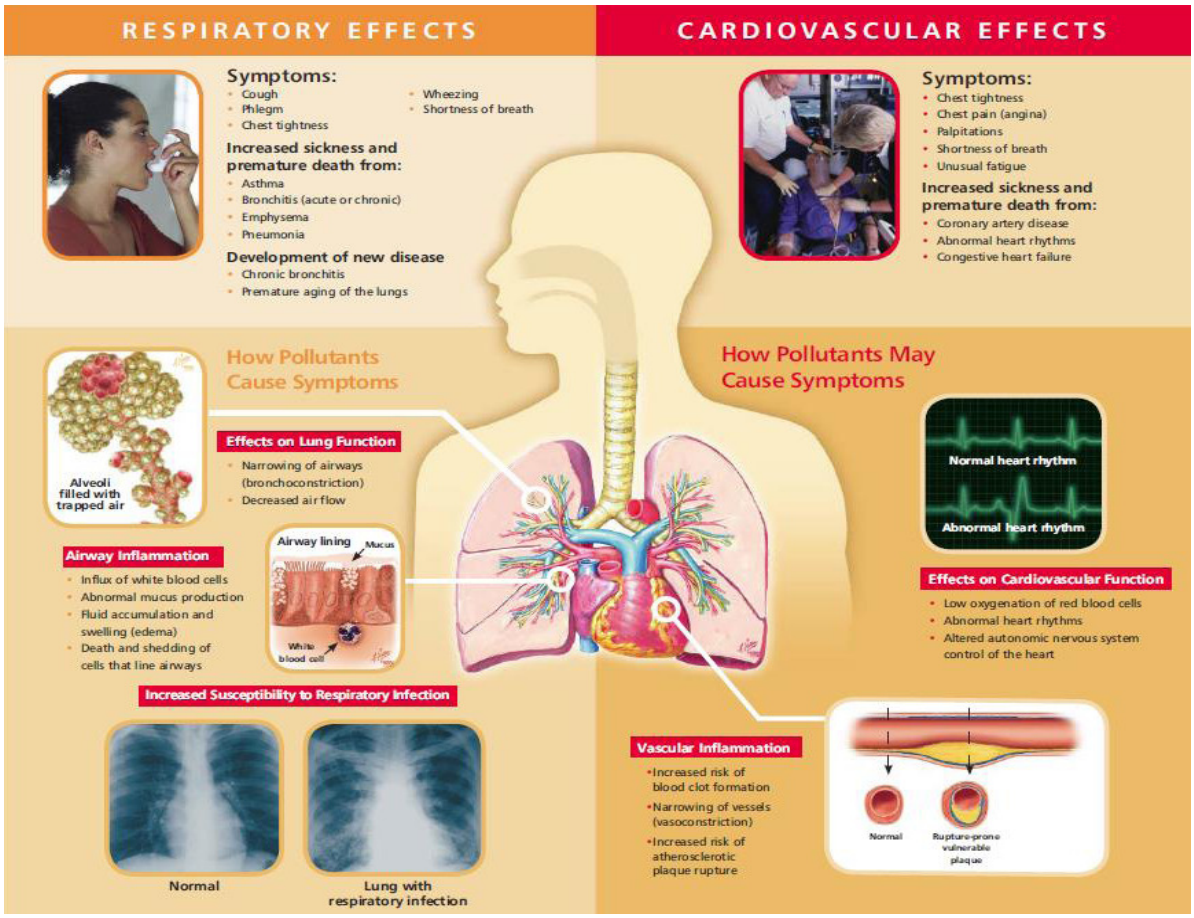
3.5. We know that exhaust emissions from traffic, and particularly from diesel vehicles, contributes most to urban background and localised air pollution and, therefore, the focus for the West Yorkshire Low Emission Strategy (WYLES) is on reducing transport-related exhaust emissions over the next five years and beyond. However, the WYLES 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 West Yorkshire has a role to play in improving air quality, including individuals, businesses, public sector organisations and local and national Government. However, the local Councils in West Yorkshire, together with the West Yorkshire Combined Authority (WYCA), 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 WYLES is to provide the strategic commitment from the West Yorkshire Council's and WYCA to implement a range of actions, both at a policy level and practical level, to improve air quality for the people of West Yorkshire.

4. Theme 1 – Evidence for Change: 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[1] (lung and bladder in particular), low birth weight babies[2] and subsequent neurodevelopment problems in children[3]. In 2013, the World Health Organisation (WHO) classified diesel exhaust emissions as carcinogenic to humans[4]. The main health effects associated with the inhalation of vehicle emissions are shown in Figure 2 below:

Figure 2: Main health effects of vehicle pollutants



[1] http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf
[2] http://www.thelancet.com/journals/lanres/article/PIIS2213-2600(13)70192-9/abstract
[3] http://www.ncbi.nlm.nih.gov/pubmed/25229653
[4] http://terrance.who.int/mediacentre/audio/press_briefings/

4.2. The two main pollutants of concern in urban areas are nitrogen dioxide (NO_2) and particulate matter (PM_n). Studies have shown an association between nitrogen dioxide in outdoor air with adverse health effects, including reduced life expectance, however, it has not been clear if these effects were caused by NO_2 itself or other pollutants (such as particulate matter) emitted from the same source: for example traffic will produce both NO_2 and PM_n emissions. In a statement[5] recently published by the Government Committee on the Medical Effects of Air Pollutants (COMEAP), the evidence that NO_2 itself is responsible for adverse health effects such as asthma, respiratory conditions and increased cardiovascular risk has strengthened substantially.

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

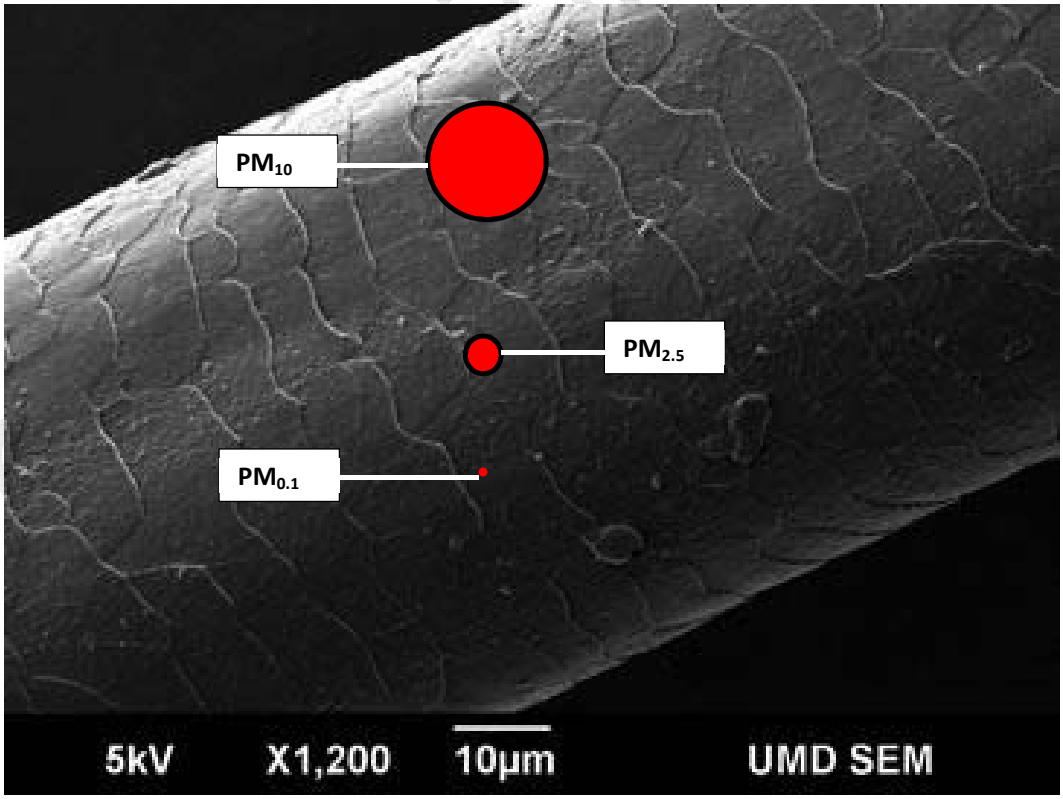
PM_{10} – particles smaller than 10 microns (0.01mm)

$PM_{2.5}$ – particles smaller than 2.5 microns (0.0025mm)

$PM_{0.1}$ – particles smaller than 0.1 microns (0.0001mm)

Figure 3 below illustrates the size of this particulate matter relative to a human hair.

Figure 3: Particle size relative to human hair.



[5] Statement on the Evidence for the Effects of Nitrogen Dioxide on Health, COMEAP (March 2015)

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, COMEAP reports[6] 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 (PHE) have developed a methodology[7] for assessing the equivalent number of deaths and life years lost that can be attributed to long term exposure to particulate air pollution arising from human activity. Using this methodology, PHE calculate that particulate air pollution in West Yorkshire has a health impact equivalent to approximately one in twenty of all deaths: equating to around one thousand deaths and 11,000 life years lost each year. These figures do not represent the actual number of individuals whose life has been shortened as a direct consequence of exposure to air pollution, rather the combined impact which air pollution has on the wider population: i.e. exposure to air pollution contributes a small amount to the deaths of a larger number of people.

4.6. The Department for Health and Public Health England use the Public Health Outcomes Framework[8] (PHOF) to determine the relative health of the population and includes an indicator for the number of deaths attributable to long term exposure to fine particulate ($PM_{2.5}$) air pollution based on the PHE methodology. Table 1 below shows the most recent figures from the PHOF indicator for West Yorkshire and the equivalent life years lost.

Table1: Estimated fraction of mortality attributable to particulate air pollution (2012 data).

	Percentage mortality attributable to $PM_{2.5}$	Number of registered deaths (over 30*)	Equivalent number of deaths attributable to exposure to air pollution ($PM_{2.5}$)
West Yorkshire	**4.9%**	**18,378**	**901**
Bradford	4.7%	4,028	189
Calderdale	4.4%	1,797	80
Kirklees	4.7%	3,437	162
Leeds	5.0%	6,108	306
Wakefield	5.4%	3,008	163
*The PHOF indicator excludes deaths from lower age groups as long-term exposure to air pollution is unlikely to have been a contributory factor.			

[6] Statement on the Evidence for Differential Health Effects of particulate Matter According to Source or Components, COMEAP (March 2015)

[7] Estimating Local Mortality Burdens Associated with Particulate Air Pollution, Public Health England, 2014

[8] Public Health Outcomes Framework: Indicator 3.01 – Fraction of all-cause adult mortality attributable to anthropogenic particulate air pollution (measured as fine particulate matter, $PM_{2.5}$) (Public Health England).

4.7. The indicator shows that some local authority areas have slightly higher mortality rates due to air pollution than others, which is indicative of the differences in pollution sources and proximity to where people live: for example the Wakefield district has a greater proportion of heavy vehicles (which emit more particulates) on the strategic motorway network than other areas.

4.8. In 2010 COMEAP[9] produced a detailed report on the mortality effects on the long-term exposure to air pollution which produced some significant headlines, including that, in 2008, particulate matter had an effect on mortality in the UK equivalent to 29,000 deaths, with an associated total loss of life of 340,000 life-years.

4.9. The Department for the Environment and Rural Affairs (DEFRA), the Government department with responsibility for air quality, also report[10] that air pollution reduces life expectancy of every person in the UK by an average of six months, with an estimated annual cost to society of up to £16 billion per year.

4.10. 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 that the number hospital admissions for asthma, coronary obstructive pulmonary disease (COPD), and heart conditions (in this instance myocardial infarctions), in West Yorkshire are considerably higher than those for England as a whole. If the incidence rates for England were to apply in West Yorkshire there would be 678 fewer asthma admissions, 1,245 fewer for COPD and 463 fewer heart attacks. 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 region.

Table 2: West Yorkshire hospital admissions for Asthma, COPD and MI 2012/13

Cause of Admission to Hospital 2012/13	Admissions per 1000 population		Additional admissions in West Yorkshire compared to England
	West Yorkshire	England	
Asthma	1.39	1.09	678
COPD	2.63	2.07	1,245
Myocardial Infarction	1.39	1.18	463

[9] The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom, COMEAP (2010)

[10] Protecting and Enhancing our Urban and Natural Environment to Improve Public Health and Wellbeing, DEFRA, (accessed May 2015).

4.11. 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[11],which increases the risk of vascular dementia, low birth-weight babies[12] and cognitive development in schoolchildren[13].

[11] Short term exposure to air pollution and stroke: systematic review and meta-analysis, BMJ March 2015; 350:h1295

[12] Maternal Exposure to Particulate Air Pollution and Term Birth Weight: A Multi-Country Evaluation of Effect and Heterogeneity, Environmental Health Perspectives, (March 2013)

[13] Association between Traffic-Related Air Pollution in Schools and Cognitive Development in Primary School Children: A Prospective Cohort Study, PLOS Medicine (March 2015)

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

5.1. Although improving public health is the main driver for the WYLES, there is also a legal imperative to improve air quality. Air Quality Directive 2008/50/EC[14] 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[15,16].

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, local authorities are required to carry out a Local Air Quality Management (LAQM) function to review and assess air quality within local authority administrative boundaries. The LAQM function requires local authorities 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 and Air Quality Action Plans (AQAP). The Air Quality Objectives which local authorities are required to work towards are very similar as the Limit Values which the UK Government is required to achieve. Appendix 1 shows a table of the National Air Quality Objectives Levels and EU Limit Values for all pollutants. Table 3 shows the levels for the two most relevant pollutants: nitrogen dioxide and particulate matter.

