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## Scrutiny Report of Cardiff's Environmental Scrutiny Committee

# Improving Cardiff's Air Quality

**May 2018**



**Cardiff Council**

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## CHAIR'S FOREWORD

Clean air is essential. It has a direct impact on our health, our daily activities and our overall quality of life. For the sake of our friends and loved ones, it is something that we should not take for granted.

Since 2010 the United Kingdom has struggled to respond to and meet the targets set by the EU directives on air quality. This ongoing failure has triggered a number of successful legal actions by Client Earth against the United Kingdom Government and more recently the Welsh Government. All of this now means that Cardiff, as a local authority in breach of the targets, is now legally bound to meet compliance with EU air quality directives "in the shortest time possible". A significant challenge.

In response to this challenge the Environmental Scrutiny Committee identified improving air quality as one of its priorities for 2017/18 - not just for the Committee, but for the Council and Cardiff as a city. To reflect this priority the Committee decided to run this inquiry to review current air quality standards, to scrutinise the development of Cardiff's Clean Air Strategy and to explore the challenges and opportunities around 'Improving Cardiff's Air Quality'.

The inquiry included nine task group meetings that supported seventeen separate witness sessions, dealt with 38 expert witnesses and made 31 recommendations designed to help improve Cardiff's air quality. The exercise was designed to support the wider development of Cardiff's Clean Air Strategy and was structured around the following eight key topics - the current air quality position; development of Cardiff's Clean Air Strategy; the Welsh Government position on air quality; transportation; other pollution sources; planning & development; sustainable fuels and clean air zones. Having considered each of these areas the report made a number of key recommendations including:

- Putting public health at the heart of Cardiff's Clean Air Strategy;
- Creating a low emission zone in Westgate Street by focusing on reducing NO<sub>2</sub> emissions from diesel buses;

- Pushing for more sustainable fuel infrastructure for Cardiff to support the growth in the use of low emission vehicles;
- Accelerating public transport and active travel infrastructure, for example, more bus and cycle lanes;
- Using short term initiatives within the Council's control to drive modal shift, for example, 20 mph zones and increasing the number of 75% residential parking schemes.

To conclude I would also like to thank everyone who has taken part in the task & finish exercise. This includes the members of the Environmental Scrutiny Committee members, Cabinet members, external witnesses and Council staff. Without your help this inquiry would not have been possible. My hope is that the contents of this report are helpful to the Cabinet and that the recommendations provided play a part in helping to improve Cardiff's Air Quality.



**Councillor Ramesh Patel**

**Chairperson – Environmental Scrutiny Committee**



## INQUIRY METHODOLOGY

Cardiff's Environmental Scrutiny Committee reviewed the development of Cardiff's Clean Air Strategy and considered a number of areas that had the most significant impact on air quality in the city. In doing this it explored the key themes that formed the basis of the Cardiff's Clean Air Strategy, for example, the current air quality position; the Welsh Government position; transportation; planning & development; sustainable fuels and clean air zones. In reviewing the information the task group drew upon a number of witness contributions and information sources including:

- Cabinet Members from Cardiff Council;
- Officers from Cardiff Council including representatives from Planning, Transportation, Energy & Sustainability, Highways, Waste Management and Fleet Management;
- Officers from Shared Regulatory Services;
- Public Health Wales;
- Cardiff & Vale Local Public Health Team;
- University of South Wales;
- Society of Motor Manufacturers;
- Representatives from local taxi companies including Premier Taxis, Dragon Taxis and Uber;
- University of the West of England;
- Bus industry representatives including Cardiff Bus, New Adventure Travel, Stagecoach Bus, Bus Users Cymru and Confederation of Passenger Transport;
- Welsh Government;
- Natural Resources Wales;
- Cardiff University;
- For Cardiff (Cardiff BID).

From this body of evidence the Members drew key findings and the 31 recommendations made in this report. The Environmental Scrutiny Committee Task & Finish Exercise will report to the Environmental Scrutiny Committee on the 17<sup>th</sup> April 2018, and subject to approval of the draft report it will be commended to Cardiff Council's Cabinet for consideration and response.

## INQUIRY TERMS OF REFERENCE

The aim of the inquiry is to provide Members with the opportunity to explore and consider how the Council can help to improve air quality in Cardiff. This will include reviewing:

- **Current Air Quality Position** - to include a report and analysis of the worst affected areas; the major contributing factors to air pollution in Cardiff; resources, monitoring arrangements & statutory responsibilities; the impact on public health; consider any existing air quality action plans for Cardiff; to consider air quality responsibilities placed on the Council.
- **Development of Cardiff's Clean Air Strategy** – to include a report on the aims and objectives of the strategy; associated policies that support the development of the strategy; resources and timescale for delivering the strategy; desired impact of the strategy and the main areas that the strategy will target.
- **Welsh Government Position on Air Quality** – to gain a better understanding of the policy objectives of the Welsh Government in terms of air quality; to understand the applicable timescales and consequences of the Council not meeting these policy objectives; to identify the key areas that Welsh Government believes should be targeted to achieve the best outcomes for air quality.
- **Transportation** – to understand the positive and negative impacts that transport (and transport systems) can have on air quality in Cardiff; to establish a hierarchy of transport pollution sources and evaluate what can be done to better manage the worst polluting sources; to review transport schemes and infrastructure planned for development or in the process of being delivered in Cardiff; to explore the benefits of sustainable fleet management in Cardiff; to consider the impact that changes in technology and public perception can have on air quality.

- **Other Pollution Sources** – to consider a range of pollution sources (excluding transport) and the impact that these have upon air quality in Cardiff; to establish a hierarchy of pollution sources (excluding transport) and evaluate what can be done to better manage the worst polluting sources; to review proposals currently being developed or delivered (excluding transport) to reduce pollution in Cardiff.
- **Planning & Development** – to understand how the planning and development process can be used to improve air pollution in Cardiff; to consider the current planning processes / policies and how these impact upon air pollution; the impact that the growth of the city might have upon air quality.
- **Sustainable Fuels** – to understand the challenges and opportunities that the growth of sustainable fuels can have upon air quality in Cardiff; to consider the role of the Council in terms of helping to establish the local market for sustainable fuels; to consider what the Council and its partners can proactively do to support the move to sustainable fuels.
- **Clean Air Zones** – to understand how Clean Air Zones work; the impact that a Clean Air Zone could have upon air quality in Cardiff and the wider implications for the city; the costs and opportunities of setting up a clean air zone; best practice in delivering Clean Air Zones (to include domestic and international examples).

## RECOMENDATIONS

The recommendations for this report are set out in this section of the document. They based on seven separate areas that the task group believe should be the basis for the development of Cardiff's Clean Air Strategy. The seven areas are set out below:

- Public Health;
- Clean Air Strategy – The Next Steps;
- Planning;
- Transport;
- Sustainable Fuels;
- Council & Public Sector Partner Responsibilities;
- Consultation & Engagement.

The recommendations are based on the evidence received during the task & finish exercise and the key findings that are documented on pages 31 to 156 of this report.

### **Public Health Recommendation**

- **Recommendation 1** – It is clear that poor air quality is a significant health issue and that it has a negative impact on people living in Cardiff and across the wider region. It is estimated that it contributes to approximately 40,000 premature deaths in the United Kingdom every year and that some doctors believe that this is just the tip of the iceberg. Given the scale of the problem the task group recommends that improving public health should be documented as the primary reason for introducing a Clean Air Strategy in Cardiff. Ultimately nothing should be more important to the Council and its partners than improving public health.

## Clean Air Strategy – The Next Steps

- **Recommendation 2** - During the task & finish exercise it became apparent that achieving the EU air quality standards by 2022 was virtually impossible by using and / or accelerating existing practice, for example, by improving sustainable transport infrastructure and driving widespread public behaviour change. Not one of the many witnesses we asked was confident that the EU air quality target would be achieved in the short timescale available by carrying on with or accelerating the current approach. It was also clear in the evidence sessions that reaching the challenging target 'in the shortest time possible' would almost certainly involve the creation of some kind of clean air zone or low emission zone. That said, working out what is best for Cardiff in terms of air quality is an evidence based scientific exercise that will be delivered in the form of a feasibility study. Such a study will review a range of alternative options for achieving the air quality standards and assess which is most likely to achieve the change needed 'in the shortest time possible'. There are many different 'Clean Air Zone' options and variations, for example, congestion charging zones, low emission zones and low emission neighbourhoods. These are further complicated by geographical boundaries, emission levels, vehicle types, financial implications and time / date restrictions. Working out the best option to take is a significant challenge that will require time, expertise, clear guidance and financial resources - unfortunately based on the evidence provided Cardiff appears to be short on all four. With all of this in mind the task group recommends that the Council:
  - Continues to work with and lobby the Welsh Government for a clear direction and guidance on the next steps to take in terms of achieving air quality compliance 'in the shortest time possible';
  - Ask the Welsh Government to provide financial assistance to undertake the feasibility study and to deliver the option identified to

improve air quality in the feasibility study;

- Employ suitably qualified experts to deliver the feasibility study and help implement the option identified in the feasibility study to improve air quality;
  - Consider, evaluate and scrutinise the advice before taking a final decision as to the way forward;
  - Waste no further time in carrying out the feasibility study – the EU air quality limits need to be addressed by either 2022 or in the soonest time possible. The evidence presented suggests that feasibility studies take about two years to deliver and at the point of writing this report the Council had not started its feasibility study for Cardiff.
- **Recommendation 3** - All evidence presented to the task group identified nitrogen dioxide produced by motor vehicles to be the single biggest air quality pollutant in Cardiff - with diesel vehicles being the major offender in this category. As we are ultimately looking to reduce air pollution in the city the task group recommends that the new clean air strategy cites the reduction of nitrogen dioxide from diesel vehicles as one of its key aims, and that whenever possible actions resulting from the clean air strategy specifically reflect this aim.
  - **Recommendation 4** - The task group believe that Cardiff on its own cannot fully address the air pollution issues facing the city. As has been explained in the report nitrogen dioxide is Cardiff's largest pollutant and privately owned cars, particularly diesel, predominantly produce this. It is estimated that there are 81,800 commuter journeys into Cardiff each day from neighbouring local authorities and this volume of traffic undoubtedly has a negative impact on air quality. The two sections of road that when modelled breach EU emission limits and mandate that action is taken are located on two of the main commuter routes into the city. In addition to this Cardiff is the main commercial hub for the South East Wales region, this means that a significant number of public transport journeys occur from neighbouring local authorities into the city. Understanding this

relationship means that we have to work with our neighbours to address the air quality problem, therefore, the task group recommends that we consult and work with neighbouring local authorities to develop the Clean Air Strategy and supporting action plan to improve air quality. It is important to remember that air pollution from motor vehicles does not start at the city boundaries and so any regional transport initiatives that encourage modal shift into Cardiff should in some way feature in any evolving air quality improvement action plan.