Table 3: Summary of Air Quality Objectives, Limit Values and Targets

Pollutant	National Air Quality Objectives	Date to be achieved / retained	EU Limit Value	Date to be achieved / retained
NO2 (annual mean)	40µgm^{-3}	31/12/2005	40µgm^{-3}	1/1/2010
PM_{10} (annual mean)	40µgm^{-3}	31/12/2004	40µgm^{-3}	1/1/2005
$PM_{2.5}$ (annual mean)	N/A	**Stage 1:**	25µgm^{-3}	1/1/2015
		Stage 2:	20µgm^{-3}	1/1/2020

5.3. It is important to note that the above limit values and objective levels do not mean that levels below these values do not affect human health. For example, the World Health Organisation (WHO) clearly state[17] that there is no "safe" level of air pollution and therefore policy makers determine air quality limit values on the basis of the acceptability of risk, which may differ

[14] DIRECTIVE 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, 21 May 2008
[15] Air Quality Standards Regulations 2010
[16] Air Quality (England) Regulations 2000
[17] Air Quality Guidelines – Global Update 2005 (World Health Organisation)

between different societies. The National Objective Levels and European Limit Values for particulate matter in Table 3 are above those recommended by the World Health Organisation; who suggest guideline values of 20µgm^{-3} and 10µgm^{-3} for PM_{10} and $PM_{2.5}$ respectively. Even still, a review[18] of the evidence on which the air quality guidelines were based have shown that exposure to levels of particulate air pollution below 10µgm^{-3} can have shown adverse health effects and demonstrate that there is no safe threshold of exposure.

5.4. The National Objective Levels and EU Limit Values are therefore set in a policy and legal context, rather than a pure health-based context, in order to achieve a staged reduction in the level of particulate air pollution. Member States are required to achieve a reduction in $PM_{2.5}$ exposure relevant to a 2010 baseline Average Exposure Indicator (AEI). The 2010 AEI baseline was calculated to be 13µgm^{-3}, and the UK is required to achieve a 15% reduction by 2015, with a further reduction by 2020. These targets, even though they are above the WHO Guideline values, are considered to be challenging and policy makers will be required to make difficult decisions in order to achieve these targets within the above timeframe.

5.5. The latest DEFRA reports[19,20] indicate that the West Yorkshire Urban Area (one of 43 zones in the UK used for EU reporting on air quality) is meeting the targets for PM_{10} and $PM_{2.5}$, although recognises that reducing particulate exposure continues to be a challenge. However, the annual mean limit value for nitrogen dioxide continues to exceed the EU Limit Values. The latest DEFRA predictions indicate that parts of the region have a maximum annual mean level of 73µgm^{-3} in 2015, falling to 53 µgm^{-3} by 2020. Only the Greater London zone is predicted to have higher concentrations of nitrogen dioxide in the UK and the West Yorkshire zone is only one of three of the 43 zones in the UK where the Limit Value of 40µgm^{-3} is not anticipated to be met until after 2030 (more than 20 years after the original date for compliance).

5.6. 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[21], the Supreme Court ruled that the UK Government should submit new Air Quality Plans to the European Commission by the 31st 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

[18] REVIHAAP Project: Technical Report, World Health Organisation (2013)
[19] Updated projections for Nitrogen Dioxide (NO2) compliance, DEFRA, July 2014
[20] Air Pollution in the UK, DEFRA, September 2014
[21] 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

beyond 2020, would result in further legal action and possible infraction fines against the UK Government.

5.7. Meeting air quality obligations is not the role for Government alone. 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.

5.8. DEFRA has written 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***". Given that the West Yorkshire zone is not predicted to achieve compliance with the limit value for nitrogen dioxide until after 2030, there is an urgent need to ensure that responsible local authorities are doing all that they 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 local authorities.

5.9. 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 Government guidance[22] includes a French fishing case in which a fine of €20m lump sum and a further fine of €58m every six months was imposed until compliance was achieved.

[22] Policy Statement for Part 2 of the Localism Act 2011, Department for Communities and Local Government (2012)

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

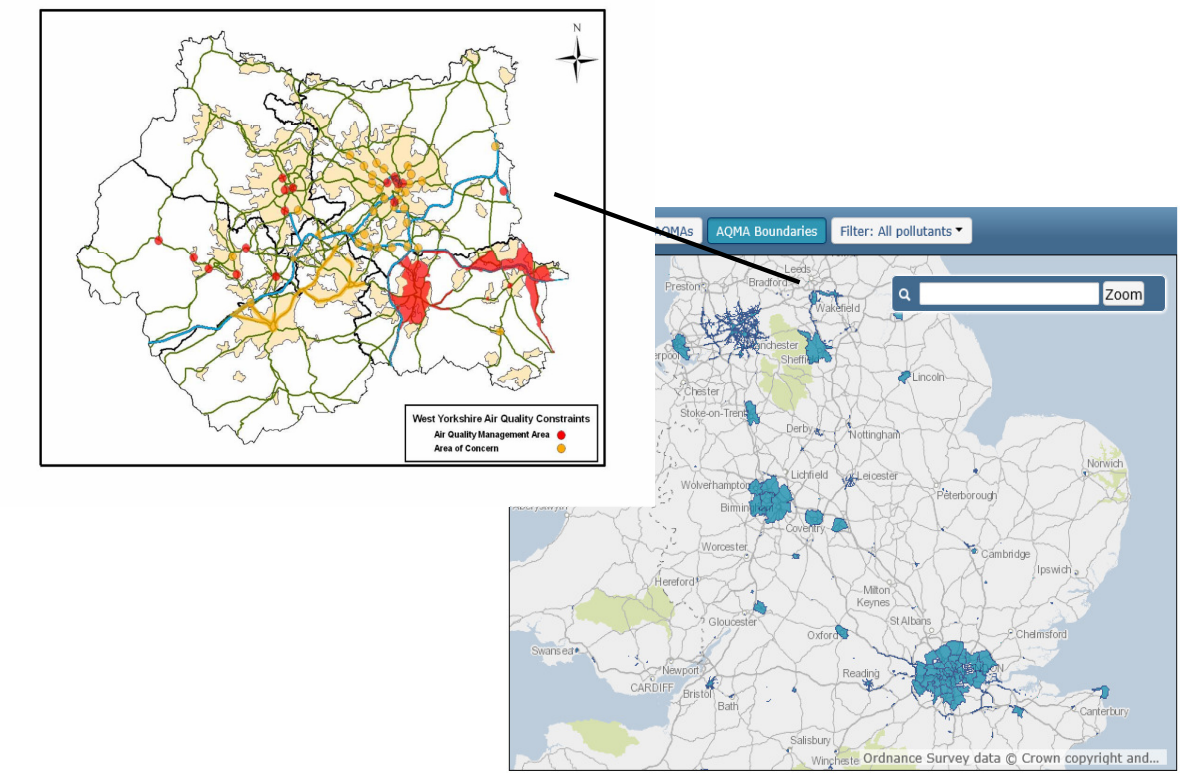
6.1. There is no single defining map which clearly shows air quality in the West Yorkshire region, however a number of sources can be used to better understand where air quality is of greatest concern.

Local Air Quality Management Information

6.2. As outlined above, local authorities have responsibility to review and assess air quality in their areas. A combination of measuring the concentration of pollutants at locations which are of concern and computer modelling software using data, for example traffic data, is used to determine air pollution levels. Whereas the reports and modelled data provided by DEFRA at a national level are at a relatively large scale (1km^2), local air quality monitoring and modelling can provide information at a local level and identify "hot-spot" locations.

6.3. When local authorities identify locations where air pollution levels exceed the National Air Quality Objectives (Appendix 1 and Table 3 above) they must declare an Air Quality Management Area (AQMA). Twenty-nine AQMAs have been declared in the West Yorkshire area declared, 28 because of NO_2 concentrations and one because of particulate (PM_{10}) concentrations. Figure 4 below is an extract from DEFRAs interactive map of AQMAs declared in England, together with a map of the AQMAs and areas of concern within West Yorkshire.

Figure 4: Air Quality Management Areas Declared by Local Authorities



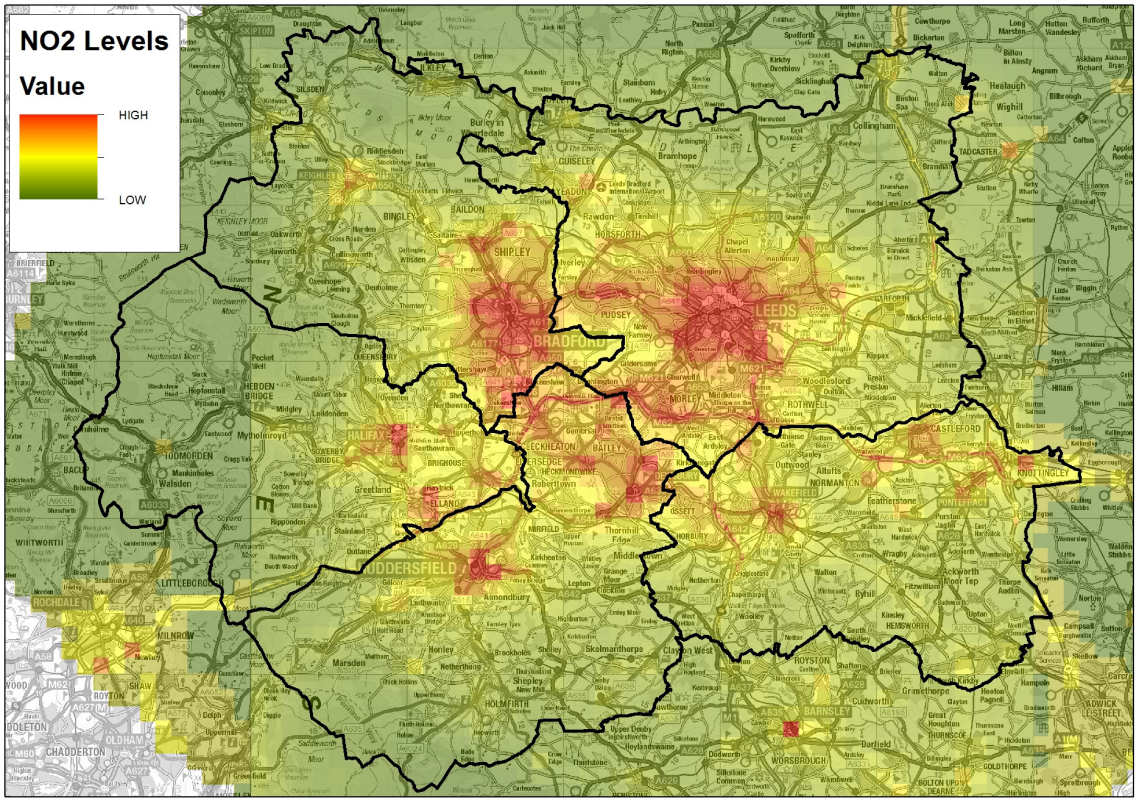
6.4. The way in which individual local authorities declare AQMAs does differ, for example some authorities declare only the specific area where exposure exceeds Air Quality Objectives, whereas others, such as some AQMAs declared by Wakefield Council, cover not only the area of exposure, but also the surrounding area and road network which contributes to the Air Quality Objective being exceeded at a location. This difference in approach, when considered in a regional context, can give a skewed impression of where air quality problems are most significant and do not necessarily assist decision-making at a West Yorkshire level. Further work is proposed to provide a consistent approach across the region in order to aid decision-making.

6.5. What the local air quality monitoring and modelling work does show is that there are a number of localised hot-spots within urban areas and along the arterial road network and at road junctions where air pollution is of greatest concern.

Low Emission Zone Studies

6.6. In 2014 Leeds and Bradford Council's carried out Low Emission Zone feasibility studies (see Section 7), which included modelling emissions from transport and other sources. This has subsequently been extended to provide information across the West Yorkshire region. Figure 5 shows a map of modelled concentrations of NO_2 across the region.

Figure 5: Modelled Nitrogen Dioxide Concentrations in West Yorkshire (2015)



6.7. The above maps show that for most of the geographical area of West Yorkshire air quality is relatively good, however, it is also clear that air quality is a problem in some towns and cities and, with the exception of a small number of industrial operations, is largely due to emissions from traffic within urban areas along major roads.

7. Theme 1 – Evidence for Change: *Low Emission Zone Studies*

7.1. Low Emission Zones (LEZ) are a method of traffic management which restrict access to a controlled Zone, so that only the cleaner vehicles can enter the Zone, or more polluting vehicles are subject to a financial penalty. Traffic management in and around towns and city centres is not unusual and there are many examples of bus lanes, bus gates, pedestrianised zones and access restrictions being placed on public highways using Traffic Regulation Orders (TRO). Low Emissions Zones are common across Europe[23] and can be found in cities such as London[24], Oxford[25] and Norwich. London is also currently consulting on plans to introduce an Ultra-Low Emission Zone[26] to limit access to the centre of London to only the cleanest of vehicles from 2018 onwards.

7.2. LEZ's can apply to different types of vehicles and emission standards, but deciding which restrictions should apply in order to deliver the greatest air quality benefits is done through modelling of various scenarios. DEFRA[27] has developed a Cost v Benefit assessment tool: Marginal Abatement Cost Curve (MACC) to test out relative scenarios that could be implemented through a LEZ approach in order to accelerate compliance with meeting the NO_2 limit values. DEFRA have tested many different scenarios, but found that targeting a LEZ at the most polluting heavy duty vehicles (lorries and buses), would deliver the most significant reduction in NO_2 emissions relative to the cost to implement the scheme. The DEFRA study recognised that testing various options that would deliver air quality benefits would be only the first step and further feasibility work would be required at a local level to determine whether a scheme would be practical and acceptable to implement.

7.3. In 2014, LEZ feasibility studies were carried out by Bradford and Leeds Councils, involving joint working with public health professionals. The Studies involved the collection detailed traffic data for the Leeds and Bradford areas with subsequent modelling of various scenarios to determine the impact on vehicle emissions and air quality. All the scenarios which were tested can be found in Appendix 2, however, four scenarios were identified that would lead to the most cost effective air quality improvements, these are:

- Reducing emissions from buses in urban areas.
- Reducing emissions from Heavy and Light Goods Vehicles.
- Reducing emissions from diesel cars (including taxis / private hire) in urban areas.
- Reducing all vehicle journeys in urban areas by 10%.

7.4. The air quality improvements associated with each scenario was subsequently used to inform a Health Impact Assessment (HIA). The HIA was able to quantify the specific health benefits that each scenario could bring as a result of lowering

[23] www.lowemissionzones.eu
[24] https://www.tfl.gov.uk/modes/driving/low-emission-zone
[25] http://www.oxford.gov.uk/PageRender/decEH/OxfordLowEmissionZone.htm
[26] https://consultations.tfl.gov.uk/environment/ultra-low-emission-zone
[27] Air Quality Plans for the achievement of EU air quality limit values for nitrogen dioxide (NO2) in the UK, draft Overview Document, Defra, June 2011

$PM_{2.5}$ and NO_2 emissions for future years compared with the 2012 baseline. The HIA findings for each scenario can be seen in Table 4 below. It should be noted that not all health benefits associated with air quality improvements are included in current HIA methodologies, for example increased uptake of active travel and health impacts with weaker associations to air quality, are not taken into account, and therefore these results are likely to under-estimate the actual health benefits.

Table 4: Estimated Health Benefits from Low Emission Zone Scenarios[28]

	LEZ Modelled Scenario			
	All pre-euro 4 HGVs and buses upgraded to euro6 by 2016	All pre-euro 5 buses upgraded to euro 6 by 2021	Reduction in number of diesel cars from 50% to 20% (as in the year 2000)	10% reduction in number of car journeys by 2021
	Approximate health benefit across Leeds and Bradford population			
Deaths ($PM_{2.5}$)	-15	-18	-18	-19
Cardiopulmonary deaths ($PM_{2.5}$)	-8	-11	-10	-10
Coronary events ($PM_{2.5}$) (Bradford only)	-24	-45	-45	-45
Low birth weight babies <2500g ($PM_{2.5}$)	-12	-14	-14	-15
Pre-term births ($PM_{2.5}$)	-3	-4	-4	-4
Low birth weight babies <2500g (NO_2)	-19	-38	-45	-37
Childhood asthma development <18yrs (NO_2)*	-254	-506	-596	-494
Annual years of life gained for newborns (all births combined)	+267	+322	+321	+346
* Childhood asthma development is a 'one-off' health impact and is not additive on an annual basis				

7.5. The above scenarios show direct health benefits to individuals, but, preventing Ill-health also provides an economic benefit by saving on healthcare costs to the NHS and Social Services. The University of York, Centre for Health Economics (funded by the Collaboration for Leadership in Applied Health Research and Care - Yorkshire and Humber) used health economics methodology to quantify the economic benefit the above scenarios could potentially bring. The methodology uses an approach commonly used by the NHS to determine the relative cost effectiveness of different health interventions. The technique uses the concept of

[28] Cooper D et al, West Yorks LEZ Feasibility Study, HIA Methodology & Preliminary Findings, April 2014

Quality Adjusted Life Years (QALY) and assigns a notional cost (or saving) per QALY of £20,000 to £30,000. Table 5 shows the key findings of the potential health economic benefits from the various Low Emission Zone scenarios.

Table 5: Health Economic Benefits from Low Emission Zone Scenarios[29]

	LEZ Modelled Scenario			
	All pre-euro 4 HGVs and buses upgraded to euro6 by 2016	All pre-euro 5 buses upgraded to euro 6 by 2021	Reduction in number of diesel cars from 50% to 20% (as in the year 2000)	10% reduction in number of car journeys by 2021
	Approximate health benefit across Leeds and Bradford population			
Deaths ($PM_{2.5}$)	-15	-18	-18	-19
Cardiopulmonary deaths ($PM_{2.5}$)	-8	-11	-10	-10
Coronary events ($PM_{2.5}$) (Bradford only)	-24	-45	-45	-45
Low birth weight babies <2500g ($PM_{2.5}$)	-12	-14	-14	-15
Pre-term births ($PM_{2.5}$)	-3	-4	-4	-4
Low birth weight babies <2500g (NO_2)	-19	-38	-45	-37
Childhood asthma development <18yrs (NO_2)*	-254	-506	-596	-494
Annual years of life gained for newborns (all births combined)	+267	+322	+321	+346
Annual Health Cost Saving	**£3,880,242**	**£5,514,536**	**£5,530,811**	**£5,682,536**
One-off health Cost Saving – Cases of Childhood Asthma*	**£4,322,064**	**£8,610,096**	**£10,141,536**	**£8,405,904**
* Childhood asthma development is a 'one-off' health impact and is not additive on an annual basis				

7.6. This data shows the potential economic benefits to health and social care provision by taking action to improve air quality. It should be noted that the figures only represent data provided as part of the Leeds and Bradford Low Emission Feasibility Studies and therefore the savings would be much higher if implemented across West Yorkshire.

[29] Costs and Benefits Associated with Emissions: Case Study exploring the Health Impacts of West Yorkshire Low Emission Zone. Loma et al, University of York, Centre for Health Economics (2014)

7.7. Studies in California, where there have been aggressive emission reduction policies on place for the last 20 years support these findings[30]. Where they have reduced air pollution they have seen improvements in health and lung function and lung growth in children.

7.8. Tables 4 and 5 above show that different scenarios can be tested to better understand the relative impact that each has in order to help inform decision-making. However, implementation of any particular scenario has to be seen in a wider context of the economic, social and environmental considerations as well as the deliverability of any preferred option.

7.9. The evidence from the LEZ studies suggests that implementing a LEZ traffic management scheme would appear to be an effective mechanism for targeting the most polluting vehicles and improving air quality in urban areas. However, before deciding whether the implement a LEZ and if so, what type of vehicles should it apply to, what emission standard should apply and when should it be implemented (to allow sufficient lead-in time). In addition, concerns regarding potential economic impacts, practical implementation considerations, and possible unforeseen consequences, such as increased fares on buses and potential displacement of more polluting vehicles would all need to be considered before implementing a LEZ.

7.10. Both Leeds and Bradford Councils have considered the findings of the Low Emission Feasibility study and have concluded that further detailed work is required to understand the impacts, benefits and practical issues around the implementation of Low Emission Zones. Before any final decision is made on using the LEZ approach air quality improvements are to be pursued through a Low Emission Strategy approach and increased partnership working with key stakeholders. This WYLES takes forward the recommendations from Leeds and Bradford LEZ feasibility studies at a regional level.

[30] http://www.nejm.org/doi/full/10.1056/NEJMoa1414123

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

8.1. The WYLES should be used to help inform and influence other relevant strategies and policies, both at a regional and local level. Figure 7 illustrates how the WYLES 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 WYLES is to support sustainable economic growth by providing the regional context for what is needed to improve air quality moving forward. Decision-makers at all levels should use the WYLES to influence their own strategies, polices and plans, and West Yorkshire Combined Authority's Strategic Economic Plan and Single Transport Plan, provides a real opportunity to translate the objectives of the WYLES into positive action.

8.3. Local authorities are 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 should be used to inform local authorities when making local plans and taking planning decisions.

8.4. The WYLES 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 WYLES should therefore be used to help inform health professionals working across the region 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

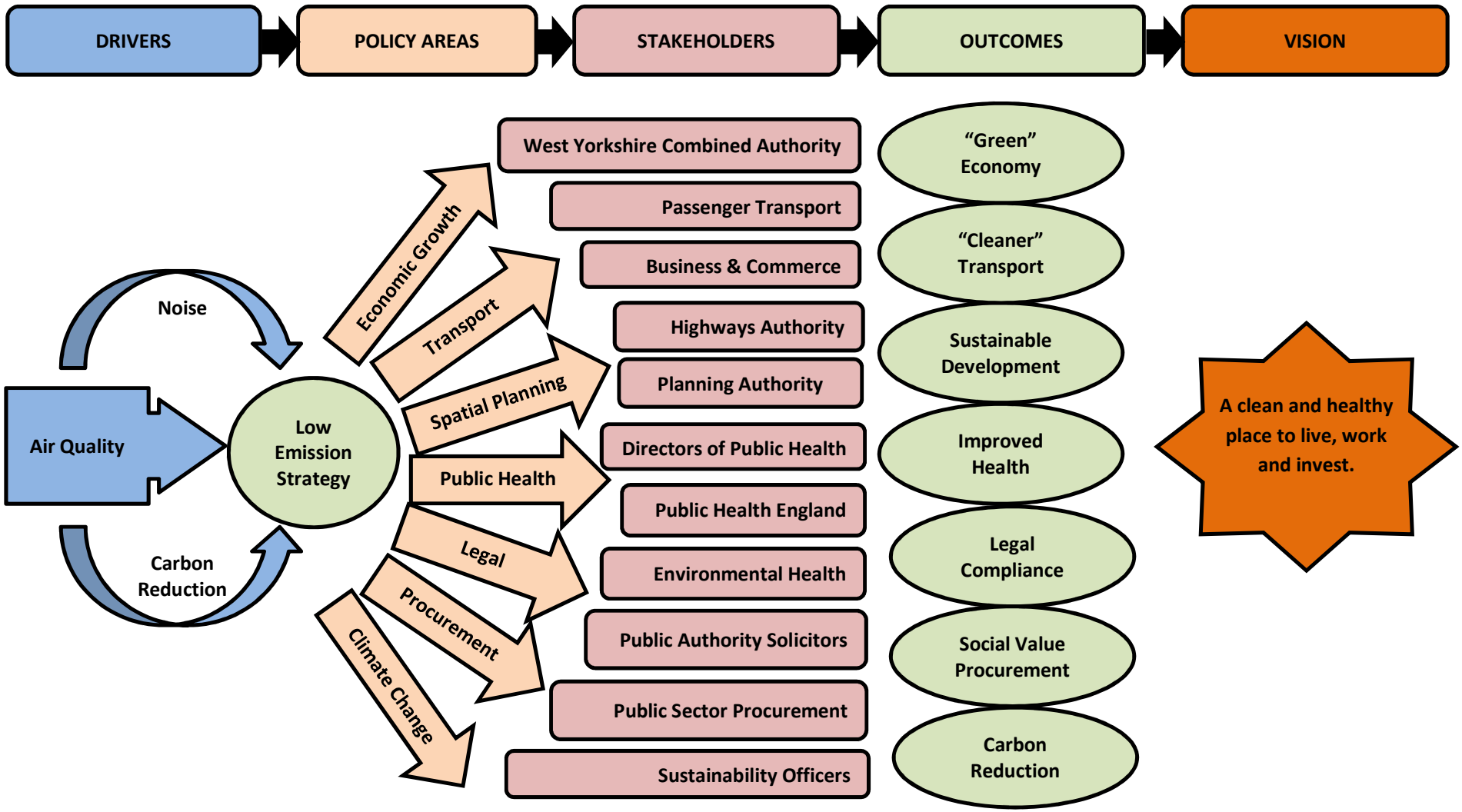
there is a potential for policy conflict, the option which has the greatest benefit, or least impact, on public health should be chosen.

8.6. In the way that the WYLES 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[31]. DEFRA have produced maps[32] of the roads which cause the highest noise exposure levels: unsurprisingly there is a strong correlation between these roads and the traffic on roads which produce emissions which also impact on air quality. Highways Authorities are required to take action in areas where people are exposed to high noise levels from road traffic and although not all actions to improve air quality will necessarily result in improvements in noise it is very unlikely that there would be any negative impact and more likely that there would be positive beneficial impact of reducing noise.

[31] Public Health Outcomes Framework – Indicator 1.14: Noise Complaints and Exposure to Noise, Public Health England

[32] Noise Maps for England, DEFRA: http://services.defra.gov.uk/wps/portal/noise/

Figure 6: West Yorkshire Low Emission Strategy and links to other key Policy Areas



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

Planning Policy

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)[33] recognises the importance of air quality and sustainable transport when deciding where new development is needed and when determining individual planning applications.

9.2. 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)[34] 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. West Yorkshire local authorities are at various stages in their production of their Local Plans, with some authorities having already adopted their Plans and others in the development and consultation phases. Planning authorities are guided by NPPF in the preparation of their Local Plans and this Strategy can help shape their development and implementation to ensure developments are sustainable moving forward.

Development Management

9.5. 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:

[33] https://www.gov.uk/government/publications/national-planning-policy-framework--2
[34] http://planningguidance.planningportal.gov.uk/

- 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 how the development can be made acceptable (for example through mitigation) or whether permission should be refused.

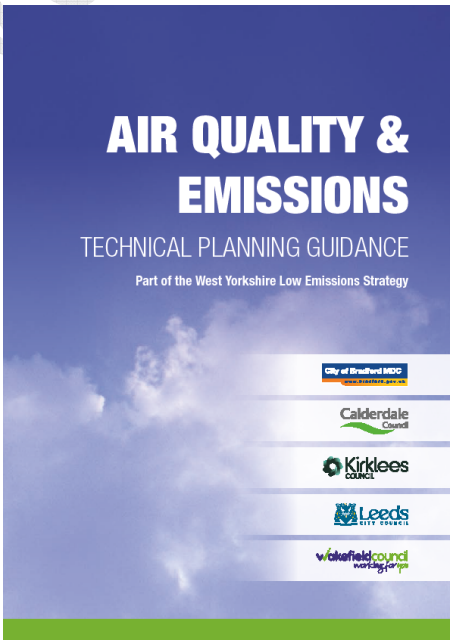
9.6. Examples of mitigation are suggested in the Guidance, including:

- 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.