- **Recommendation 5** - It was noted during the task and finish exercise that the introduction of clean air zones, congestion charging zones and low emission zones tended to have a dramatic impact in increasing modal shift, for example, the London congestion charging scheme increased bus patronage by 14% in a very short period of time. Cardiff has in recent years worked hard to increase modal split and has the proud ambition of achieving a 50:50 modal split by 2026. Should the feasibility study recommend some type of clean air zone, congestion charging zone, or low emission zone as the way forward the Council should not be afraid to implement the decision as it will ultimately help achieve its biggest existing transportation target.
- **Recommendation 6** - A low emission neighbourhood is an area-based scheme that includes a package of measures delivered within a specific area and is focused on reducing emissions and promoting sustainable living locally. Such schemes have been implemented in five areas across London and have focused on locations with high pollution. They aim to reduce pollution levels through local measures and reducing the number of local journeys undertaken. Key to their success is the partnership and involvement of the local community, businesses and the local authority to jointly identify and deliver a common set of goals. Relevant projects could include working with major landowners to improve emissions from buildings; better management and reduction of freight movement and service vehicles entering the area, for example, the consolidation of deliveries and use of shared supplier scheme; the implementation of



emissions based on street parking charges and the introduction of electric vehicle charging infrastructure. The task group recommends that the Council look into the feasibility of creating a low emission neighbourhood in an area of Cardiff with the worst air pollution levels. It could act as a pilot for trialling air quality improvement initiatives and would be a first of its kind for Wales.

- **Recommendation 7** - Evidence provided and research gathered for the task & finish exercise clearly indicated that the cities that made the biggest improvements in terms of air quality also made the largest investment in terms of resources for dealing with the problem. In addition to this, the cities that have been the most successful in reducing air pollution received significant support from central government – both financial and policy guidance terms. For example, three of the top twelve performing European cities in terms of reducing air pollution were in Germany. Germany is also responsible for 55 of the 225 European low emission zones - in contrast the United Kingdom has only created two low emission zones. On this basis the task group recommends that the Council continues to lobby the Welsh Government for clear direction and financial support, and that it invests as much money and effort as possible to drive air quality improvements across the city.

## Planning Recommendations

- **Recommendation 8** - Cardiff has a well-established planning system that is able to assess, consider and deal with any air quality issues that might arise through the planning process. The Shared Regulatory Service is able to act as a consultee on any specific air quality planning matters and other public sector bodies such as Natural Resources Wales can provide specialist expertise on the topic should a complex case arise. However, the numerous factors that impact on our relationship with air quality standards is constantly changing, and means that we continually need to review our planning process to ensure that they keep pace with changing demands. For example, Newport City Council has recently created supplementary planning guidance for dealing with air quality issues, while other local authorities have developed supplementary planning guidance for dealing with emerging issues such as sustainable fuel infrastructure. As a result the task group recommends that the Planning Service reviews its existing supplementary planning guidance in relation to managing air quality and implementing sustainable fuel infrastructure alongside the development of the Clean Air Strategy. If the Planning Service identifies any significant gaps in statutory planning guidance provision then an appropriate document(s) should be commissioned to ensure that such matters are properly addressed.
- **Recommendation 9** - When assessing planning applications the wider knock on effect on air quality should always be thoroughly considered. For example, the creation of a new housing development might accidentally create a traffic driven pollution problem several miles away that had not been properly considered by the planning process. The task group acknowledges that such assessments are sometimes carried out and that the introduction of the development master planning process has helped, however, this isn't always the case and sometimes the wider local implications are not considered. With this in mind the task group recommends a review into the wider traffic and pollution implications of

new developments. This should include a review of traffic modelling techniques and how planning obligation monies can be applied across a wider area to deal with the impact of traffic and pollution.

- **Recommendation 10** - In a world of shrinking financial resources it is important for the Council to take advantage of any additional expert support currently available. During the inquiry the Members were told that the Health Protection division of Public Health Wales and Natural Resources Wales were available to offer free expert advice on technical and complex air quality issues. The task group recommends that the Planning Service takes advantage of these expert resources as and when required.

## Transport Recommendations

### ➤ General

- **Recommendation 11** – There was broad agreement that the Council's travel plans for Cardiff were sound and if delivered would have a positive impact in terms of driving modal shift and improving air quality in the city. In addition to this it was acknowledged by several witnesses that we don't currently have the necessary infrastructure to ensure that we meet the EU air quality targets, and that the Metro proposals wouldn't be delivered within 'the soonest time possible'. One notable witness stressed that now was the time to deliver against the plans as we have moved from the position of 'predict & provide' to 'provide & promote'. On this basis the task group recommends that the Council notes the urgency of required change to meet air quality targets and does all that it can to deliver and then promote its existing transport proposals.
- **Recommendation 12** - Delivering the long-term infrastructure that is required to grow sustainable travel and drive modal shift is very important. The Council needs to be involved in helping to bring the large pieces of infrastructure to Cardiff and the wider South East Wales Region, for example, by playing its part in the development of schemes like the Metro. However, it is quite often the case that the Council is just a partner in such schemes and that ultimately it is reliant on the purse strings of other organisations (such as the Welsh Government) to ensure that large infrastructure schemes are delivered. At the same time it is important to remember that the Council has a number of short-term initiatives for influencing travel behaviour that are within its control. For example, the introduction of 20 mph zones; increasing residential parking schemes to 75%; working with and educating the public, local businesses and schools, etc.. The small changes that the Council is able to make can have a huge difference to influencing public behaviour and driving modal shift. On this basis the task group recommends that the Council should increase its

focus on the affordable short-term measures within its control.

- **Recommendation 13** – There are a number of existing and potential traffic / parking control measures that the Council is able to employ to help control the use of the public highway. For example, the Council currently delivers civil parking enforcement and moving traffic offences across the city and in theory could introduce a range of other charging schemes including congestion charging, low emission zones and a work place parking levy. All of these schemes are capable of generating significant levels of income that could be used to underpin the delivery of transport infrastructure improvements. With this in mind the task group recommends that monies raised from existing or proposed traffic / parking control measures is reinvested directly back into transport infrastructure. This would create a virtuous circle where driver penalties are reinvested to provide clean and sustainable long-term travel alternatives.
- **Recommendation 14** – During the task & finish exercise Members were informed that the Council is due to publish ‘Cardiff’s Transport & Clean Air Green Paper’ in the spring of 2018. The Environmental Scrutiny Committee would welcome the opportunity to scrutinise this document once it becomes available.

### ➤ **Public Transport Infrastructure**

- **Recommendation 15** - Several witnesses stressed the importance of completing the Cardiff Central Transport Interchange and the positive impact that it will have on increasing the use of public transport. It is felt that the facility will act as the heart of the regional transport network and, therefore, help drive modal shift. The task group agrees with this and urges the Council to work with developers to complete this facility ‘in the soonest time possible’. As an interim measure the Council should republish and distribute the map that was made available when the old bus station was first closed; this will provide a vital navigation tool for new / infrequent users of public transport and visitors to the city.

## ➤ **Active Travel (Cycling & Walking)**

- **Recommendation 16** – The task group agrees with the Public Health position around accelerating the improvement of infrastructure to support active travel (cycling & walking). Based on the evidence received during the inquiry the task group recommends that:
  - The Council continues with improvements and ongoing development of dedicated walking and cycling infrastructure, for example, by accelerating the development of segregated cycle lanes in Cardiff;
  - The Council continues to improve access to local green spaces by active travel, for example, improving walking and cycling access in Cardiff's parks;
  - The Council actively promotes and encourages the use of its recently introduced 'NEXTBIKE' cycle hire scheme. Members felt that such schemes provide a positive message in terms of sustainable travel and encourage behaviour change;
  - The Council continues with its roll out of 20 mph schemes in the city. Members felt that 20 mph schemes support the growth of active travel (cycling and walking) by reducing average vehicle speed. This in turn creates a safer travel environment and so encourages people to undertake more cycling and walking journeys. Quite a few of the witnesses to the inquiry were very supportive of the continued roll out of 20 mph zones.
- **Recommendation 17** - The Council, public sector partners, major employers and For Cardiff (the Cardiff BID) should do all it can to encourage their staff to use active travel to get to work and carry out day to day trips whenever possible. The Council should work with these groups to create a strategy to drive this change and identify practical incentives that can be directed at staff to encourage modal shift. Suggestions could include the expansion of flexible working; increasing

the option of home working; travel discounts for using park & ride facilities; involving major employers in the planning of car free days; issuing support and direction to employers to provide and fund bike stands; providing information on cycle lanes and safe cycle routes; selling the health and well-being benefits of active travel.

## ➤ **Parking**

### **Recommendation 18**

Car parking is an important factor in managing travel behaviour. Cheap plentiful parking encourages car journeys into an area, while placing physical restrictions and financial barriers on parking supply encourages a positive modal shift. As stated in many parts of this report, reducing car journeys into and out of Cardiff is key to meeting air quality targets. It is also, in part, something that the Council has control over and so is able to change. With this in mind the task group recommends that the Council should:

- Consider gradual increases in public car parking charges in city centre areas as public transport options are improved. The funding raised by the public parking charges should then be used to pay for and accelerate improvements in active travel facilities and public transport;
- Run a consultation on private parking facilities in the city to identify how much it is used and to understand the impact that it has on businesses, congestion and air quality;
- Consider what the Council can do to manage the large amount of private parking in Cardiff, for example, a review of the planning process around car park development to encourage modal shift;
- Review the option of introducing a workplace parking levy to Cardiff. Nottingham has successfully introduced a workplace parking levy which has increased modal shift and raised significant funds (£44 million) for transport initiatives in the city;

- Consider variable parking charges to correspond with traffic parking demand when next reviewing the parking charges within the Parking Revenue Account;
- Develop further methods to encourage 'For Cardiff (Cardiff BID)' members and their staff to use the park & ride facilities offered by the Council - if successful this would help reduce traffic movements into the city.