9.7. Given that the West Yorkshire region is failing to meet the EU obligations on air quality it is clear that planning authorities have 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.

9.8. One key strand of the WYLES 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.



9.9. 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 is 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

9.10. 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 designers to

consider appropriate mitigation at the design stage so that mitigation becomes an integral part of the development and not an after-thought.

9.11. 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.

9.12. The Technical Guide uses evidence from HM Treasury to quantify the damage cost attributable to air quality impact from increases in air pollution (NO_2 and $PM_{2.5}$) 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. Figure 7 below provides an example of the methodology used.

Figure 7: Air Quality Mitigation - Example

Proposal: 150 house residential development in an urban location and within an Air Quality Management Area.

Development Classification: "Major"

Increase in Traffic = 288 vehicle trips (6%)

Increase in NOx = 0.27 tonnes per year
Increase in PM_{10} = 0.032 tonnes per year

Equivalent Health Damage Cost (5 years) = £12,941

Mitigation to offset impact:

- ***EV Charging Points in each property.***
- ***S106 Contribution to cycle infrastructure.***
- ***S106 Contribution to City Car Club.***
- ***Travel Plan for Site.***
- ***Public Transport infrastructure / services***

9.13. Using the Guide, only developments categorises as "major" or where air quality is already known to be poor would require 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 6 below) and the control of particulate (dust) emissions during demolition and construction.

Table 6 – EV Charge Point Provision for New Developments

Development Type	Electric Vehicle Charging
Residential	One EV charge point per unit (dwelling with dedicated parking) or 1 EV charge point per 10 spaces (unallocated parking)
Commercial / Retail	EV charging for 10% of car parking spaces.

9.14. The West Yorkshire Planning Authorities, supported by specialist advice from air quality officers, travel planning officer and highway officer, 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 WYLES.

Single Transport Plan

9.15. The Single Transport Plan 2015 to 2035[35] is being developed by West Yorkshire Combined Authority as a long-term plan for the future transport provision in West Yorkshire. Creating cleaner, healthier places to work, visit and live in is at the heart of the Plan, which has five core principles:

- **One system, HS2/HS3 ready**: a core ambition being a 'metro-style' public transport network that integrates all modes, into one-system that is easily understood, easy to access by a range of options and offers quick, convenient connections within the city region. The public transport

[35] Single Transport Plan (Draft), West Yorkshire Combined Authority (January 2015): http://www.westyorks-ca.gov.uk/transport/

network would reduce pressure on roads and facilitate the efficient movement of freight than cannot be transported by rail, canal or pipeline.

- **Place making**: interventions to make our cities, towns and neighbourhoods more attractive places to invest, live and work - ***delivering improvements to air quality and health through Low Emission Vehicles for the movement of people and goods and encouraging people to switch to cycling and walking for shorter journeys*****.**
- **Smart futures**: using technology for enhanced customer relationships and retail opportunities and for efficient management of the transport network(s), as well providing open data as part of a wider city region initiative.
- **Effective use of resources**: pooling resources between services and sectors to address financial constraints and deliver shared objectives - particularly in respect of rural communities with a lower level of public transport provision , and for young people to access education, employment and training**.**
- **Effective asset management**: to adequately maintain all of our transport system: roads, bridges, street lights, public transport stations and shelters, footways and cycle routes, to gain maximum value for money and meet the needs of users and Plan objectives.

A further cross-cutting theme of **Carbon Reduction** is also included within the STP.

9.16. The Single Transport Plan clearly states its ambition to reduce transport emissions and reduce air quality and this Strategy is considered to be a key supporting document that will be used to help deliver this ambition.

10. Theme 2 – Creating a Low Emission Future: *Travel Choice and Active Travel*

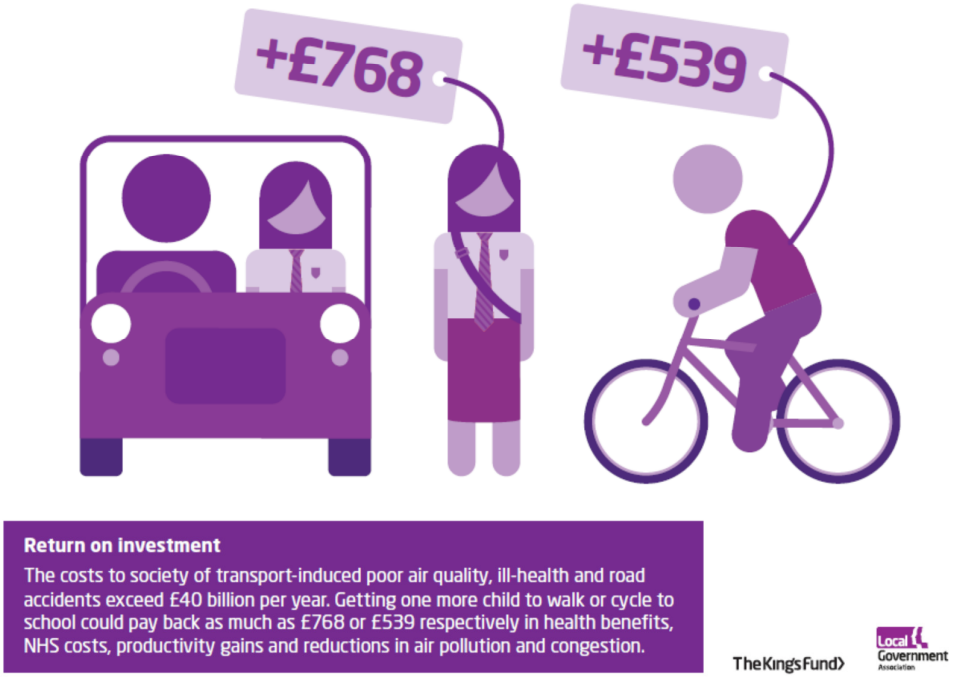
Active Travel

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_2 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%[36].
- Promote a vibrant local economy
- Benefit community cohesion

10.2. Figure 8 below shows the economic benefits each year of getting just one child to walk or cycle to school[37].

Figure 8 – Illustration of the health benefits from walking and cycling



[36] http://www.panorama.am/en/current_topics/2015/01/15/inactivity-deaths/
[37] Kings Fund inforgraphic 2014

10.3. The local authorities in West Yorkshire encourage the uptake of active travel through the provision of infrastructure and behaviour change programmes, this work has seen a steady increase in the number of people choosing to walk and cycle for shorter journeys in West Yorkshire.

10.4. Studies in other parts of the UK have indicated that reducing urban speed limits and introducing 20 mile per hour zones have potential to increase the number of people choosing to walk and cycle. The West Yorkshire local authorities are currently undertaking research to understand the benefits of varying speed limits through a combination of research and evaluated trial projects.

10.5. 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 WYLES is supportive of any action which promotes active travel, but, in order to achieve the scale of change necessary to improve air quality, the WYLES focus will be on reducing transport emissions.

Travel Planning

10.6. 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.

10.7. The West Yorkshire Travel Plan Network supports over 200 major employers in the region to promote more sustainable ways of travel to work through a wide variety of free support packages and initiatives. The Network is supported by the West Yorkshire Combined Authority to provide the following:

- **Walking** – health information (walking the way to health initiative WHI), pedometer loans and journey planners.
- **Public transport** – information, journey planners, timetables and public transport passes (Metrocard schemes)

- **Cycling** - information about the benefits of cycling, cycle training, bike maintenance and cycling, route planners, ride for rewards scheme (awards bike miles which can be redeemed)

- **Mopeds and motorbikes** – sustainability and CO2 information, free bike parking locations, free 1 hour bike trials and bike training information

- **Car journeys** – information on car sharing (WYcarshare.com), eco-driving and new car sustainability information, car parking, car clubs and fleet management information from the energy savings trust.

10.8. 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.

10.9. The current travel-planning model focuses on reducing journeys by car, however, the approach can also be used to encourage emission reductions. The WYLES will therefore use the existing Travel Plan Network to engage with key employers, providing access to over 200,000 employees in the region to promote the uptake low emission vehicles when developing travel plans.

10.10. In addition to businesses, local authority education departments work with schools to develop school travel plans for children, parents and teachers. Traffic issues associated with schools is a common cause for concern and authorities already work with schools to influence school travel behaviour. As part of the WYLES we will look to take this one step further by raising awareness of air quality issues associated with school travel and engaging with parents, schoolchildren and teachers to support alternative school travel options.

10.11. 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 off-set 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 local authorities and other public sectors organisations and socially responsible companies lead by example. Local Authorities in West Yorkshire operate over 3,000 fleet vehicles and are significant employers in the region, generating many thousands of business miles each year and are responsible for spending public money when procurement of goods and services. These represent significant opportunities for influencing change, both within local authority organisations and beyond, including employees and the many private, public and voluntary sector organisations who engage with local authorities 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 a legal requirement[38] 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 tax-payer. The Department for Transport has produced guidance[39] on what authorities need to do in order to comply with the Regulations and, as part the WYLES, this Guidance has been used to develop a West Yorkshire Low Emission 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 WYLES.

11.3. West Yorkshire local authorities already run a number of electric and electric-hybrid vehicles, but will continue to review their fleets and use the West Yorkshire Low Emission Procurement Guide to determine whether more fleet vehicles should be replaced with low emission and ultra-low emission alternatives. Public sector fleet procurement is discussed in more detail under Theme 3: *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 WYLES will seek to support and incentivise employees to consider ultra-low

[38] The Cleaner Road Transport Vehicles Regulations 2011

[39] https://www.gov.uk/government/publications/guidelines-for-the-directive-on-the-promotion-of-clean-and-energy-efficient-road-transport-vehicles-2009-33-ec

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.

Local Authority Spending

11.5. The purchasing power of the public sector is significant across West Yorkshire, 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[40] to consider "social value" as part of the procurement process. This means that when procuring goods and services authorities must 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.

Local Sourcing

11.8. Sourcing goods and services from local suppliers could contribute to reducing emissions, both from the overall number of miles travelled, but also the type of vehicle typically used: for example, local suppliers would tend to use light-goods vehicles rather than heavy goods vehicles, which might be expected from a regional distributor. Local sourcing therefore offers the potential to reduce transport emissions in the supply chain. Supporting local businesses to invest in low emission vehicles and how to incorporate their environmental advantage when tendering or quoting for contracts, coupled with a procurement strategy

[40] The Public Services (Social Value) Act 2012

which rewards those with good environmental credentials, would provide the opportunity to reduce overall emissions and support the local economy.

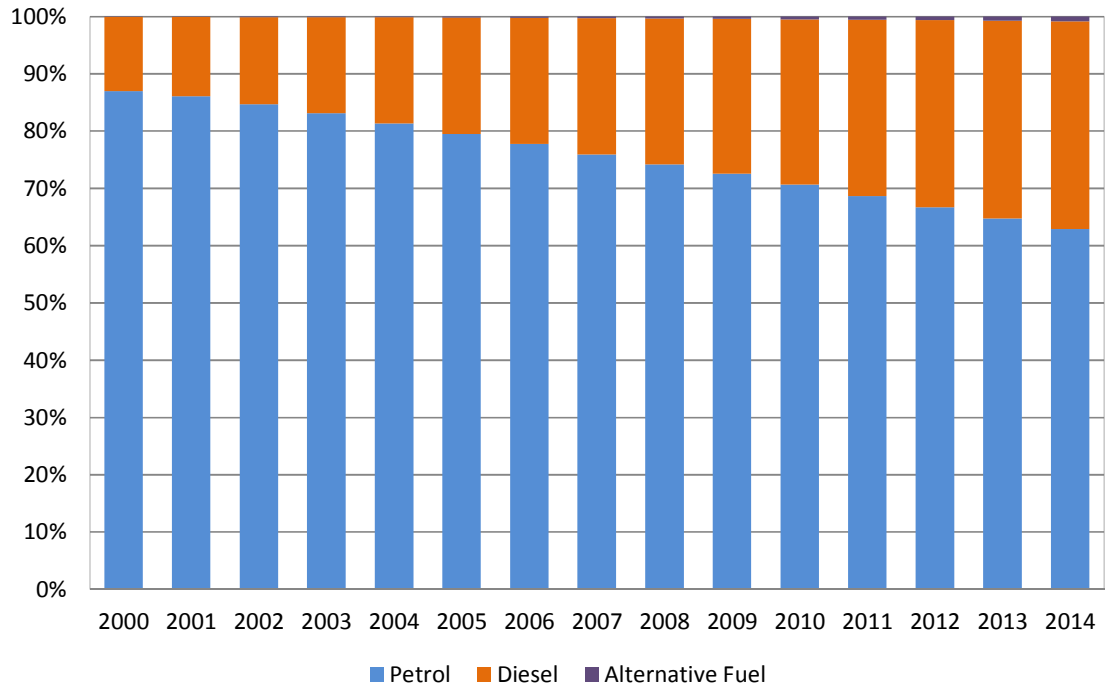
12. Theme 3 – Reducing Vehicle Emissions: *Private Cars*

What are the issues?

12.1. There are nearly one million cars[41] registered in the West Yorkshire region and cars account for 78% of the 9.8 billion miles[42] driven on West Yorkshire roads each year. Cars therefore contribute significantly to vehicle exhaust emissions and impact on air quality in the region.

12.2. One key issue has been the significant growth of diesel cars driven on our roads. As can be seen from Figure 9, diesel cars now account for more than a third of all cars on our roads, compared to a little over 1 in 10 at the start of the millennium. The growth of diesel cars is perhaps not surprising because of their relative fuel-efficiency and lower Vehicle Excise Duty, which supports vehicles with low CO_2 emissions: diesel cars produce less CO_2 per kilometre than their petrol equivalents. Unfortunately, this may have led to a public perception that diesel is more "environmentally friendly" than petrol, when, in fact, diesel cars, particularly older diesel cars, produce significantly higher emissions of NOx and PM than their petrol equivalents.

Figure 9: Cars Licensed in Great Britain by Fuel Type 2000 - 2014



[41] Licensed vehicles by body type, by local authority, Great Britain, annually from 2010, VEH0105, Dft (June 2015)

[42] Motor vehicle traffic (vehicle miles) by Local Authority in Great Britain, annual from 1993, TRA8901, DfT (May 2015)

12.3. Vehicle emissions are controlled under law through Euro Standards. New vehicles must comply with Euro emission standards under test conditions. Table 7 shows a simplified version of the Euro Standards for diesel and petrol cars and how the emissions standards for NOx and particulates (PM) have changed over time.

Table 7: Euro Standards for New Petrol and Diesel Cars (NOx and PM)

Year	Euro Std	NOx (g/km)		PM (g/km)	
		Petrol	Diesel	Petrol	Diesel
1992	Euro 1	0.97*	0.97*	n/a**	0.14
1996	Euro 2	0.5*	0.7*	n/a**	0.08
2000	Euro 3	0.15	0.50	n/a**	0.05
2005	Euro 4	0.08	0.25	n/a**	0.025
2009	Euro 5	0.060	0.180	0.005***	0.005
2014	Euro 6	0.060	0.080	0.005***	0.005

* For Euro 1 and Euro 2 NOx emissions also included hydrocarbons (HC).
**No specified PM limit for petrol engines as emissions are negligible.
***Applies only to petrol vehicles with direct injection engines.

12.4. It can be seen from above Table that emissions from diesel cars have been significantly higher than their petrol equivalent under test conditions. Studies[43] have also shown that emissions can be higher in real-world driving conditions, with diesel vehicles emitting up to 22 times more particulate matter and 4 times more NOx than their petrol equivalent. The latest Euro 6 standard will result in emissions being reduced, although it is still too early to assess whether emissions under test conditions will translate to the same emissions under real-world driving conditions. It also takes time to for people to replace their vehicles and therefore, unless there is a personal incentive to change a vehicle earlier than planned, older, more polluting cars are likely to remain on the roads in West Yorkshire for some time to come.

12.5. The growth in diesel car ownership, coupled with higher NOx and PM emissions, means that privately owned cars are a significant contributor to poor air quality in the region. The number of people driving cars means that everyone has a role to play in reducing emissions and even small changes at an individual level can result in a very significant change when taken collectively.

What can be done?

12.6. If the West Yorkshire region is to play a part in meeting EU air quality obligations in relation to air quality then steps must be taken to reduce emissions from car

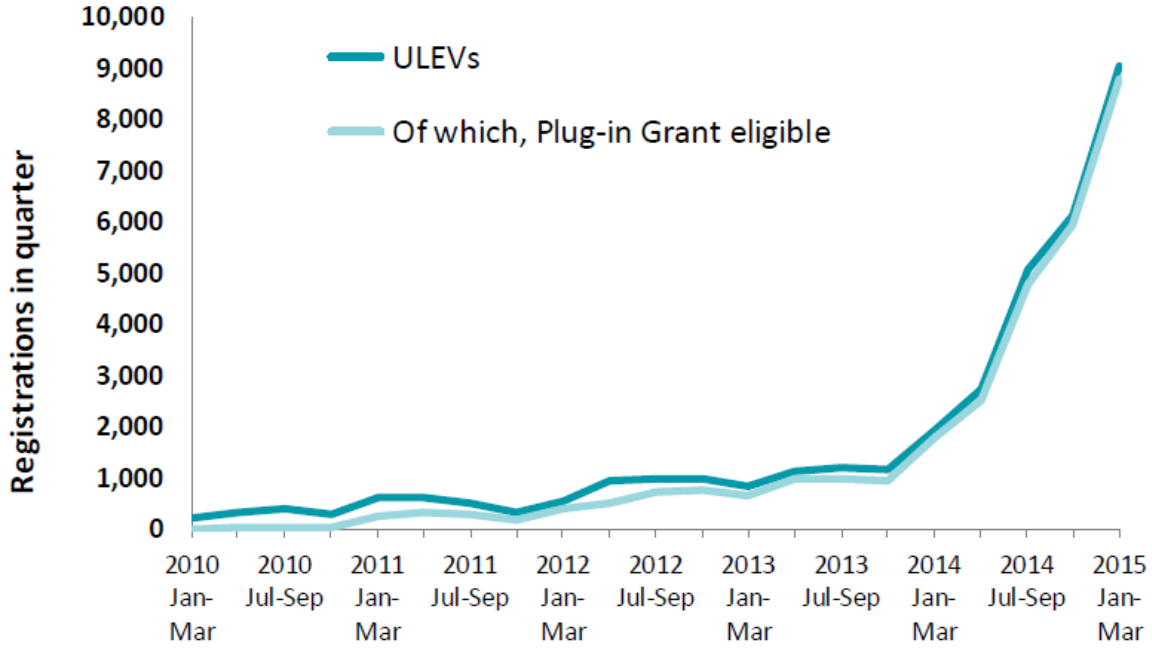
[43] Recent Evidence Concerning Higher NOx Emissions from Passenger Cars and Light Duty Vehicles, Carslaw et al, (2011)

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 vehicle (ULEV). 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.

12.7. As Figure 9 above shows, there is currently very little penetration of alternative fuelled vehicles into the UK car market and 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, gas or hydrogen fuel cell technology.

12.8. However, as Figure 10 below shows, there are early signs of the developing ULEV market, and although ULEVs still only account for a small percentage of cars overall it is a sign of potential growth in this area, which has, in part, been stimulated by the Government's plugged-in grant scheme for ultra low emission cars and vans.

Figure 10: New Ultra Low Emission & Electric Vehicles: UK 2010 – Q1 2015[44]



[44] Vehicle Licensing Statistics: Quarter 1 (Jan – Mar) 2015, DfT (June 2015)

12.9. 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 West Yorkshire and the WYLES will be used to support the growth of the ULEV market and access Government funding to support initiatives to achieve this, including:

- Carrying out research to help inform decision-making to promote the take up of ultra-low emission vehicles.
- Raising awareness and exposing more people to ultra-low emissions vehicles, for example through increasing the number of ULEVs within local authority fleets, pool cars, lease car schemes and car clubs.
- Developing and supporting electric vehicle recharging infrastructure and alternative fuel refuelling stations that are fit for purpose: understanding the market and having infrastructure which supports ULEV growth.
- Building ULEVs as part of wider journey-planning, including public transport, car clubs and active travel with smart-card technology with integrated payment and journey planning information.
- Consider policy initiatives, such as preferential parking, free EV charging and low emission zones / routes as a means to promote ULEVs.

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

13.1. The application of increasingly stringent EU standards has resulted in reduced emissions from newer buses (see Figure 11). For instance, NOx emissions from Euro VI buses are only 5% of those from Euro I buses.

Figure 11: Euro Emission Standards for Buses

Stage	Date	Test	CO	HC	NOx	PM	PN	Smoke
			g/kWh				*1/kWh*	*1/m*
Euro I	1992, ≤ 85 kW	ECE R-49	4.5	1.1	8.0	0.612		
	1992, > 85 kW		4.5	1.1	8.0	0.36		
Euro II	1996.10		4.0	1.1	7.0	0.25		
	1998.10		4.0	1.1	7.0	0.15		
Euro III	*1999.10 EEV only*	ESC & ELR	*1.5*	*0.25*	*2.0*	*0.02*		*0.15*
	2000.10		2.1	0.66	5.0	0.10[a]		0.8
Euro IV	2005.10		1.5	0.46	3.5	0.02		0.5
Euro V	2008.10		1.5	0.46	2.0	0.02		0.5
Euro VI	2013.01	WHSC	1.5	0.13	0.40	0.01	8.0×10^{11}	

a - PM = 0.13 g/kWh for engines < 0.75 dm^3 swept volume per cylinder and a rated power speed > 3000 min^{-1}

13.2. However, as with cars, real-world driving conditions have also resulted in higher emissions than under test conditions, although the latest Euro VI standard is likely to perform much better than predecessor standards in this regard.

13.3. It is not uncommon for buses to be operated for ten to fifteen years and therefore older buses, which produce higher emissions, can continue operating for many years. The West Yorkshire bus fleet is older than the national average (although younger than the average if London is excluded). Table 8 below shows the current West Yorkshire bus fleet profile by Euro Standard and indicates that a significant proportion of the bus fleet is operating to emission standards which came into effect more than ten years ago. It is estimated that current investment levels in the bus fleet replacement programme will not be sufficient to achieve the objectives of this Strategy.

Table 8: West Yorkshire Bus Fleet by Euro Standard (2015)

Euro Standard	%
Euro I	1.2
Euro II	25.3
Euro III	20.8
Euro IV	27.3
Euro V	24.4
Euro VI or equivalent	1.0

13.4. Buses are also more prevalent in urban areas: this is inevitably so because it is where people need to be and where bus station and transport hubs are located. The same buses will also make repeat journeys into urban areas as part of their route. Consequently, relative to the total number of vehicles on the roads, buses can have a significant contribution to emissions in urban areas. For example, the Low Emission Zone Feasibility Studies (see *Theme 1: Evidence for Change*)

estimated that diesel buses account for 43% of NOx emissions within the Bradford Inner Ring Road.

13.5. Targeted action to reduce emissions from these buses can result in the most significant reduction in emissions relative to the costs of implementation: this has been the conclusion of both local and national Low Emission Zone feasibility studies.

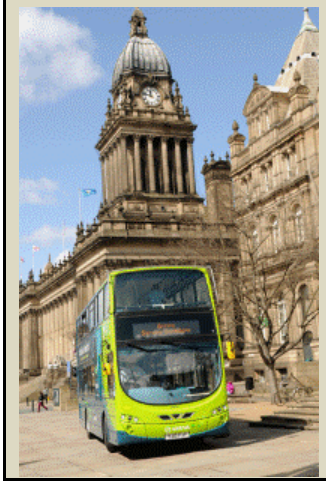
What Can be Done?

13.6. Provision of good public transport is critical to improving air quality by providing a viable alternative to car use and reducing the number of individual car journeys, however, buses also contribute to air quality problems because they operate in the most populated areas and can produce some of the highest exhaust emissions of all vehicles.

13.7. Buses in West Yorkshire are mainly operated by private bus companies, such as FirstGroup, Arriva, Transdev and a number of other smaller independent operators. Most bus services are operated on a commercial basis, with little intervention from local authorities or WYCA. There is, however, a strong working relationship with bus operators in the region and authorities will work with operators to reduce emissions from the bus fleet in West Yorkshire. Figure 12 shows some of the initiatives that bus operators working with local authorities have achieved.

Figure 12: Recent Initiative to reduce bus emissions.

165 "Yellow" school buses go green by fitting NOx and Particulate abatement technology to reduce exhaust emissions – resulting in older buses now achieving emission standards better than Euro VI and protecting the health of children.



Arriva introduce 12 hybrid buses and FirstGroup introduces 22 hybrid buses in the region, with further hybrid buses being introduced in Bradford and Calderdale.

Bradford Council work with FirstGroup and Transdev to fit exhaust abatement technology on 25 buses operating on urban routes resulting in at least 95% of buses going to the Bradford interchange being Euro IV or better by 2016.

Strategy for reducing bus emissions

13.8. West Yorkshire has densely populated towns and cities, such as Leeds and Bradford, surrounded by large rural areas (the largest rural area of any metropolitan region). In rural areas air quality is significantly less of an issue than the urban areas. The strategy has therefore focussed on bus services which frequently operate in towns and cities. An assessment, based on the frequency of bus services in towns and cities, has identified nine hundred buses, which should be targeted for emission reduction.

13.9. Three options are outlined below:

Option 1: Euro III by 2020 (Business as Usual)

13.10. Under business as usual it has been 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 emission buses within their fleet. This level of investment would mean that although Euro I and Euro II buses would likely to be taken out of bus fleets, Euro 3 buses would continue to be in operation.

Option 2: Minimum Euro III with abatement technology by 2020 (Euro III+)

13.11. This option would mean that Euro I or Euro II buses would not operate on urban routes and that all other buses operating on urban routes would need to be replaced with either newer buses, alternative fuel technology or fitted with emission abatement technology (Euro III+) by 2020. This option assumes accelerated investment in new fleet, retro-fitting of Euro III, Euro IV and Euro V buses with "clean bus" technology and all pre-Euro III buses removed from urban routes.

13.12. The following minimum standards would apply:

- Alternative Low Emission Fuel ("Tank to Wheel") - e.g. Electric / Hydrogen / Biomethane / Natural Gas.
- Euro VI diesel electric hybrid.
- Euro VI diesel
- Euro V diesel electric hybrid
- Euro V diesel with thermally effective SCR (selective catalytic reduction)
- Euro IV diesel with effective SCR & DPF (diesel particulate filter)
- Euro III with SCR & DPF

13.13. This option requires a greater proportion of investment (estimated £6.5m) on retro-fitting emission abatement technology across the wider bus fleet to reduce emissions than on investing in new buses.

Option 3: Minimum Euro IV with abatement technology by 2020 (Euro IV+)

13.14. This option would mean that Euro I, Euro II and Euro III buses would not operate on urban routes and that all other buses operating on urban routes would need to be replaced with either newer buses, alternative fuel technology or fitted with emission abatement technology (Euro IV+) by 2020. This option assumes accelerated investment in new fleet, retro-fitting of Euro IV buses with "clean bus" technology and all pre-Euro IV buses removed from fleets.