➤ **Taxis**

- **Recommendation 19** – As a part of the task & finish exercise Members met with representatives from the taxi industry to discuss the air quality challenges facing taxi drivers and companies in the city. It was clear during discussion that there is an understanding of the future challenges facing the industry, for example, some companies have already taken steps to address the problem by procuring low emission vehicles. However, the ongoing Welsh Government Taxi Consultation and a lack of financial assistance for the taxi industry in Wales has created uncertainty and stalled vehicle investment decisions. Other issues discussed during the meeting included existing taxi licensing policy; emissions levels and the use of bus lanes. Based on the evidence gathered, discussion at the meeting and the key findings the task group recommends that:

- The Council makes a clear statement that sets out the Council's ambitions for taxi emission standards in the city and explains out how this might be achieved, for example, Nottingham has stated that it wants to significantly reduce taxi emissions in the city by converting all of its taxi fleet to electric by 2025;
- The Council needs to work with Cardiff's taxi companies and drivers to establish and implement a reasonable timescale to set a minimum emissions standard for taxis operating in the city, with the new minimum emissions standard being built into the existing licensing policy. To support this change the Council should work with the taxi companies and drivers to identify potential financial assistance to



deliver the change, for example, an approach could be made to Welsh Government asking for support – such transitional support has been provided in cities like Dundee, Derby and Birmingham;

- Taking the Welsh Government Taxi Consultation into consideration the Council should review the use of the ‘Exceptional Conditions Policy’ and wider ‘Taxi Licensing Policy’ to make sure that it is fit for purpose and complies with the aim of improving air quality in the city;
- The Council needs to work closely with the taxi companies and drivers to ensure that parking or blocking of bus lanes stops. It should be made clear that enforcement action will be taken by the Council against any drivers who block the bus lanes. The task group recommends that any driver found blocking a bus lane should be fined and ultimately have the privilege removed if they persist in doing it. In return for this support the Council should acknowledge that the number of Hackney Carriage licences greatly exceeds the number of taxi rank spaces and carries out a review of taxi rank facilities in the city centre. It would be appreciated that any response to this recommendation is supported by a series of proposed actions and agreed timescales as this matter has been raised at previous scrutiny meetings during the last twelve months.

### ➤ **Buses**

- **Recommendation 20** – As a part of the task & finish exercise Members met with a number of bus company and passenger group representatives. It was clear from discussion that they understood that overall bus emission levels needed to fall to help improve air quality, however, to achieve this substantial and ongoing financial assistance would be required from the public purse. Several references were made to the lack of Welsh Government funding to support bus services in Wales; this was in contrast to the support offered other parts of the United Kingdom and indeed to the rail network. Other issues discussed during the meeting included emission

levels in the city centre; bus company business planning and investment in future vehicles; the introduction of low emission buses; park & ride and bus lane infrastructure and a single ticketing approach. Based on the evidence gathered, discussion at the meeting and the key findings the task group recommends that:

- The City Centre Air Quality Management Area (predominantly based around Westgate Street) has the highest levels of nitrogen dioxide concentrations in Cardiff - this is significantly impacted by approximately 140 bus movements per hour. It is estimated that buses account for 56% of the nitrogen dioxide emissions and that 63% of the bus movements in the Westgate Street area are from vehicles that are Euro 4 or less. To provide some context the Euro 5 standard was established on the 1<sup>st</sup> September 2009; this means that over half of the bus movements in Cardiff's worst polluted street are from vehicles that are approaching ten years of age or more. This local air pollution problem is compounded by the canyon nature of the street. Members of the task group believe that air quality improvements are urgently required in this very busy area and recommend that the Council should work with local bus companies to explore the feasibility of restricting older buses from the area. Options that should be considered might include the creation of a 'greener bus route' or developing a low emission zone in the area that might exclude buses that fail to meet a specified emissions standard, for example, Euro 6. The Members of the task group acknowledge the challenges that this might present to local bus companies, however, such restrictions have been applied in other parts of the country and have dramatically reduced nitrogen dioxide emissions.
- Bus companies should be asked to work with the Council and provide a business plan to illustrate how they plan to reduce bus emissions for bus journeys in the Cardiff in the next three years. This would correspond with the timescale for achieving compliance with the EU air quality limits and help provide focus on the role that they have in

helping to achieve this target.

- In terms of financial support to reduce bus emissions it is clear that Welsh bus companies are a poor relation when compared to their Scottish and English counterparts. Government funding has been put in place in other parts of the United Kingdom to help support the transition to cleaner buses, while the Welsh Government in comparison has provided very little. The Council should support the local bus companies by lobbying the Welsh Government for financial assistance for bus services in Cardiff and Wales.
- There are no low emission buses operating in Cardiff or indeed Wales. The Council should do what it can to bring a low emission bus to the Capital City, for example, supporting a major bus provider to procure and introduce one or more hydrogen buses would be a very positive step forward.
- The Council should continue with its development and promotion of Park & Ride and bus lane infrastructure across the city. These are essential in driving modal shift and will be a key ingredient in supporting the wider Metro effort. Effective bus lanes help reduce journey time and improve punctuality – this in turn breeds confidence and convenience into the system, important for delivering modal shift. To compound this park & ride journeys should be punctual, quick and direct. Members were aware of park & ride journeys that made multiple stops between the park & ride facility and city centre – this adds time and makes the park & ride journey less attractive compared to using the private car, on this basis the Committee recommends that all park & ride journeys should be direct, i.e. not feature additional stops.
- Bus and train services in Cardiff should work towards a single ticketing approach in the South East Wales Region. Introducing this in line with the new Metro developments would appear to be a good opportunity and the functionality of the ticket should be similar to that of the London

Oyster Card.

- The Council should work with local bus companies and consider the potential option of introducing bus mounted transponders onto buses using bus lanes to enter and exit the city. In doing this feedback should be sought from the Swansea bus lane transponder scheme where they are used to send a signal to traffic lights before the bus actually arrives at the light. The signal changes the traffic light in favour of the bus to allow it to proceed smoothly without having to wait as standing traffic. This makes the bus journey quicker and ultimately more reliable – two important characteristics in helping to increase bus patronage.

➤ **Other**

- **Recommendation 21** - In recent years Cardiff has promoted itself as a cruise liner destination and has managed to attract some interest from visiting cruise liners. The task group was told that when a cruise liner visits a port it emits the equivalent amount of particulate matter as approximately of 100,000 vehicles entering the city – this is greater than the average number of commuter vehicles entering the city on a typical day. While the task group acknowledges the economic benefit created by cruise liners it is also concerned at the level of particulate emissions that they produce and the impact that these emissions might have on public health. With this in mind the committee feels that when the Council is assessing the economic benefits of allowing cruise liners to dock it should also factor the environmental impact that they might create into the overall assessment.

## **Sustainable Fuel Recommendations**

### **➤ The Wider Picture**

- **Recommendation 22** - Recent market trends clearly illustrate that that low emission vehicles are the future of motoring – this is a very positive thing as the technology is much cleaner than traditional crude oil based fuels. The growth of sustainable fuels such as electric and hydrogen will result in air quality improvements, but will not necessarily reduce congestion. This future direction of travel means that Cardiff and Wales cannot afford to be left behind; therefore, the Council and its other public sector partners must do everything they can to embrace and support the change. With this in mind the task group recommends that:

- The Council continues with the development of its Sustainable Fuel Strategy and supporting list of short, medium and long-term action plans. Clearly documenting the actions that the Council is planning to take is a positive step forward;
- The Council works with and lobbies Welsh Government to create a sustainable fuel strategy for all of Wales. This is something that countries like Scotland have done and it would send a clear message of intent to all Welsh local authorities, public sector bodies, businesses and the wider public;
- The Council engages with other local authorities in the South East Wales region to encourage them to create and publish sustainable fuel strategies. When developing the strategies they should be encouraged to publish short, medium and long-term actions that align with those established for Cardiff. It is important to reiterate that air pollution doesn't just start at Cardiff's boundaries and so a regional approach is required;
- The Council engages with its public sector partners across the South East Wales Region to encourage them to create and publish

sustainable fuel strategies. When developing the strategies they should be encouraged to publish short, medium and long-term actions that align with those established for Cardiff. The Cardiff Public Services Board would seem to be a good place to table the debate on improving air quality and developing suitable sustainable fuel strategies across the public sector;

- The Council should encourage neighbouring local authorities and other public sector partners to issue positive proposals on how and when they intend switching existing fleet to sustainable fuel options. In addition to this, they should also be encouraged to build the use of sustainable fuels (such as electric and hydrogen) into their procurement processes for vehicles and the wider supply chain;
  - Cardiff has very little in the way of sustainable fuel infrastructure. Without the necessary charging and refuelling infrastructure it is very difficult to increase the use of electric and hydrogen fuelled vehicles in Cardiff and across the wider area. The Council needs to work with neighbouring local authorities, public sector partners and local businesses to identify what they can do to grow sustainable fuel infrastructure across the South East Wales Region. Welsh Government, neighbouring local authorities, public sector partners and major businesses should be asked to provide information on the sustainable infrastructure that they currently have and intend to provide or support. This information should then be collated to create a 'South East Wales Region Sustainable Fuel Infrastructure Map' that would then be published and circulated to various stakeholder groups to raise awareness of the options available.
- **Recommendation 23** –The task group recommends that the Council should work with local car dealerships to encourage the growth of electric, hybrid or hydrogen vehicle sales. In particular the following information should be clearly communicated:
    - That there is an urgent and legal need to improve air quality in the city

- this in part can be addressed through the increased use of electric, hybrid or hydrogen vehicles;
    - Details of existing and proposed sustainable fuelling infrastructure in the South East Wales Region;
    - The benefits to their customers for owning new electric, hybrid or hydrogen vehicles;
    - Details of any financial assistance available for the purchase of new electric, hybrid or hydrogen vehicles.
  - **Recommendation 24** – The Council should work with the motor industry to bring a trade show for electric, hybrid or hydrogen vehicles to Cardiff. To achieve this it should approach an established industry body or motor trade show provider (for example, the Society of Motor Manufacturers & Traders or Green Fleet Urban) and invite them to deliver an event aimed at the motor vehicle industry in Wales. Such an event would help to stimulate further interest in electric, hybrid and hydrogen vehicles and hopefully increase local take up of the vehicles.
- **Electric (EV)**
- **Recommendation 25** - Cardiff has no on street electric vehicle-charging infrastructure. Some private companies such as IKEA and ASDA have charging points at their sites but the offer is very limited. This means that electric vehicle charging opportunities are very limited in the city, making it difficult for people to refuel electric or hybrid vehicles. Cities like Manchester, Leeds and Bristol are pushing ahead in creating public on street charging infrastructure and it would be a shame for Cardiff to be left behind. The Council has recently commissioned a report that aims to identify the best way forward for electric charging infrastructure in the city. It aims to explore different charging methods; the challenges of installing on street charging; the various implementation options and the potential economic opportunities being presented to the Council and private sector.

It is important that we understand all of these factors before taking the next step. With this in mind the task group recommends that the Council considers and evaluates the content of the report before deciding on how to roll out electric charging infrastructure to the city. That said the need to make progress is immediate and so the Council should ensure that there are no unnecessary delays in the decision making process for taking this forward. Once a clear picture has been identified then it is essential that the Council does what it can to accelerate the delivery of this much needed infrastructure.

- **Recommendation 26** – The Council currently has only one electric vehicle. From the evidence provided it is clear that electric vehicles are a part of the solution in terms of improving air quality, therefore, we need to procure more of these vehicles. With this in mind the task group recommends that the Council builds the use of sustainable fuels (such as electric & hydrogen) into the vehicle and wider supply chain procurement process to support the growth of low emission fuels. If suppliers and contractors are keen to win our business then they should support our objective of improving air quality by using cleaner vehicles;

### ➤ **Hydrogen**

- **Recommendation 27** - Cardiff has no hydrogen-fuelling infrastructure; the closest refuelling site being found a few miles north of the city in Treforest. In total there are only three hydrogen-refuelling stations in all of Wales. The lack of convenient and accessible hydrogen refuelling infrastructure has been identified as the single biggest barrier to owning and running a hydrogen vehicle in Cardiff; without more infrastructure the market for hydrogen vehicles will simply not grow. The slow take up of hydrogen-fuelled vehicles seems to be a shame for a number of reasons, these include:
  - Producing hydrogen fuel is a relatively simple chemical process that



can be achieved anywhere;

- Water is the only emission produced by hydrogen fuelled cars;
- Refuelling a hydrogen car is a relatively quick process which can take anywhere between one and five minutes – this is comparable to refuelling to a petrol or diesel car and significantly quicker than charging an electric vehicle;
- The drive range on a tank of hydrogen is comparable to most petrol or diesel cars;
- South Wales has significant expertise in the production of hydrogen fuel;
- The hydrogen fuel cell was invented by a Welshman called Sir William Grove in 1839. It seems a shame to have invented the technology in Wales and then to have fallen behind the rest of the world in rolling out its use in motor vehicles;
- South Wales could play a significant role in supporting the supply chain for the production of hydrogen vehicles in the United Kingdom.

With all of this in mind the task group recommends that the Council needs to review and then do what it can to bring at least one hydrogen refuelling facility to Cardiff. Potential options include supporting a major fuel supplier to install a facility or developing a Council / public sector facility to fuel Council or other public sector vehicles. In particular, the Members of the task group would like to see a hydrogen bus and waste truck being introduced to the streets of Cardiff – the introduction of public sector hydrogen vehicles could act as a catalyst to underwrite the development of new refuelling infrastructure. Members understand that hydrogen vehicles are approximately twice the cost of similar petrol or diesel vehicles and so financial support would be required to make the purchase a reality. Contacting the Welsh Government for financial assistance for such a purchase would be a good starting point.

## **Council & Public Sector Partner Responsibilities - Recommendations**

- **Recommendation 28** – Improving air quality in Cardiff is an issue that affects everyone in the city. This means that a united public sector response is required and so it is vital that the Council and other major public sector partners assume a leadership role in driving this agenda forward. On this basis the task group recommends that the Council works with its public sector partners to:
  - Agree and work towards setting clear and meaningful targets for air quality improvement;
  - Implement air quality strategies and that detail time focused action plans to help achieve air quality compliance;
  - Communicate and educate the public on air quality issues;
  - Monitoring the progress achieved.
  
- **Recommendation 29** – The Council and all major public sector organisations should run a programme to encourage their staff to switch to active travel and encourage workplace practices to reduce the number of unnecessary journeys. For example, increasing work from home opportunities where practical; creating partnerships and discounted travel offers with public transport providers; increasing use of conference calls; emphasising the benefits of sustainable travel and implementing flexible start times.

## Consultation & Engagement Recommendations

- **Recommendation 30** – Once the Clean Air Strategy is complete and a clear direction of travel is established the task group recommends that the Council should do all it can to raise the profile of what is being done to improve air quality in Cardiff and explain why it is being done. This should involve a huge communications, consultation and engagement exercise that targets neighbouring local authorities, public sector organisations, major employers and the public. The aims and ambitions of the strategy should be highlighted; specific actions should be detailed and an explanation on the potential benefits provided. As with most change there will be negative feedback, however, evidence suggests that in the medium to long term the popularity of any significant proposals will increase.
- **Recommendation 31** – The Council should support an interactive consultation event during the feasibility study period with its public sector partners and Members of the business community to explain the air quality challenges facing Cardiff. This event should include a brainstorming session with the group to explore practical steps that Cardiff's employers could take to help improve air quality in the city. It would seem sensible to work with For Cardiff (Cardiff BID) to deliver this event as they are in direct contact with most of the employers in the city centre. A business community representative who took part in the inquiry felt that drawing on the collective experience and knowledge of the business community might identify ideas that public sector partners might not have considered. For example, drawing on his wider experience he explained that some cities in the United Kingdom had worked with businesses to introduce a voluntary ban on private workplace deliveries which it is estimated account for approximately 40% of private deliveries in a typical city centre.

## KEY FINDINGS

### **‘Improving Cardiff’s Air Quality’ - Meeting 1 - Wednesday 1st November 2017 - Setting the Background**

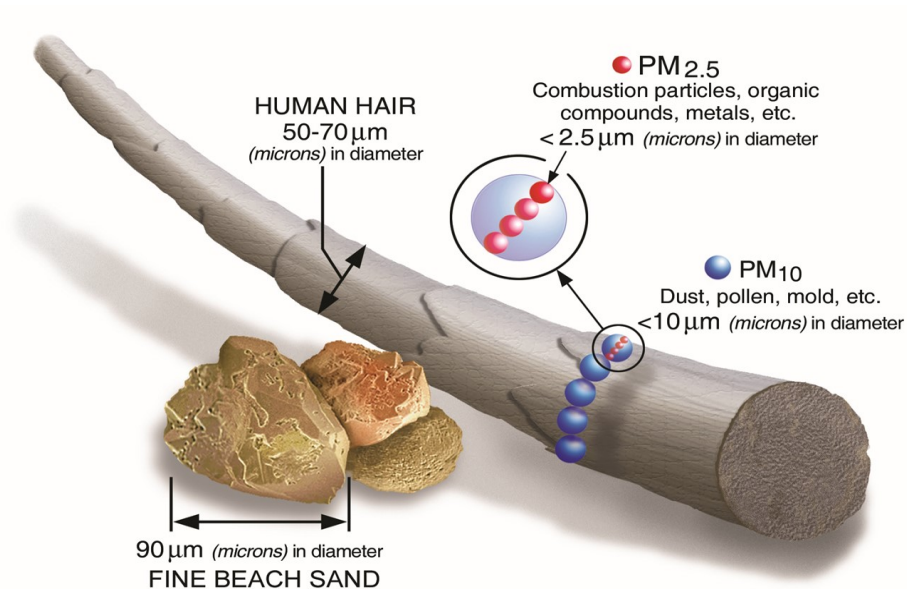
**Part 1 - A Review of Cardiff’s Current Air Quality** – Councillor Michael Michael, Cabinet Member for Clean Streets, Recycling & Environment, Councillor Caro Wild, Cabinet Member for Strategic Planning & Transport and Councillor Susan Elsmore, Cabinet Member for Social Care, Health & Well-being were invited to brief the task group on air quality in Cardiff. In doing this they identified the challenges and opportunities facing Cardiff’s air quality as well highlighting the main problem areas in the city. They were supported by officers from Shared Regulatory Services and the City Operations Directorate.

#### **Key Findings**

- Local air quality management is a statutory duty for all local authorities in the United Kingdom. This statutory responsibility is set out under Part IV of the Environment Act 1995 and air quality objectives for specific pollutants are prescribed in air the quality regulations.
- Exposure to air pollution reduces life expectancy by increasing mortality and morbidity risks from heart disease and strokes, respiratory diseases, lung cancer and other illness.
- In the UK, the health burden is substantial. It is estimated that the equivalent of 40,000 deaths occur each year as a result of exposure to outdoor pollution.
- Public Health Wales estimates that there are 225 attributable deaths to PM 2.5 and 220 attributable to nitrogen dioxide per annum in the Cardiff and Vale Health Board area each year.

- Particulate Matter (PM) – These are fine particles composed of a wide range of materials and sources. Current regulatory monitoring is focussed on PM<sub>10</sub>, however, PM<sub>2.5</sub> and ‘ultrafine’ particles are also vitally important in public health terms.
- Particulate matter can be carried deep into lungs. This can cause inflammation and worsen heart / lung diseases. It is also possible for particulate matter to carry surface-absorbed carcinogenic compounds into the lungs.
- The primary man made sources of PM are fuel combustion, transport, quarrying and construction.
- **Diagram 1** illustrates the relative sizes of particulate matter when compared against grains of sand and human hair.

**Diagram 1 – Relative Size of Particulate Matter (PM)**



- Nitrogen dioxide is the most common air pollutant in Cardiff. It is a secondary pollutant that that is mainly produced by vehicle emissions. Nitrogen dioxide is created when Nitric oxide is emitted from vehicles as a

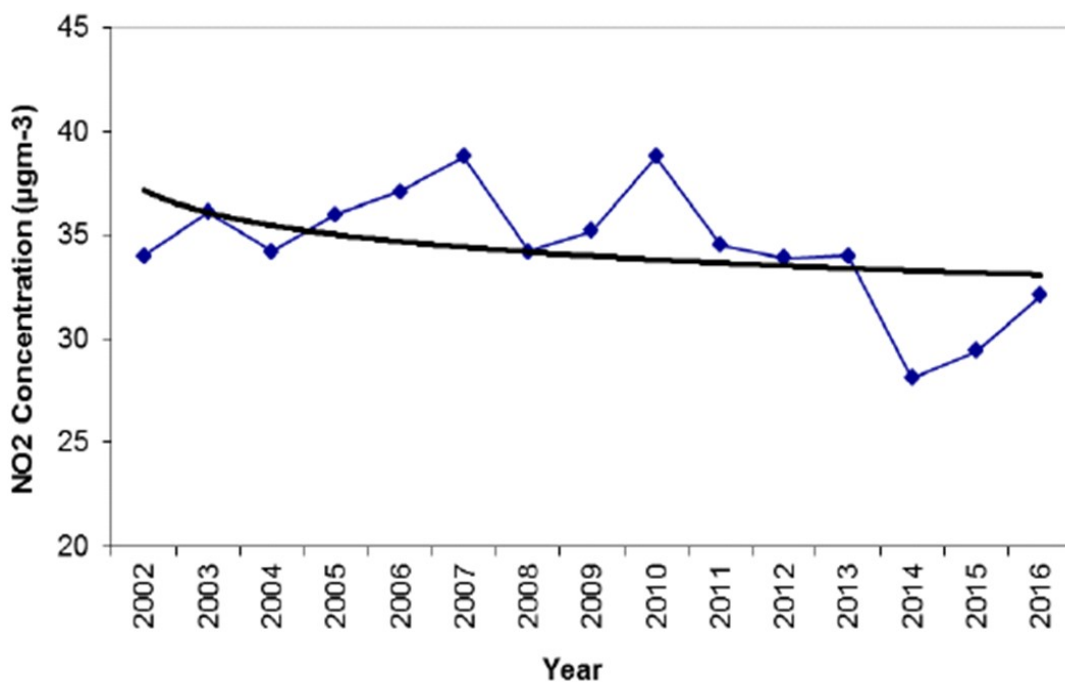
result of the combustion process – on its own it is not harmful to human health. However, nitric oxide then oxidises with atmosphere to form nitrogen dioxide which is harmful to health. Nitrogen dioxide can irritate lungs and lower resistance to respiratory infections.