13.15. The following minimum standards would apply:

- Alternative Low Emission Fuel ("Tank to Wheel") - e.g. Electric / Hydrogen / Biomethane / Natural Gas.
- Euro VI diesel electric hybrid
- Euro VI diesel
- Euro V diesel electric hybrid
- Euro V diesel
- Euro IV diesel with SCR & DPF

13.16. This option requires greater investment in newer buses and less (estimated £2.5m) on retrofitting abatement technology.

13.17. Each of the above options is predicted to have a different impact on bus emissions and Table 9 below indices the relative percentage emission reduction from each option.

Table 9: Estimated Emission Reduction from each Option

Scenario	NOx	PM
Option 1: Euro III by 2020	-44%	-75%
Option 2: Euro III+ by 2020	-89%	-88%
Option 3: Euro IV+ by 2020	-79%	-85%

13.18. Option 1 (investment under business as usual conditions) is not predicted to achieve the necessary reduction in emissions to meet the aims of this Strategy and consequently greater investment under either Option 2 or 3 will be required.

13.19. Option 2 achieves a slightly better reduction in emissions than option 3 (particularly NOx emissions), with less capital cost, but the bus fleet would be slightly older than if Option 3 was implemented.

13.20. Option 3 would result in slightly less improvement in emissions compared with Option 2 and would have a higher capital cost, but this option would result in a

relatively newer bus fleet, with possible consequential benefits of increased bus patronage.

Working with Bus Operators

13.21. West Yorkshire Combined Authority is the lead organisation who works with bus operators to provide bus services in the region. WYCA have produced a West Yorkshire Low Emissions Bus Strategy, which is produced as a supporting document to the WYLES. WYCA will lead engagement with the region's bus operators to accelerate the investment in new buses, alternative fuels and abatement technologies, and assist with potential funding streams, in order to achieve the emission reductions through the implementation of Option 2 or Option 3 above.

14. Theme 3 – Reducing Vehicle Emissions: *Trains*

What are the Issues?

14.1. Diesel trains emit high levels of particulates and NOx, however, when considered on the basis of pollution per passenger per kilometre travelled, emissions are much less than other forms of transport including cars and buses. Trains are therefore part of the solution to reducing transport related emissions. This is not to say that trains do not produce emissions, such as NOx, particulates, CO_2 and noise, with emissions from trains being most significant at train stations in urban locations such as Leeds and Bradford train stations. Therefore, any action to reduce emissions from trains will benefit air quality and the quality of our environment.

14.2. The impact of trains on local air quality varies according to the type of rail vehicle in use. Older trains emit more pollution so renewing train fleets will help reduce emissions. Electric vehicles impose minimal impact on local air quality compared to diesel trains and therefore the most effective way to ensure that trains do not contribute to local air quality problems and reduce passenger exposure is to support calls for electrification of the regional rail network.

What can be done?

14.3. The procurement and deployment of rail rolling stock is generally determined at a national level as part of the rail franchising process. As with bus operations, WYCA is the lead organisation at a regional level which engages with train operating companies and Network Rail. Acting through Rail North, WYCA is seeking to influence decisions regarding rail rolling stock and to advance the process of replacing older, more polluting trains with newer, cleaner rolling stock.

14.4. Whilst electric trains operate between Leeds and Wakefield, and connect Leeds and Bradford with Shipley, Keighley, Skipton and Ilkley, the remainder of the West Yorkshire rail network is operated by diesel trains. Many of the diesel rail vehicles in use in West Yorkshire are over 30 years old and do not benefit from modern engine technologies. Incremental improvements in emissions can therefore be obtained by replacing older diesel vehicles with electric trains or cleaner, newer diesels.

14.5. Electrification of the Transpennine rail route between York, Leeds, Huddersfield and Manchester planned for 2019/20 will replace diesel vehicles with electric providing a commensurate benefit to air quality. Further electrification is subject to funding however the Leeds – Harrogate and Leeds, Bradford, Halifax lines are high in the regional priority for electrification in the early 2020s.

14.6. In addition to the plan to electrify more of the rail network, plans to replace older diesel trains are included in the revised Northern and Transpennine rail franchises which will start in 2016. These plans involve the replacement of the older “Pacer”

trains with brand new diesel vehicles with improved emission control. It is anticipated that the new rolling stock will be in service from 2019 onwards.

14.7. A step change improvement in the content and quantity of emissions from rail vehicles is therefore expected from 2019/2020 onwards.

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

What are the issues?

15.1. Freight represents a low proportion of traffic flows at around 8% of traffic in the West Yorkshire region[45], but produces a disproportionate amount of emissions. Road freight is not just about Heavy Goods Vehicles (HGVs), Light Goods Vehicles (LGVs) such as vans have seen significant growth, rising by 46% between 2000 and 2009.

15.2. West Yorkshire is a prime location for the distribution of goods, having an excellent strategic road network from North to South (M1 and A1) and East to West (M62). It is not surprising that many distribution centres and logistics operators are located within the region, with the freight sector contributing about 25% of the region's economy. Road freight is the most used mode for freight movements in West Yorkshire, moving around 1,900 million tonnes of freight in West Yorkshire (2008 data). Motorways account for the majority of freight trips by length of journey, specifically the M1, M621 and M62. Freight can account for up to 16% of traffic flows by mode on the motorway network[46].

15.3. The West Yorkshire Local Transport Plan: Freight Strategy (2012) recognises the importance of the freight sector to the West Yorkshire economy and also recognises the disproportionate contribution that road freight has in terms of emissions compared with non-road freight. The WYLES supports the Freight Strategy by promoting actions to reduce emissions from freight and commercial vehicles.

What can be done?

15.4. Freight and commercial activity is potentially one of the most difficult for local authorities 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 CO2 emissions and are encouraged to reduce their emissions and the West Yorkshire authorities will seek to support commercial operators to reduce transport emissions.

15.5. 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 a recent Gas Infrastructure Feasibility Study commissioned by Wakefield Council found that three strategic LNG/CNG gas refuelling stations could be supported at key locations near to the M1 (j41), M62 (j30) and the A1 (Barnsdale Bar) highway networks.

[45] West Yorkshire Freight Study 2010
[46] West Yorkshire LTP Freight Strategy 2012

- 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 West Yorkshire Air Quality & Planning Technical Guide to ensure new commercial developments incorporate facilities for ultra-low emission 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.

- Exploring the potential for the regions' canals and waterways for the transport of goods.

- Using sustainable procurement criteria to reward those businesses which have a lower environmental impact.

- 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 Zones.

- Supporting fleet operators to reduce emissions through improved driver training, fuel management and the adoption of accreditation scheme such as "Eco Stars" to reduce transport emissions.

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

What are the Issues?

16.1. There are approximately 11,000 taxis (hackney carriages and private hire vehicles) operating in the West Yorkshire region, with more than 90% of these being are diesel cars and vans. Most taxi journeys take place within and between the regions' towns and cities, with some high-use taxis covering in excess of 100,000 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 NOx and particulate emissions so contribute disproportionately to poor urban air quality.

16.2. Taxis and private hire vehicles are also used by many people, which creates the opportunity for them to be used to expose passengers to new alternative fuels and technologies, such as electric vehicles.

What can be done?

16.3. As with other commercial operations, local authorities 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:

- Work with taxi and private hire companies to apply for Government funding (for example the £20m ULEV Taxi Grant Scheme announced in 2015[47]) to support ULEV taxis and private hire vehicles.
- Using the local authority 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 (see Figure 13 for a summary of a recent Leeds / Institute for Transport Studies case-study).
- 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.

16.4. If encouragement is not effective or widely supported, then the local authority licensing function remains an option for specifying minimum emission standards of taxi and private hire cars.

[47] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/382190/taxis-preliminary-guidance.pdf

Figure 13: Taxis Case Study by Leeds Council and Institute for Transport Studies.

Aim: to demonstrate the economic and environmental benefits of low emission taxis and private hire vehicles compared to diesel equivalents.

Taxis and PHVs in Leeds:

- **537 Hackney Carriages**
- **3,500 Private Hire Vehicles**
- **Approx. 90% Diesel**

Study:

Using a Petrol Hybrid Electric Vehicle typical taxi and private hire journeys have been simulated within Leeds city centre, while exhaust emissions and fuel consumption are monitored and recorded. Data gathered will quantify the relative cost and emissions under real-world driving conditions.

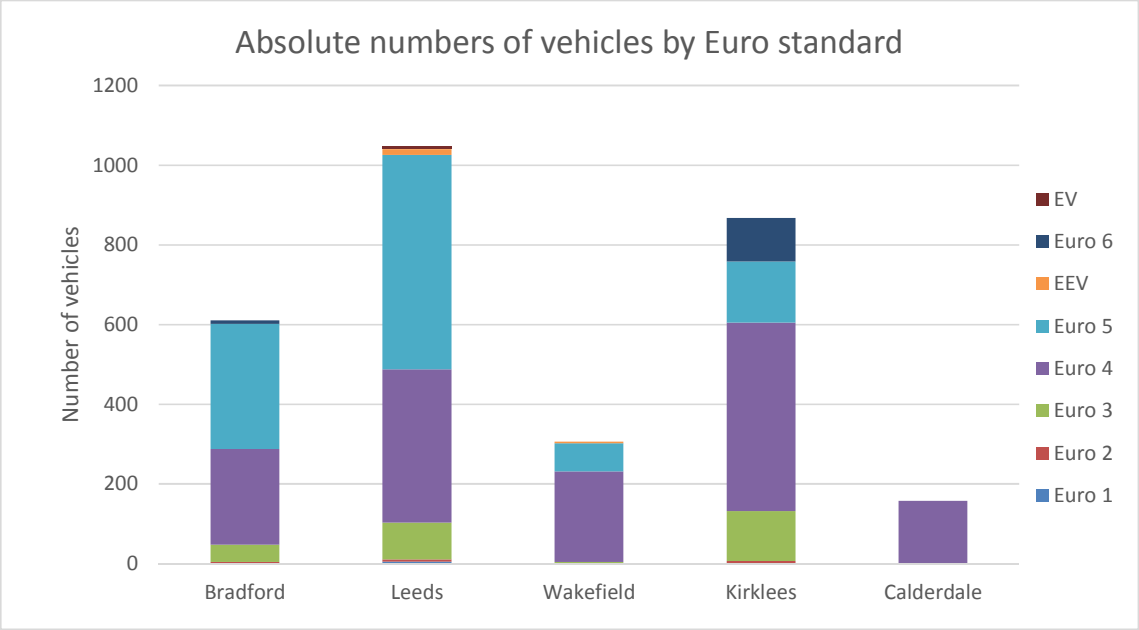
The information will be available in Autumn 2015 and will be used to demonstrate the business case to taxi and private hire operators for switching to low emission technology.

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

17.1. Local authority fleet operations are an ideal opportunity to 'lead by example' and influence public vehicle purchasing decisions.

17.2. West Yorkshire local authority currently operate approximately 3,000 fleet vehicles of which the overwhelming majority are diesel vehicles of varying Euro Standard (see Figure 14).

Figure 14: West Yorkshire Local Authority Fleet – vehicles by Euro Standard



17.3. The fleet emission profile of purchased vehicles tends to be below that of leased fleet vehicles. All West Yorkshire Authorities have demonstrated low emission vehicle alternatives and some are beginning to look at more intensive fleet transformation to use cleaner fuels and technologies. Appendix 3 provides further guidance on Low Emission Vehicles and alternative fuels and the impact on air quality.

17.4. 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.

17.5. In order to achieve compliance with the above Regulations and to support local authority procurement teams a West Yorkshire Low Emission Procurement Guide has been produced as a supporting document to the WYLES.

17.6. As part of the WYLES project, a public sector fleet benchmarking exercise was also carried out, including:

- Review of fleet emission profiles.
- Review of vehicle emission strategies and feedback from low emission vehicle demonstration projects.
- Assessment of opportunities and barriers to ULEV take-up.
- An understanding of whole life costs, including standard diesel and ULEV alternatives.
- Sharing knowledge and expertise in vehicle procurement frameworks and contracting requirements.
- Explore possibilities for shared infrastructure.
- Consideration of the use of 'off-set' funding secured through the planning process (see section 7) to help develop low emission refuelling infrastructure.

17.7. Several barriers were identified to the take up of low emission vehicles, including:

- Fleet managers with capital budgets did not have sufficient resources to cover the incremental cost of procuring certain low emission technologies as they would not benefit from any operational cost savings as these budgets were controlled by separate client departments.
- Some low emission vehicles did not meet the specifications required by specialist vehicles.
- Where significant operational cost savings could be made, the incremental capital cost of certain vehicles was considered to be prohibitive.
- Lack of information regarding the performance and maintenance of new technologies.
- Cost of infrastructure for certain technologies was seen as prohibitive.
- Existing contracts and framework prevented the take-up of certain low emission vehicle technologies in the short to medium term.

17.8. Local authorities will continue to share knowledge and seek opportunities to establish best practice by regularly appraising available low emission vehicle alternatives to standard technology, demonstrating suitable low emission vehicles and incorporating whole life cost considerations into procurement processes. This should include annual appraisal and assessment of all feasible LEV and ULEV options as follows:

- A re-assessment of previous LEV / ULEV technology that has previously been deemed 'unsuitable' for public sector use

- Any new vehicles and technology that have come onto the market since the previous study and an assessment of whether such vehicles would be 'fit for purpose' within the fleet. Where LEV / ULEVs are identified as being fit for purpose there will be a study undertaken to identify the whole life cost and total cost of ownership of the current vehicle use in comparison to the LEV / ULEV options to include the pros and cons of each option in terms of suitability, emissions (NOx, PM and CO_2) and costs.