- Continued or frequent exposure to concentrations higher than those normally found in the ambient air may cause increased incidence of acute respiratory illness in children.
- 2016 Local Air Quality Monitoring in Cardiff – there are 77 diffusion tubes located across Cardiff that are used to monitor nitrogen dioxide on a long term basis to provide annual average concentrations.
- Real time monitoring of ozone, particulate (PM10 & PM 2.5), sulphur dioxide, nitrogen dioxide is undertaken by the AURN on Frederick Street. This provides an overall background reading for the city – the latest results can always be accessed online by visiting:  
  
[http://www.welshairquality.co.uk/current\\_levels.php?lg=](http://www.welshairquality.co.uk/current_levels.php?lg=)
- Cardiff has four 'Air Quality Management Areas' which have been declared due to elevated nitrogen dioxide concentrations as a result of vehicle emissions. These are:
  - Stephenson Court Air Quality Management Area
  - Ely Bridge Air Quality Management Area
  - Llandaff Air Quality Management Area
  - City Centre Air Quality Management Area
- Maps of Cardiff's four Air Quality Management areas are attached to this report as **Appendix 1**.
- During 2016 Cardiff had a number of sites with exposure exceeding the 40µg/m<sup>3</sup> annual mean objective. In addition to this, it had a number of monitoring sites (11) that exceeded the 40µg/m<sup>3</sup> annual mean objective for nitrogen dioxide. The exceedences were predominantly contained within

the declared Air Quality Management Areas; however, there were four monitoring locations that were not located within Air Quality Management Areas.

- During 2016 the City Centre Air Quality Management Area experienced an increase of  $2\mu\text{g}/\text{m}^3$  in nitrogen dioxide concentrations.
- **Diagram 2** illustrates the results of nitrogen dioxide concentration monitoring for the years 2002 to 2016. Overall there has been a reducing trend during this period, however, since 2014 the nitrogen dioxide concentration levels have increased quite steadily.

**Diagram 2 – City Centre Air Quality Management Area Nitrogen Dioxide concentration monitoring - 2002 to 2016**

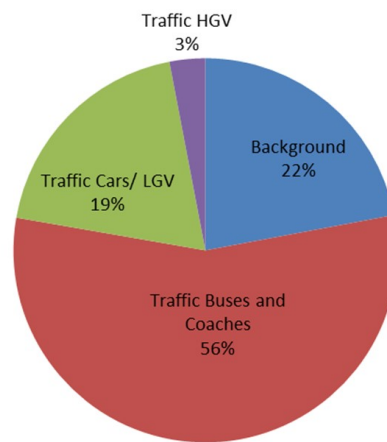


- Road traffic is the primary source of elevated concentrations of nitrogen dioxide for Cardiff. This is mainly caused by cars (predominately diesel), buses and coaches. A breakdown of the nitrogen dioxide source apportionment analysis for each of Cardiff's four Air Quality Management Areas is attached to this report as **Appendix 2**.

- The City Centre Air Quality Management Area (predominantly based around Westgate Street) has the highest levels of nitrogen dioxide concentration in Cardiff. This is significantly impacted by approximately 140 bus movements per hour. A breakdown of the nitrogen dioxide contributions by percentage can be seen in **Diagram 3** below:

**Diagram 3 – City Centre Air Quality Management Area Nitrogen Dioxide Contributions**

**City Centre AQMA (Westgate Street)**



- It is important to note that 56% of the Nitrogen Dioxide emissions for this area are caused by buses and coaches. From the 140 buses using this area:
  - 72 (51% of the overall total) have engines that comply with Euro 3 standards;
  - 17 (12% of the overall total) have engines that comply with Euro 4 standards;
  - 15 (11% of the overall total) have engines that comply with Euro 5 standards;
  - 36 (26% of the overall total) have engines that comply with Euro 6 standards.



- The Euro engine emission standards were first established in July 1992 with the launch of the Euro 1 standard. Since then an additional five overall standards have been added with the aim of reducing emissions and improving air quality. The most recent standard to be introduced is the Euro 6. **Appendix 3** that is attached to this report details the six Euro categories that have been created to date.
- Travel Patterns – during the presentation it was explained that 38% of Cardiff's workforce travel to Cardiff from outside the county area. This figure increased by 10% between 2004 - 2014. Figures from the census conducted in 2011 suggest that between 76% - 84% of the commuting workforce travel by car.
- Progress on Action Plans - Cardiff Council has a statutory requirement to produce Air Quality Action Plan(s) for Air Quality Management Areas. Previous experience in implementing singular action plans has not been as successful as has been required. Air Quality Action Plans focus on introducing local measures to individual road links/ areas - this only targets improving air quality within the identified Air Quality Management Area itself. Sometimes localised measures can lead to adverse impacts on air quality in surrounding areas as they don't address the actual root cause of air quality issues.
- The development of a Clean Air Strategy will target the whole of Cardiff to try and improve the overall air quality within the city. In doing this it is hoped that the Clean Air Strategy will help protect and improve public health.

**Part 2 - Development of Cardiff's Clean Air Strategy** - Councillor Michael Michael, Cabinet Member for Clean Streets, Recycling & Environment, Councillor Caro Wild, Cabinet Member for Strategic Planning & Transport and Councillor Susan Elsmore, Cabinet Member for Social Care, Health & Well-being were invited to briefed the task group on the development of Cardiff's Clean Air Strategy.

## **Key Findings**

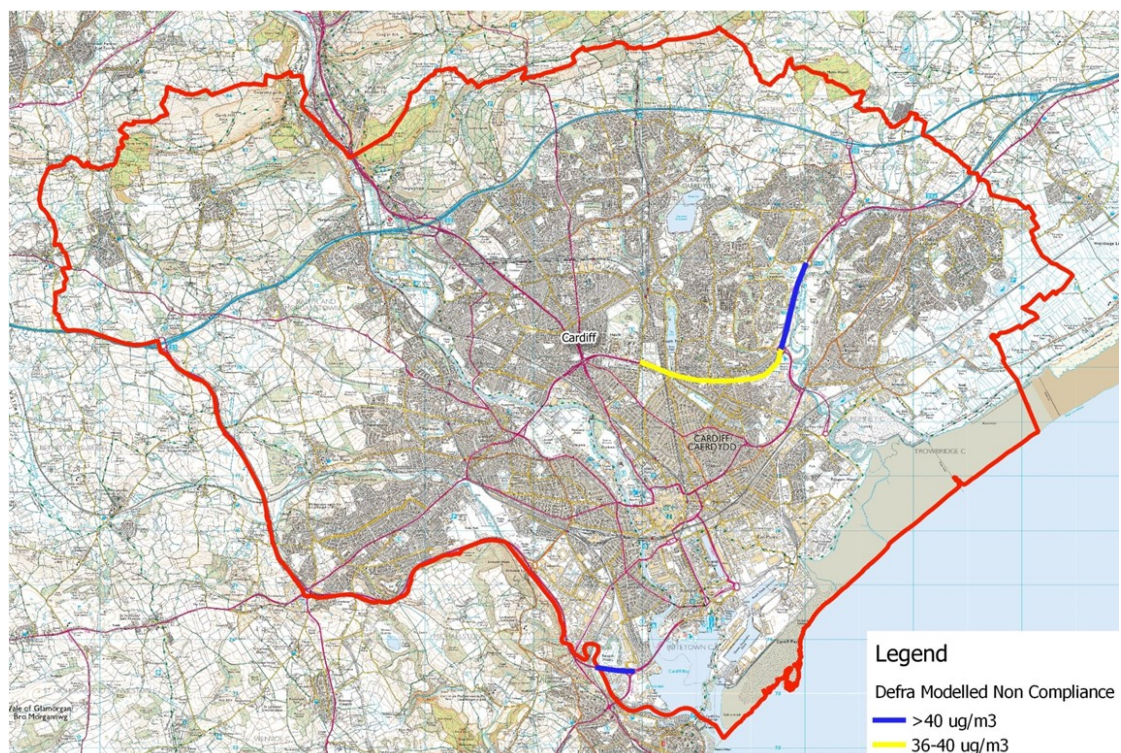
- It was explained that a collaborative approach is being taken in the development of Cardiff's Clean Air Strategy, i.e. the work was being spread across a number of portfolios and that it would involve the harmonising of existing strategies and policies. To help achieve the aims of this important strategy they are working with a number of external bodies, for example, Public Health Wales, Welsh Government and Industry/ Businesses.
- In developing the strategy the collaborative working group were reviewing best practice, NICE Guidance and a number of relevant strategies produced by other local authorities. A key aim of the strategy is to develop a number of strategic measures that would then be implemented through an action plan.
- The overarching aim of the Clean Air Strategy is to Improve Air Quality in order to protect and improve public health. Officers anticipated that this would be achieved by:
  - Enhancing Local Planning Policy - for example, by adhering to air quality related Local Development Plan policies and by creating relevant supplementary planning guidance to help improve air quality.
  - Enhancing Cardiff's Transport Infrastructure - for example, by delivering a Transport Strategy with the aim of reducing congestion,

increasing car clubs, delivering on 20mph zones and influencing behavioural change.

- Increasing the Uptake of Sustainable & Active Travel – for example, by delivering active travel improvements to increase cycling and walking; by supporting public transport improvements through buses, the Metro, trains, school travel plans and influencing behavioural change.
  - Implementing a Renewable Fuel Strategy & Improving OLEV Capacity – for example, by increasing electric charging infrastructure, by supporting alternative fuels (e.g. hydrogen); by delivering green fleet changes (with the Council to take a lead); by supporting industry change and by helping to influence behavioural change in the area of sustainable fuels.
  - Increasing Public Information & Behaviour Change Initiatives – for example, by delivering an effective communications strategy; by focusing on the promotion and marketing of the wider health and environmental benefits of tackling air quality.
  - Implementing Additional Regulatory Interventions – for example, by creating non-idling zones; through parking permit reform and as a part of a taxi policy review.
- The Clean Air Strategy will be vital to develop and implement strategic long term measures to improve air quality below and beyond Air Quality Standards across Cardiff, however, the strategy may not be sufficient to enable Welsh Government to meet legal ruling that compliance with the Ambient Air Quality Directive needs to be achieved in ‘the shortest time possible’ – this was established in a recent court case between Client Earth and the United Kingdom Government.
  - In order that legal compliance is achieved the United Kingdom and devolved governments have legal obligations to achieve nitrogen dioxide annual average limit value (40ug/m<sup>3</sup> AA) as set out in the EU Ambient Air Quality Directive (2008/50/EC) ‘in the shortest possible time, and is likely’.

- The United Kingdom government published its final action plan on the 26th July 2017. The policy paper titled 'Air quality plan for nitrogen dioxide (NO<sub>2</sub>) in UK (2017)' set out to detail the measures required to bring about compliance in shortest time possible.
- Modelling undertaken by Defra indicates that Cardiff will be non-compliant beyond 2023, and as such will be in breach of the Directive that could result in legal action/ fines being implemented. **Diagram 4** (below) illustrates the results of this modelling and indicates that the two routes highlighted in dark blue on the map would exceed the 40ug/m<sup>3</sup> limit and so create non-compliance. The two areas are both along key arterial routes into and out of the city, i.e. the A48 from the centre of the city going east and the A4232 in Grangetown to the west of the city. This theoretical modelling has concluded that the main reason for 40ug/m<sup>3</sup> limit breaches in these areas is the volume of diesel fuelled private vehicles using the routes, for example, the use of private diesel fuelled cars in the section of the A48 in breach accounts for 46% of the nitrogen dioxide emissions for the section.

**Diagram 4 – Defra Modelled 40ug/m<sup>3</sup> Estimated Limit Breaches in 2023**



- The following statements were included in the United Kingdom Published Action Plan in July 2017:
  - *‘The latest modelling undertaken by Defra identified areas across the UK that may need to implement a Clean Air Zone to achieve compliance in the shortest time. One area identified in Wales, for which, based on current projections, a zonal approach would accelerate compliance, is in Cardiff’.*
  - *‘Welsh Government anticipates a Clean Air Zone, with vehicle access restrictions, could be implemented in Cardiff during 2021 or earlier if possible, thereby achieving compliance by 2022 or sooner’.*
- If a local authority can identify measures other than charging zones that are at least as effective at reducing nitrogen dioxide, those measures should be preferred as long as the local authority can demonstrate that this will deliver compliance as quickly as a charging Clean Air Zone. If Cardiff cannot demonstrate compliance and doesn’t introduce a charging Clean Air Zone then Welsh Government can mandate the Council to implement a Clean Air Zone under Section 87 (2(j)) of the Environment Act 1995.
- Client Earth have stated that local authorities should ensure their plans meet the legal test set out in the High Court by:
  - Explaining exactly how the limit values can be met;
  - Taking the route that reduces people’s exposure as quickly as possible;
  - Ensuring that compliance is not just ‘possible’, but ‘likely’.
- Five cities in England were directed to implement Clean Air Zones in 2016. These were Leeds, Derby, Nottingham, Birmingham and Southampton. The 2017 Plan details additional local authorities in England that have been required to undertake action to achieve statutory nitrogen dioxide limit values within shortest time. These local authorities

have to produce draft action plans by March 2018, with final plans approved December 2018. The United Kingdom Government will assess these plans – if they are not able to demonstrate compliance in shortest time possible then they will be forced to implement a clean air zone.

- A £255m implementation fund has been created to support local authorities in preparing their plans and to deliver targeted action to improve air quality - £40m of this fund is immediately available. At the time of receiving this evidence, the Welsh Government had not indicated if Cardiff could apply for this funding or requested that such plans were put in place. Ongoing discussion was taking place on the issue.
- A Clean Air Zone is an area where targeted action is taken to improve air quality and resources are prioritised and coordinated in a way that delivers improved health benefits and supports economic growth. There are two types of Clean Air Zones, non charging and charging.
  - Non Charging Zones are defined geographic areas used as a focus for action to improve air quality.
  - Charging Zones are areas vehicle owners are required to pay a charge to enter, or move within, a zone if they are driving a vehicle that does not meet the particular emission standard for their vehicle type in that zone.
- Before any decisions are taken on the best option(s) for a Cardiff clean air zone a feasibility study will need to take place. At the time of the meeting it was hoped that a feasibility study would start in Quarter 1 2018 and that this could be delivered within a year. The Council had not identified a funding source to pay for a feasibility study and were negotiating with Welsh Government to attempt to secure monies to deliver the work. They acknowledged that the timescale for delivering a feasibility study was short – other local authorities (for example Bristol) had taken at least two years. The hope was that the Council would learn from the mistakes of the other local authorities and deliver the piece of work in a year. It was anticipated

that much of the work for the feasibility study would involve traffic modelling across the city.

- It was hoped that the results of the feasibility study would go out for consultation in early 2019 with a final plan being delivered by the end of 2019.
- At the time of the meeting the Welsh Government had yet to define the strategic measures to be applied in the development of the feasibility study. English local authorities have received guidance on the strategic measures to be used in feasibility studies from DEFRA.
- Members felt that clear guidance and funding was needed from the Welsh Government to help drive the whole process forward.

**Part 3 – Welsh Government Statement** - The task group to received an air quality update statement from the Welsh Government. The statement set out the current Welsh Government position on managing air quality in Wales and the Cardiff local authority area.

### **Key Findings**

Representatives from the Welsh Government were unable to attend the meeting and so provided a statement to set out the Welsh Government position titled 'Air Quality in Wales – the National Context'. The statement is attached to this report as **Appendix 4**. Extract containing the main points from **Appendix 4** are set out below:

- *Taking further action to improve air quality in Wales is a key priority in the Welsh Government's National Strategy, Prosperity for All. In 2018, the Welsh Government will develop and consult on a new Clean Air Plan for Wales, including a Clean Air Zone framework.*
- *The United Kingdom currently meets the legal limits for almost all pollutants but faces significant challenges in reducing levels of nitrogen dioxide.*
- *Non-compliance with EU legal limits for nitrogen dioxide across the United Kingdom and Europe is associated principally with high vehicle emissions in urban areas. This is due both to the significant growth in vehicle numbers and to European vehicle emission standards not delivering the expected reductions in emissions of nitrogen oxides from diesel vehicles.*
- *In the event of exceedances of EU legal limits, air quality plans produced by Member State governments are required to set out appropriate measures to attain compliance in the soonest time.*
- *New evidence received from Defra in early 2017 showed compliance with EU legal limits for nitrogen dioxide in Wales will take longer than the 2015*



*UK Air Quality Plan had previously predicted. Defra's modelling now predicts non-compliance in Cardiff until 2023.*

- *The Welsh Government therefore set out further remedial measures to accelerate the pace of compliance in Wales. These were published in July 2017, within a new UK Air Quality Plan:*

<https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017>.

- *We need all levels of measure, local and national, to deliver compliance in the soonest time possible, requiring close joint working with Local Authorities and others.*
- *The need for urgent action is not just about compliance with law; the essential reason for action is the health of our citizens.*
- *The Welsh Government is working with Cardiff Council to help the Council bring its area within the legal limits in the soonest possible time and to protect the health of people over a wider geographical area.*
- *The Welsh Government is also working with Local Authorities to strengthen air quality provisions in Planning Policy Wales to prevent new problems from arising.*

### **Clean Air Zones**

- *The latest modelling undertaken by Defra identified areas across the United Kingdom that may need to implement a Clean Air Zone to achieve compliance in the shortest time. One area identified in Wales, for which, based on current projections, a zonal approach would accelerate compliance, is in Cardiff. The Welsh Government anticipates a Clean Air Zone, with vehicle access restrictions, could be implemented in Cardiff during 2021 or earlier if possible, thereby achieving compliance by 2022 or sooner.*

- *Implementation of a Clean Air Zone will need to be subject to further assessment and ongoing work with Cardiff Council to understand whether alternative local measures could achieve compliance more quickly. Where alternative local measures are suggested, to be effective they must be capable of achieving compliance within the same amount of time, or sooner, than a Clean Air Zone with access restrictions. This further assessment will need to be based on local as well as national data modelling relating to both air quality and transport. The modelling will be followed by a thorough options assessment, local consultation, planning and implementation. The actions up to the point of implementation should complete during 2019.*
- *The Welsh Government intends to consult on a Clean Air Zone framework for Wales as soon as possible and in any event no later than the end of April 2018.*

## **Legislation**

- *Under domestic legislation, specifically the Environment Act 1995 and associated regulations, the local air quality management (LAQM) regime requires Local Authorities to review and assess air quality in their areas against objectives and standards for a range of averaging periods for a number of air pollutants. Assessment of air quality is focused on locations where members of the public are regularly present and where there is exposure to the pollutant in question over the timescale for which the air quality objective is defined. Under LAQM, Cardiff Council has declared four air quality management areas for non-compliance with the annual average air quality objective for nitrogen dioxide. The Council has produced an action plan for only one of these areas to date, but has advised the Welsh Government that the Council's new Clean Air Strategy and Action Plan, expected in draft by the end of March 2018, will incorporate actions covering all four air quality management areas as well as the city as a whole.*

- *The Well-being of Future Generations (Wales) Act 2015 (“the WFG Act”) requires public bodies in Wales, including the Welsh Government and Local Authorities, to carry out sustainable development. This is the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the seven national well-being goals. Specifically, public bodies in Wales must act in a manner which seeks to ensure the needs of the present are met without compromising the ability of future generations to meet their own needs.*
  
- *One of the national well-being indicators under the WFG Act is average population exposure to nitrogen dioxide.*  
*(<https://statswales.gov.wales/catalogue/environment-and-countryside/air-quality>). This has been calculated at a Local Authority as well as a national level, and indicates that Cardiff Council has the highest average concentration of nitrogen dioxide where people live of any Welsh Local Authority, Statutory guidance issued by the Welsh Government in June 2017*  
*(<http://gov.wales/topics/environmentcountryside/epq/airqualitypollution/airquality/guidance/policy-guidance/?lang=en>) joined up these two domestic regimes by requiring Local Authorities in Wales to follow the ways of working set out in the WFG Act when carrying out LAQM. The Welsh Government also made regulations in 2017 requiring Public Services Boards to consider Local Authorities’ LAQM progress reports when carrying out assessments of local well-being.*
  
- *National improvements in air quality have also been driven by European Directives, including those that set limits on:*
  - *Concentrations of pollutants in ambient air (for example, the Ambient Air Quality Directive which sets EU limit values for air quality in Member States, similar to the national air quality objectives under LAQM);*
  - *Annual pollutant emission totals for each Member State, helping to tackle trans-boundary pollution (for example, the National Emission*

*Ceilings Directive, which implements the UNECE Gothenburg Protocol); and,*

- *Concentrations of pollutants from specific sources (for example, the Industrial Emissions Directive which, together with domestic environmental permitting legislation, controls emissions to air from industrial sites regulated by Natural Resources Wales and Local Authorities, and EU legislation covering car and lorry exhaust pipe emissions).*
- *Under European legislation, the Ambient Air Quality Directive (2008/50/EC) requires the Welsh Ministers to secure compliance as soon as possible with EU air quality limit values at locations where the public has access. The work of Local Authorities in relation to LAQM makes an important contribution to actions being implemented by the Welsh Government to achieve compliance with EU legal limits.*
- *The Cabinet Secretary for Environment and Rural Affairs wrote to the Leaders of all Welsh Local Authorities in July 2017, emphasising the importance of their public protection, planning and transport departments taking joint ownership of the LAQM work programme, and, in Cardiff's case, of having regard to the non-compliance with EU air quality limit values highlighted in the UK air quality assessment.*

## **Improving Cardiff's Air Quality - Meeting 2 – Public Health - Wednesday 8th November 2017**

**Impact of Air Quality on Health – Public Health View** – Dr Huw Brunt and Dr Tom Porter were invited to provide the Public Health Wales view on the impact of air quality on health in Cardiff. Councillor Susan Elsmore, Cabinet Member for Social Care, Health & Well-being was also invited to attend to provide context on the work that the Council is delivering in this area.