Funding for Ultra-low Emission Vehicles

17.9. 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 ultra-low emission vehicles, for example under the Governments Plugged-in-Fleets initiative[48]. West Yorkshire local authorities will use these available funding streams as a means of reducing emissions form their fleet operations.

[48] https://www.gov.uk/government/publications/ultra-low-emission-vehicles-getting-wider-public-sector-fleets-ready

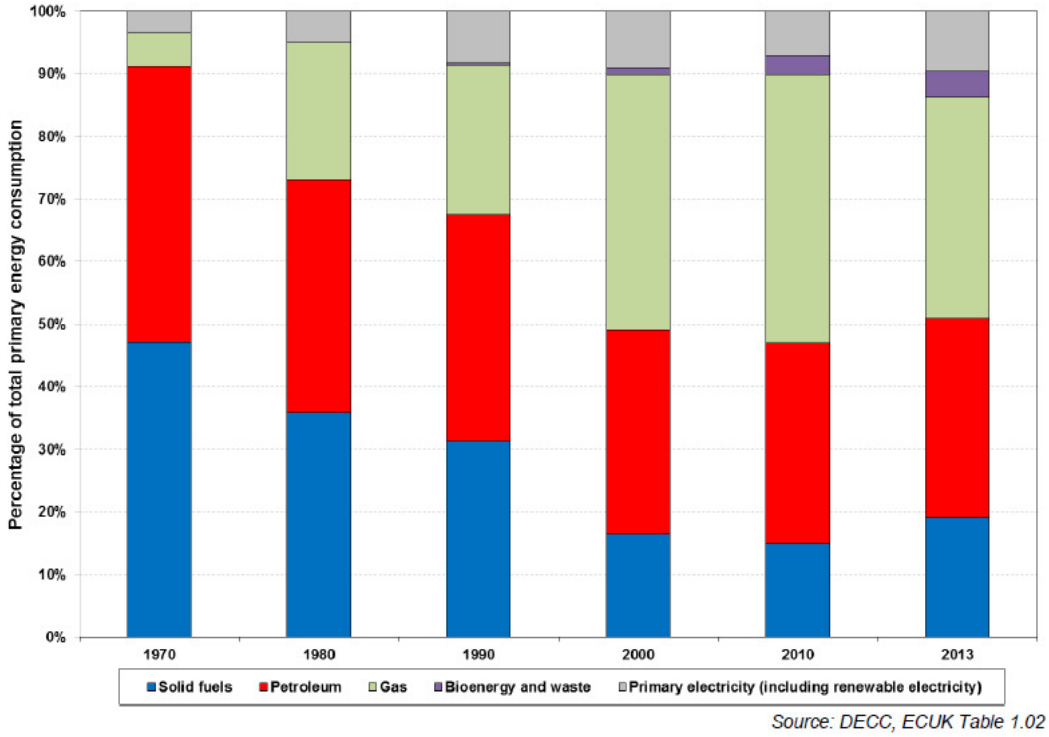
18. Theme 4 – Controlling Emissions from Non-Transport Sources

18.1. Although the focus of the WYLES is to reduce transport emissions, it is important to recognise other non-transport emission sources within this Strategy. In terms of the pollutants of concern: Oxides of Nitrogen (NOx) and particulates (PM_{10} and $PM_{2.5}$), energy generation, industrial emissions and domestic combustion are the other main sources of concern. Domestic and European laws have brought in tighter emission controls, particularly for the industrial and energy sectors, which have seen significant reductions in most air pollutants from these sectors over recent decades

Energy & Industry

18.2. Emissions from the energy and industrial sectors have reduced over recent years due to a combination of moving away from traditional fossil fuel combustion and improved abatement technology. Figure 15 shows how the fuel mix for primary energy consumption over the decades has changed, with a significant shift away from solid fuels, growth in the use of gas, and in more recent years an increase in the proportion of biofuels and waste as a source of energy.

Figure 15: Total Primary Energy Consumption in the UK, 1970 to 2013



Source: DECC, ECUK Table 1.02

18.3. The growth in the use of waste and biofuels is positive in terms carbon reduction, but we also need to be aware of the potential for increase in NOx and particulate emissions from these types of fuel. Although controlling emissions from the energy sector and large-scale industry sits mainly with national bodies, such as the Environment Agency, rather than local authorities, we will seek to ensure that

emissions from these sectors, including the increased use of waste and biofuel, do not have an adverse impact on air quality in the region.

Combined Heat & Power (CHP)

18.4. As can be seen from Figure 15, power stations and major industry produce emissions which are widely dispersed and contribute mainly to background air quality. In terms of health impact, local sources of air pollution can be of greater concern and in recent years we have seen an increase in the number of combined heat and power (CHP) plants being installed to serve the heating and electricity needs to single buildings or clusters of buildings at a local level. CHP plants are considered beneficial for carbon reduction because they are more efficient because energy is produced closer to where is used.

18.5. Because the energy generation is carried out at a local, rather than regional level, there is greater potential for the emissions from CHP plant to have an impact on local air quality and impact on the health of the local population: energy generation becomes a potential local air quality "hot-spot", rather than part of the regional background (see Introduction).

18.6. Careful consideration therefore needs to be given to where CHP plants are installed: where air quality is good, the carbon reduction benefits may outweigh air quality concerns, but where air quality is a problem then introducing a further and potentially significant source of pollution to add to the problem should be avoided. West Yorkshire local authorities have a role to play in ensuring that the air quality impacts of CHP plants are fully considered when carrying out their planning and regulatory functions to ensure that air quality is not made worse in the region.

Biomass and Wood-burning

18.7. Over the last half a century there has been a significant shift in the fuel used by domestic consumers. Local authorities have played a significant role in reducing emissions from the domestic sector through the introduction of smoke control areas and the use of other pollution control legislation. The most significant benefits from this have been reductions in sulphur dioxide and smoke emissions, which had a devastating impact on health and the environment.

18.8. As described above, the main source of local air pollution is now urban traffic, but this does not mean that we should ignore the domestic sector altogether. An emerging concern in relation to local air quality is the increased trend in the use of biomass boilers and wood-burning on domestic heating appliances: perceived to have good carbon reduction credentials (with some appliances benefiting from the Government's Renewable Heat Incentive Scheme). Burning wood or biomass results in more particulate emissions and this is a cause for concern to local authorities as existing controls available through clean air legislation and planning may not be sufficient to prevent the increase in emissions from these appliances.

18.9. Local authorities will use existing powers to control emissions from domestic heating appliances, including wood-burning appliances, raise awareness of the potential impact on local air quality with installers and consumers and, if existing regulatory control prove insufficient, will consider what alternative regulatory controls may be available to prevent harmful emissions to the environment.

List of Abbreviations

AEI	Average Exposure Indicator: the baseline indicator used to report on progress on meeting $PM_{2.5}$ reduction targets.
AQAP	Air Quality Action Plan: local authorities are required to produce an air quality action plan when they have declared an air quality management area (AQMA).
AQMA	Air Quality Management Area: a geographical area declared by local authorities when they have determined that air quality is exceeding air quality objectives.
AQO	Air Quality Objective: concentration levels for certain prescribed pollutants that have been determined in UK law.
COPD	Coronary Obstructive Pulmonary Disorder
CVD	Cardio-vascular Disease
DEFRA	Department for the Environment and Rural Affairs
LAQM	Local Air Quality Management: the term used to describe the function of local authorities to review and assess air quality in their areas and declare AQMAs and produce AQAPs.
LEV	Low Emission Vehicle: the general term used for vehicles which produce lower emissions (usually referred to in relation g/km Carbon). LEVs may include internal combustion engines.
LEZ	Low Emission Zone: a designated area, usually in towns or cities where a traffic regulation order restricts access except for vehicles which meet a specified emissions criteria.
LV	Limit Value: refers to the Limit Values set out in EU Directive 2008/50/EC
MACC	Marginal Abatement Cost Curve: a tool used to assess the cost-v-benefits of introducing various abatement options.
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen – including Nitrous Oxide (NO) and Nitrogen Dioxide (NO2)
NPPG	National Planning Policy Guidance
NPPF	National Planning Policy Framework
OLEV	Office for Low Emission Vehicles: part of the Department of Transport set up to increase the number of ULEVs.
PHE	Public Health England
PM_n	Particulate Matter with a diameter of "n" (usually in microns) including PM_{10}, $PM_{2.5}$ and $PM_{0.1}$.
QALY	Quality Adjusted Life Year
TRO	Traffic Regulation Order: a regulation made by local authorities to manage traffic on the roads.
ULEV	Ultra Low Emission Vehicle: vehicles which emit very low emissions (usually referred to in g/km Carbon) and used to determine eligibility for plugged in grants: https://www.gov.uk/plug-in-car-van-grants/overview

Appendix 1 – National Air Quality Objectives and EU Limit and Target Values

National air quality objectives and European Directive limit and target values for the protection of human health							
Pollutant	**Applies**	**Objective**	**Concentration measured as[10]**	**Date to be achieved by and maintained thereafter**	**European obligations**	**Date to be achieved by and maintained thereafter**	**New or existing**
Particles (PM_{10})	UK	50µg.m^{-3} not to be exceeded more than 35 times a year	24 hour mean	31 December 2004	50µg.m^{-3} not to be exceeded more than 35 times a year	1 January 2005	Retain existing
	UK	40µg.m^{-3}	annual mean	31 December 2004	40µg.m^{-3}	1 January 2005	
	Indicative 2010 objectives for PM_{10} (from the 2000 Strategy and 2003 Addendum) have been replaced by an exposure reduction approach for $PM_{2.5}$ (except in Scotland – see below)						
	Scotland	50µg.m^{-3} not to be exceeded more than 7 times a year	24 hour mean	31 December 2010			Retain existing
	Scotland	18µg.m^{-3}	annual mean	31 December 2010			
Particles ($PM_{2.5}$) Exposure Reduction	UK (except Scotland)	25µg.m^{-3}	annual mean	2020	Target value 25µg.m^{-3} [12]	2010	New (European obligations still under negotiation)
	Scotland	12µg.m^{-3}		2020	Limit value 25µg.m^{-3}	2015	
	UK urban areas	Target of 15% reduction in concentrations at urban background[11]		Between 2010 and 2020	Target of 20% reduction in concentrations at urban background	Between 2010 and 2020	
Nitrogen dioxide	UK	200µg.m^{-3} not to be exceeded more than 18 times a year	1 hour mean	31 December 2005	200µg.m^{-3} not to be exceeded more than 18 times a year	1 January 2010	Retain existing
	UK	40µg.m^{-3}	annual mean	31 December 2005	40µg.m^{-3}	1 January 2010	
Ozone	UK	100µg.m^{-3} not to be exceeded more than 10 times a year	8 hour mean	31 December 2005	Target of 120µg.m^{-3} not to be exceeded more than 25 times a year averaged over 3 years	31 December 2010	Retain existing

National air quality objectives and European Directive limit and target values for the protection of human health							
Pollutant	**Applies**	**Objective**	**Concentration measured as**	**Date to be achieved by and maintained thereafter**	**European obligations**	**Date to be achieved by and maintained thereafter**	**New or existing**
Sulphur dioxide	UK	266µg.m^{-3} not to be exceeded more than 35 times a year	15 minute mean	31 December 2005			Retain existing
	UK	350µg.m^{-3} not to be exceeded more than 24 times a year	1 hour mean	31 December 2004	350µg.m^{-3} not to be exceeded more than 24 times a year	1 January 2005	
	UK	125µg.m^{-3} not to be exceeded more than 3 times a year	24 hour mean	31 December 2004	125µg.m^{-3} not to be exceeded more than 3 times a year	1 January 2005	
Polycyclic aromatic hydrocarbons	UK	0.25ng.m^{-3} B[a]P	as annual average	31 December 2010	Target of 1ng.m^{-3}	31 December 2012	Retain existing
Benzene	UK	16.25µg.m^{-3}	running annual mean	31 December 2003			Retain existing
	England and Wales	5µg.m^{-3}	annual average	31 December 2010	5µg.m^{-3}	1 January 2010	
	Scotland, Northern Ireland	3.25µg.m^{-3}	running annual mean	31 December 2010			
1,3- butadiene	UK	2.25µg.m^{-3}	running annual mean	31 December 2003			Retain existing
Carbon monoxide	UK	10mg.m^{-3}	maximum daily running 8 hour mean/in Scotland as running 8 hour mean	31 December 2003	10mg.m^{-3}	1 January 2005	Retain existing
Lead	UK	0.5µg.m^{-3}	annual mean	31 December 2004	0.5µg.m^{-3}	1 January 2005	Retain existing
		0.25µg.m^{-3}	annual mean	31 December 2008			

Appendix 2: Low Emission Zone Feasibility Study – Modelled Scenarios

SCENARIO NAME	DESCRIPTION
2012 base	Existing fleet mix
2016 base	Projected fleet mix do minimum
2016 fuel split	Projected fleet but with the petrol/diesel mix for cars and N1 vans returned to Year 2000 ratios
2016 all buses Euro VI	Projected fleet but all buses (including Euro IV and Euro V) become Euro VI buses
2016 all HGV Euro VI	Projected fleet but all HGV (including Euro IV and Euro V) become Euro VI
2016 all bus and HGVs Euro VI	Projected fleet but all buses and HGVs (including Euro IV and Euro V) become Euro VI
2016 All vans Euro 6	Projected fleet but all vans replaced with Euro 6
2016 E2&E3 retrofit	Projected fleet but with Euro II and Euro III buses retrofitted with "non TFL DPF and SCR" technology
2016 all Pre Euro IV buses Euro VI	Projected fleet but all buses older than Euro IV are replaced with an Euro VI
2016 all Pre Euro IV HGV Euro VI	Projected fleet but all HGV older than Euro IV are replaced with an Euro VI
2016 Pre Euro IV bus and HGVs to Euro VI	Projected fleet but all buses and HGVs older than Euro 4 are replaced with Euro VI
2016 10% reduction in car use	Projected fleet with 10 % reduction in car use resulting from measures to promote walking and cycling
2021 base	Projected fleet mix do minimum
2021 fuel split	Projected fleet but with the petrol/diesel mix for cars and N1 vans returned to year 2000 ratios
2021 All buses to Euro VI	Projected fleet but with all buses (including Euro IV and Euro V) become Euro VI buses
2021 All HGVs to Euro VI	Projected fleet but with all HGVs (including Euro IV and Euro V) become Euro VI
2021 All bus and HGVs to Euro VI	Projected fleet but with all buses and HGVs (including Euro V) become Euro VI
2021 All vans to Euro 6	Projected fleet but all vans replaced with Euro 6
2021 All pre Euro V buses to Euro VI	Projected fleet but with all buses older than Euro V are replaced with Euro VI buses
2021 All pre Euro V HGV to Euro VI	Projected fleet but all HGVs older than Euro V are replaced with Euro VI
2021 All pre Euro V bus and HGVs to Euro VI	Projected Leeds fleet but All Pre Euro V buses and HGVs become Euro VI
2021 10% reduction in car use	Projected fleet with 10 % reduction in car use resulting from measures to promote walking and cycling

Appendix 3: Low Emission Vehicles Guidance

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[49] these are the oxides of nitrogen (NOx) and particulate matter (PM). The second is greenhouse gas (GHG) emissions, mainly carbon dioxide (CO_2) but also methane, nitrous oxide and some others, usually measured together with CO_2 as overall CO_2e (equivalent).