### **Key Findings**

- It was identified that the linkages between air pollution and health were:
  - Air pollution has been identified as the single most significant environmental determinant of health;
  - Exposure to air pollution is associated with increased mortality and morbidity risks;
  - It has created a substantial health burden in the United Kingdom, for example, PM2.5 - equivalent of 29,000 annual deaths (or 307,000 lost life-years); Nitrogen Dioxide - equivalent of 23,500 annual deaths (or 277,000 lost life-years). Overall it is estimated that it contributes to 40,000 premature deaths in the United Kingdom every year – some doctors actually believe that this is just the tip of the iceberg.
  - On average it is estimated that it contributes to a reduction in life expectancy of seven or eight months.
- It was explained that the national-level burden estimates masked local variations in air quality. Some people are more at risk than others, this can be driven by 'differential exposure vulnerability', for example, exposure to high air pollution concentrations and 'differential susceptibilities' for example, intrinsic factors such as age, sex, genetics, ethnicity and acquired factors such as chronic illness, lifestyles and behaviours and

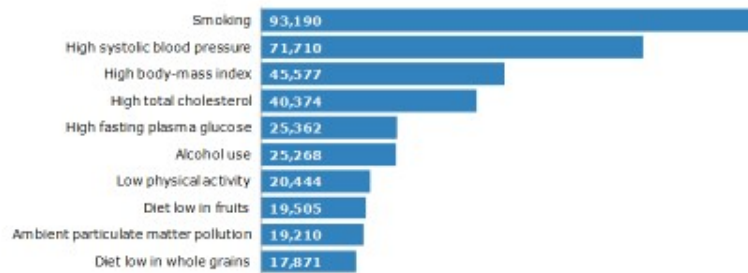
multiple deprivation. This is further complicated by interaction with a wider range of other health determinants.

- 'Triple jeopardy' in Wales – research has been carried out to explore the relationships between linked air pollution, deprivation and health data. The research identified that the air pollution concentrations are highest in the 'most deprived' areas where population most is susceptible.
- Public Health was described as a key stakeholder in dealing with air quality management. As a part of its role it aims to:
  - Support others to assess air pollution in the context of public health risks;
  - Support others to mitigate risks;
  - Advise and support planners and regulators;
  - Provide information to the public to reduce risks and drive behaviour change;
  - Manage public health risks associated with acute and chronic incidents;
  - Influence and support action to improve corporate environmental sustainability;
  - Lead evidence-based change through effective advocacy and informed policy development.
- It was explained that the main legislative drivers for change were Environment Act 1995 (LAQM); Environment (Wales) Act 2016; Active Travel (Wales) Act 2013; Climate Change Act 2008; Planning (Wales) Act 2016 and the Public Health (Wales) Act 2017. These in turn feed into the Wellbeing of Future Generations (Wales) Act 2015 which is underpinned by seven well-being priorities, i.e. a globally responsible Wales, a prosperous Wales, a resilient Wales, a healthier Wales, a more equal Wales, a Wales of cohesive communities and a Wales of vibrant culture and thriving Welsh language.

- The health impacts of air pollution are associated with cardiovascular and respiratory disease, stroke, cancer, diabetes, low birth weight and dementia. In addition it was explained that:
  - One fifth of cases of low birth weight are due to traffic related air pollution;
  - An estimated 5% of deaths in Cardiff and Vale are due to particulate matter air pollution;
  - Levels of nitrogen dioxide in Cardiff and Vale residential areas are the highest in Wales.
  
- In terms of the broader public health context it was illustrated that the way in which we travel has significantly changed over time, for example:
  - 1952 - 42% of journeys were by bus, this reduced to 5% by 2016;
  - 1952 - 11% of journeys were by bike, this reduced to 1% by 2016;
  - 1952 - 27% of journeys were by car, this increased to 83% by 2016;
  - 2015 - total motor vehicle traffic in Great Britain reached a new record level;
  - 1928 - 42 million journeys were taken by tram in Cardiff in 1928 (that is the equivalent of 150 return journeys in the city per person per annum);
  - 1950 - The Cardiff tram system closed in 1950. Most housing and commercial developments over the last 50 years have been shaped by cars, not people.
  
- **Diagram 5** sets out the top 10 risk factors for years of life lost in Wales in 2015. Four of the top ten are impacted by car use (high systolic blood pressure, high body mass index, low physical activity, ambient particulate matter pollution).

## Diagram 5 – Top 10 Risk Factors for Years of Life Lost in Wales 2015

**Figure 3. Top 10 risk factors for years of life lost (YLL) in Wales (2015). Four of the top ten are impacted by car use.<sup>16</sup>**



- The car has seven general effects on health and well-being in Wales, these were air pollution; road traffic injuries and deaths; reduction in green space; climate change; physical inactivity and sedentary lifestyles; increase in loneliness and social isolation and exacerbating health inequalities. The effects on health and well-being are expanded upon below:
  - **Physical Inactivity & Sedentary Lifestyles** – over half (54%) of adults in Cardiff and Vale are overweight or obese; sedentary lifestyles are associated with 91% increase in the risk of type 2 diabetes; people are much less likely to undertake active travel if they have a car.
  - **Road Traffic Injuries & Deaths** – there are 20 road accidents causing death or serious injury each week in Wales; the most common cause of death for children aged 5 to 14 years is being hit by a vehicle; half of car drivers in 30mph zones routinely exceed the speed limit.
  - **Increase in Loneliness & Social Isolation** – Nearly 1 in 4 vulnerable people in Cardiff and Vale report being lonely some or all of the time. Reducing car use and increasing access to public transport support healthy ageing in urban environments and is attributed to increasing social interaction.



- **Reduction in Green Space** – Green spaces are associated with improved social interactions, increased physical activity and cardiovascular health and reduced mortality.
  - **Exacerbating Health Inequalities** – Cars are owned and used more by the least deprived, but adverse impacts are felt most by the most deprived. Children in more deprived wards are four times more likely to be hit by a car compared with the least deprived wards.
  - **Climate Change** – Global temperatures are expected to increase by 4 degrees celsius by 2100 if current trends continue, with some areas experiencing 10 degrees Celsius increases. Flood related displacement of communities has been found in the United Kingdom to cause significant and enduring mental health issues; one quarter of domestic greenhouse gas emissions are due to car transport.
  - **Air Pollution Health Impacts** – cars are associated with cardiovascular and respiratory disease, stroke, cancer, diabetes, low birth rate and dementia.
- Public Health Wales believes that addressing the causes of transport-derived air pollution will have broad public health benefit. In doing this we need to:
    - **Support active travel and public transport** – Daytime journeys of less than 2km should be walkable for individuals aged 5 to 74; for many people the trigger to take up active travel is a significant life event; to achieve change we need to provide high quality, flexible public transport. The National Institute for Health & Care Excellence found that off-road cycle routes were good value for money, with every £1 investment in off road routes returning around £14 in benefits.
    - **Reduce Air Pollution & Carbon Emissions** – NICE (National Institute for Health & Care Excellence) recommends the introduction of Clean Air Zones which support low emission travel. The NHS should set the benchmark for clean air and safe workplaces.



- Maximise opportunities presented by the Metro programme;
  - Introduce bike hire schemes (including e-bikes);
  - Consider the widespread introduction of 20mph zones;
  - Increase electric vehicle charging infrastructure, particularly for areas without off-street parking;
  - Reject planning proposals which have an adverse impact on walking or cycling;
  - Support local renewable energy generation.
- Public Health felt that it was important to support staff to choose active travel options and suggested that the Council should work with employers to help them:
    - Encourage all staff to travel actively, to reduce sickness absence and productivity;
    - Provide visible senior leadership and role modelling;
    - Assess opportunities at times of workplace moves;
    - Support employees preparing for retirement.
- Public Health Wales felt that it was important to engage with the local community and businesses on the benefits of active travel and to discourage unhealthy and polluting travel, suggestions on how to do this included:
    - Agree consistent communication across local public sector;
    - Emphasise increased customer spend in walkable areas;
    - Organise and promote co-ordinated car free days across the region;
    - Introducing 'no idling' zones outside all schools;

- Consider gradual increases in public car parking charges to fund and accelerate improvements in active travel facilities and public transport;
  - Scope the introduction of a low emission zone in Cardiff, with any charges levied used to fund active travel and public travel transport improvements;
  - Introduce low emission pool cars for major sites where they are not already in place.
- The Health Protection Division of Public Health Wales has supported Newport Council in the development of supplementary planning guidance for air quality. They are also able to deal with challenging issues around public health that relate to planning applications. The team has the skills to undertake complex health risk assessments that perhaps local authorities are not able to support. They are happy to offer their support in dealing with the more complicated health risk assessments.
  - Ocean liners emit an enormous amount of particulate matter when visiting a port. It is estimated that when one ocean liner visits a port it is the equivalent of 100,000 vehicles entering the city – this is greater than the average number of commuter vehicles entering the city on a typical day and the associated level of pollution that they produce. In 2017, Venice announced that from 2021 ships of over 55,000 tonnes in weight would no longer be allowed to enter the city harbour and would have to instead dock at a mainland port.
  - The main culprit for air quality emissions in Cardiff is road traffic with diesel fuelled vehicles being the biggest emitter (it contributes to 65% of emissions). Industry is the second largest emitter in Cardiff. As Cardiff has a working port it is also subject to emissions from shipping (again mostly nitrogen dioxide).
  - It was suggested by Public Health Wales that the Council and other public sector partners have a collective corporate responsibility for air quality and

so they should do what they can to reduce emissions, for example, through fleet management and responsible procurement practices.