Air quality

The emerging definition of 'low' emissions, in terms of NOx and PM, is the Euro 6/VI[50] 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[51].

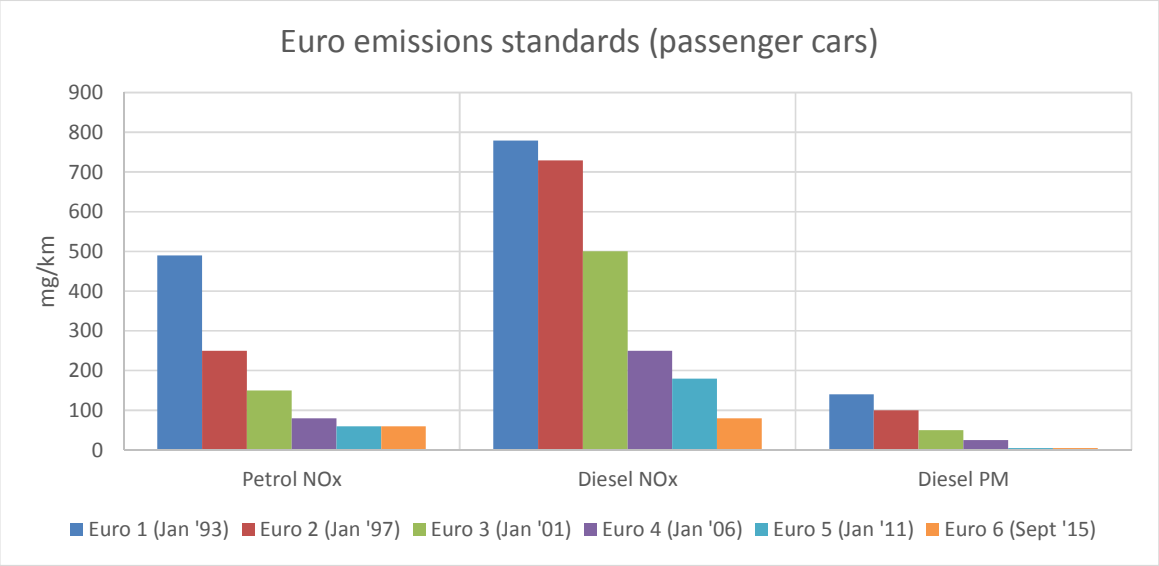


Figure 1: Evolution of Euro emissions standards for passenger cars

Three key points can be noted from the graph above. First, diesel cars have far higher NOx 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 engines – this is because PM emissions from petrol engines are inherently very low. Finally, the Euro 6 standard for NOx for diesel cars is less than half the Euro 5 standard.

[49] 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.

[50] 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.

[51] 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.

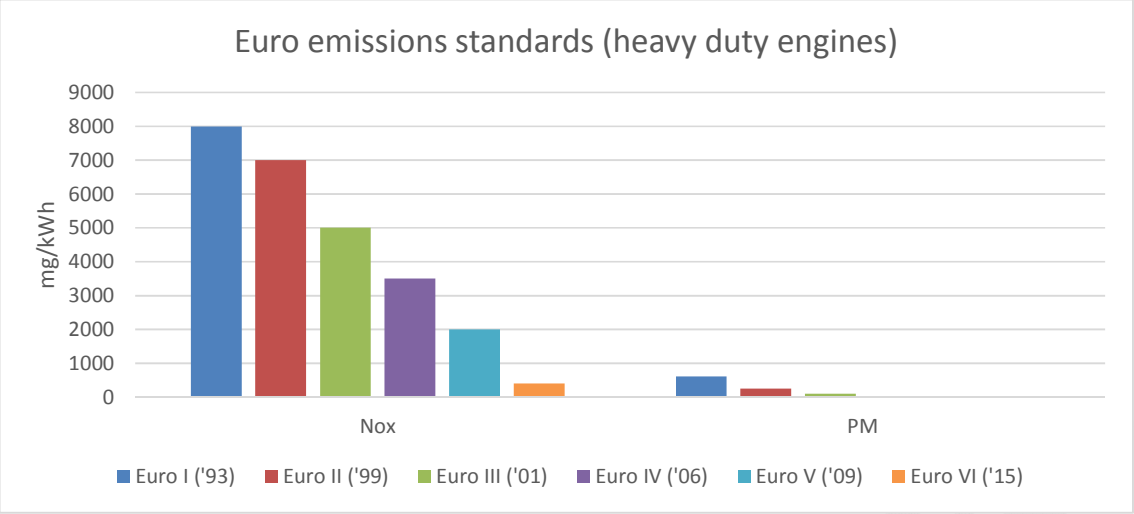


Figure 2: European emissions standards for heavy duty engines (mg/kWh). These will mostly be diesel, but the same standards would apply to larger engines running on other fuels such as gas or biofuels.

The key thing to note from Figure 2 above is that the standard for NOx 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.

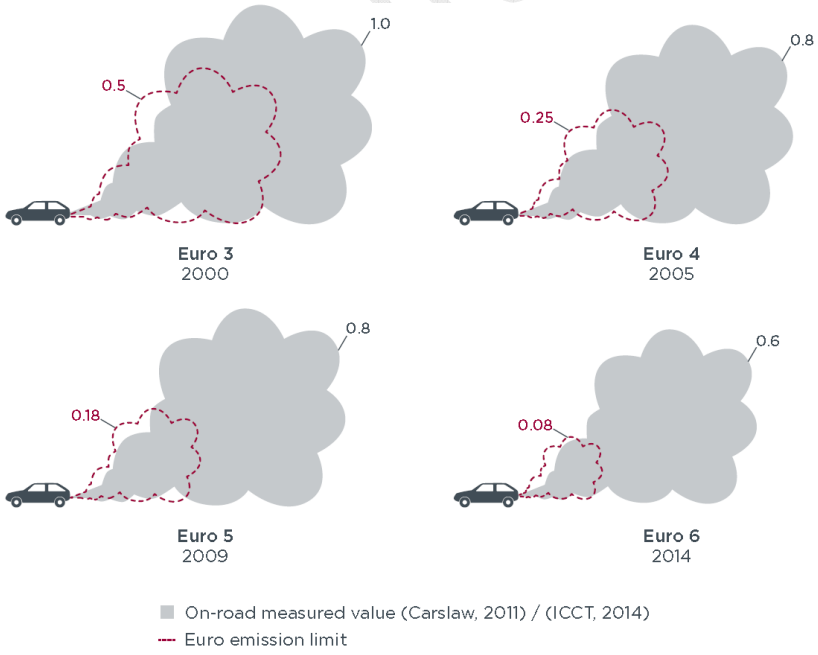


Figure 3: Real world NOx emissions of passenger cars (g/km) vs Euro standards

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 NOx were lowered by 85%, and yet the actual NOx emitted in real world driving has only decreased by about 40%. The graphic above was taken from an ICCT study[52], 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[53], 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.

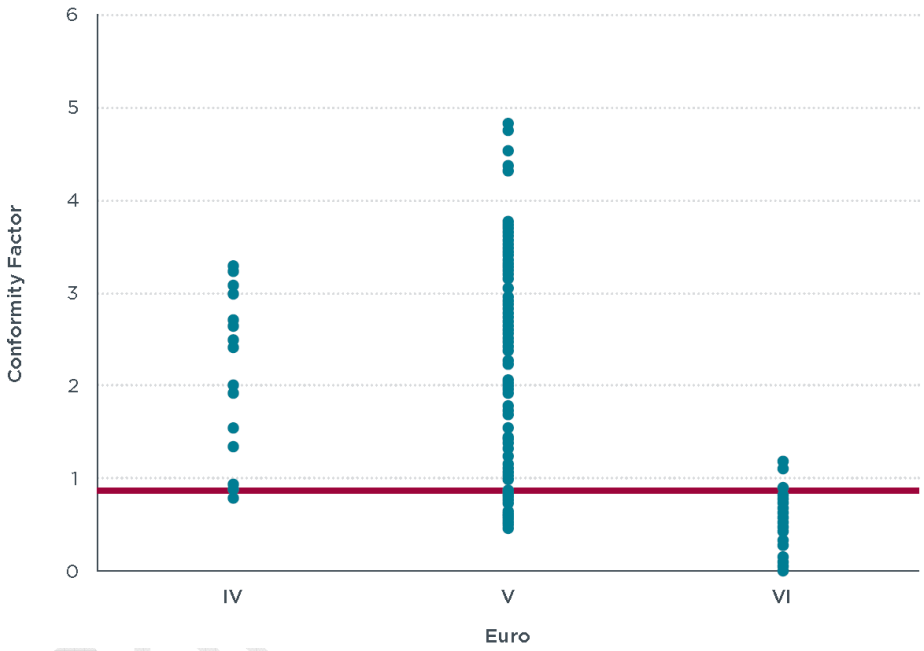


Figure 4: Performance of heavy duty engines against Euro standards

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

[52] "Fact sheet: Real-world emissions from modern diesel cars", October 2014, www.theicct.org
[53] "Briefing: Comparison of real-world off-cycle NOx emissions control in Euro IV, V, and VI", March 2015, www.theicct.org

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:

Parallel hybrid (Hybrid Electric Vehicle or HEV)	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. 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 saving fuel all the time while still having the performance of a vehicle with a larger engine. 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.
Plug in hybrid (PHEV)	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. 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.
Series hybrid (or Range Extended Electric Vehicle - REEV)	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. 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. 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.
Battery electric (BEV)	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 top of the range Tesla S can achieve 270 miles (with a £90,000 price tag). 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.
Gas	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. 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. 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^{o}C. Over a period of days, the gas will warm up and 'boil off' so such vehicles need to be in constant regular use.
Hydrogen fuel cell	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). The advantage of a fuel cell vehicle is that it is essentially an electric

	vehicle that can be refuelled at a filling station. There are still several major obstacles to fuel cell vehicles. The most immediate is the cost of fuel cells themselves, which is still 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.
Novel hybrid (flywheel, air, hydrogen)	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. 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. 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. 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.

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

LPG (liquid petroleum gas)	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. 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.
Mild hybrid	'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. 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. 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.
Dual fuel	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% more efficient than 'spark ignition' engines, which is why diesel vehicles are cheaper to run even though diesel is more expensive than petrol.

	'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. 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.

Low emission vehicles – suitability and availability by vehicle type

Cars	 [BMW i3]	• Passenger cars are available in a full range of hybrid and electric models. • 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. • For fleets running vehicles every day in urban environments, BEVs already offer a good economic payback.
Taxis	 [Toyota Prius]	• [See notes for cars above, which also apply to taxis.] • Due to their mostly urban use, the Toyota Prius has already become one the most popular choices for taxis. • 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.)

Small vans	 [ENV200]	• There are several all electric small vans available from Nissan, Renault and Peugeot, but no hybrids. • The VW Caddy is available in the UK in a gas variant. • There are currently no factory production hybrid or electric vans in the 2.5-3.5t GVW range (Transit size).
Large vans and minibuses	 [Fuso Canter hybrid]	• In the 3.5-7.5t GVW range there are a small number of hybrid options, notably the Fuso Canter (pictured). • Gas versions of the Mercedes Sprinter and Iveco Daily are available and can offer cost savings vs diesel.
Rigid trucks (15-26t)	 [Eurocargo CNG]	• Gas is the only low emissions technology available for this type of vehicle – the Iveco Eurocargo is the only readily available model. • 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 more of the cost of refuelling infrastructure is recovered from other vehicle types using more fuel.
Refuse collection vehicles	 [Econic CNG]	• 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. • 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.

Buses	 [Optare Solo Flybus]	• A full range of low emission technologies are available for buses – hybrid, plug-in-hybrid, electric, flywheel hybrid, gas and hydrogen. • 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.
HGVs	 [Volvo FM methane-diesel]	• 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. • 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 bhp. • 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.