- Public Health Wales explained that there appeared to be a challenge in terms of working on air quality issues across more than one local authority area. They also stressed that in order to deal with air quality issues it was often essential to take a cross boundary approach and so work with neighbouring authorities. For example, large volumes of traffic come from neighbouring authorities such as Rhondda Cynnon Taff and the Vale of Glamorgan. This traffic contributes significantly towards air pollution in Cardiff.
- Public Health Wales feels that as a society we have the responsibility to drive forward long term, sustainable transport solutions. To emphasise this they highlighted a number of messages including:
  - In 1928, 42 million journeys were taken by tram in Cardiff – that equates to 150 tram journeys per person per annum. The tram service closed in 1950;
  - Car ownership is now the default transport position;
  - National Institute for Health & Care Excellence found that off road cycle routes were good value for money. Every £1 spent on off road routes generated benefits equal to £14;
  - Cardiff Metro is a long term vision that needs to become a reality;
  - The London congestion charge resulted in an 80% increase in cycling;
  - Run a car free event in conjunction with another event;
  - Car clubs and car share schemes are encouraged by Public Health Wales;
  - Public Health Wales stated that feasibility studies are long costly exercises that generally require financial support for local authorities to deliver.

## **Improving Cardiff's Air Quality - Meeting 3 – Transportation (1)**

### **- Wednesday 15th November 2017**

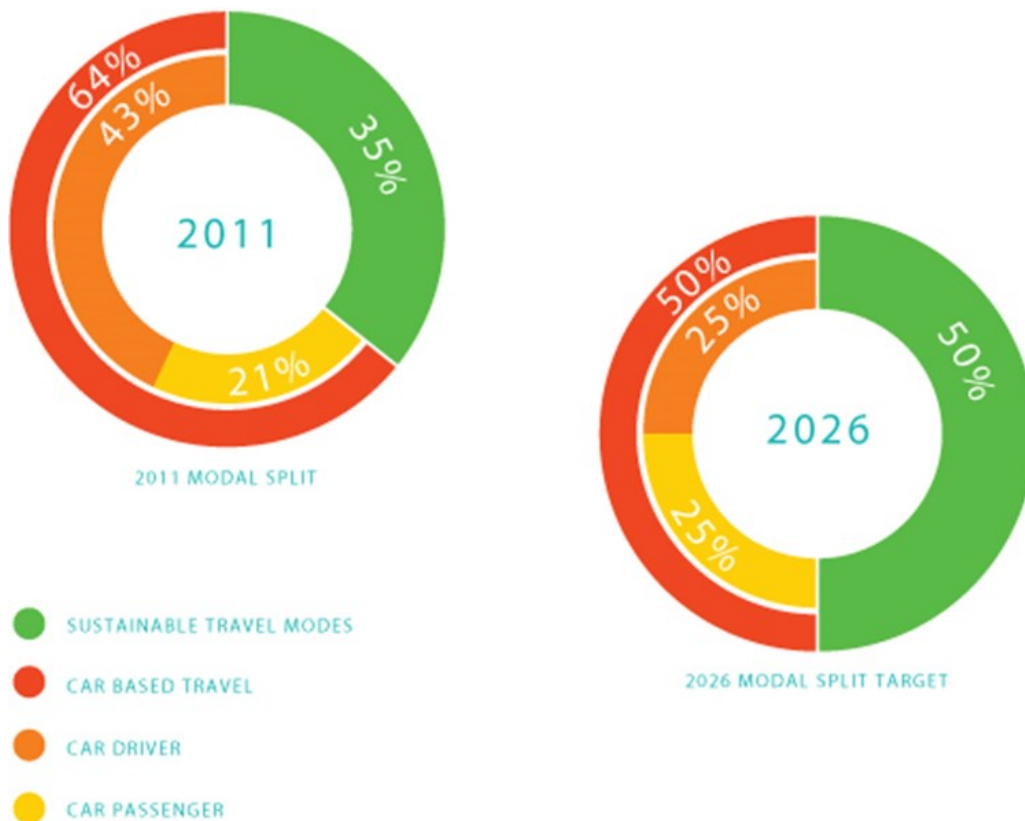
**Part 1 - A Review of Cardiff's Current Air Quality** – Councillor Caro Wild, Cabinet Member for Strategic Planning & Transport briefed the task group on the transport management work being delivered by the Council and how this will contribute to improving Cardiff's air quality. In doing this he identified the challenges and opportunities around using transport initiatives to improve air quality. He was supported by officers from the City Operations Directorate.

### **Key Findings**

- It is anticipated that much of the transport information covered in the presentation would feature in the 'Transport Green Paper' which is due to go out for consultation in April 2018. It was felt that the 'Transport Green Paper' would be a key document in terms of improving air quality in Cardiff.
- It was explained during the presentation that Cardiff's Transport Strategy priorities were:
  - Widening travel choices making it practical for most daily trips to be made by alternatives to the car, for example, public transport, walking and cycling;
  - Demand management to reduce the demand for travel overall, and particularly by car;
  - Network management using technology to make best use of the existing highway network, rather than building new roads that would generate more traffic.
- The Local Development Plan 2006 – 2026 aims to achieve a 50:50 modal split by 2026. To put this into context it aims to take the 65:35 figure achieved in 2011 and make a 1% improvement for every year over a 15 year period.

- Achieving modal shift is viewed as being vital to deal with the rapid growth of the city – it is anticipated that 41,000 new homes and up to 40,000 new jobs will be added to Cardiff by 2026. This means that transport alternatives will be required beyond using the existing network and that peak traffic periods might be extended. It is estimated that if nothing happens then this could lead to a 32% (net) increase in traffic by 2026 - finding extra capacity on the highway network cannot be achieved. **Diagram 6** illustrates the planned change in modal split between 2011 and 2020.

**Diagram 6 – Cardiff’s Planned Modal Split between 2011 & 2026**



- There are 80,000 plus traffic movements in and out of the city every day, and that managing this isn't completely within the control of the Council. Some Councillors felt that the Council needed to spend more time dealing with transport issues within its control and focus less effort on delivering the larger schemes. While the larger schemes were important there was

the tendency for the Council to focus on these instead of changing public behaviour through initiatives like 20 mph zones and 75% residential parking schemes. He felt that delivering short term measures was a tried and tested approach which worked well in places like London; they force people out of cars and into alternative means of transport. This suggestion was generally accepted, however, it was noted that Cardiff did not offer the same level of transport alternatives, for example, bus and train services were nowhere near as extensive as the options provided in London.

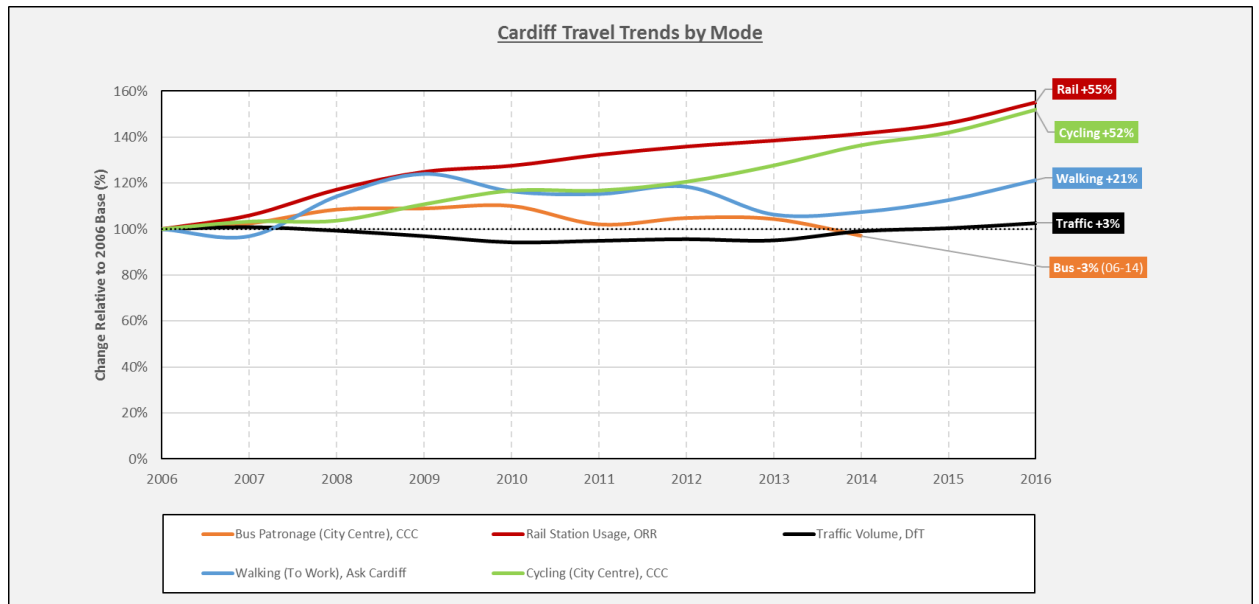
- A Council officer made a comment that the range of bus services and supporting infrastructure needed to be improved. This was supported by Professor Cole who felt that Cardiff's rail provision was reasonable, however, additional capacity needed to be added.
- Council officers identified the current transport issues, challenges and barriers facing Cardiff as congestion; through traffic; poor bus priority; a lack of cycling lanes; pedestrian safety issues; poor air quality; links with Cardiff Bay and a dated transport system.
- There have been some good strides in terms of developing Park & Ride in Cardiff in recent years, for example, Cardiff East Park & Ride, Cardiff City Park & Ride and the Junction 33 Park & Ride scheme now has planning permission. It is estimated that the Junction 33 site will have between 1200 and 1500 spaces. In addition to this there is some discussion around creating a new Park & Ride scheme in the Vale of Glamorgan which could access the city via the Cardiff Bay Barrage. Work is ongoing on identifying a suitable Park & Ride site for the A470 – sites at Nant Garw and Taff's Well have been suggested. An A470 scheme would need to be supported by bus priority measures (bus lanes) along the A470 into Cardiff.
- A comment was made that services from the Cardiff East Park & Ride into Cardiff City Centre were not direct enough, i.e. they stop at every junction on Newport Road and the journey takes approximately 30 minutes. It was felt that for the service to succeed (and act as a good alternative to the car) it needed to be convenient, quick and direct. The Park & Ride



contract for this site is due for renewal soon and with the large scale housing developments being built in that section of the city it could be possible to get new subsidies to support the upgrade of the bus routes, for example, through planning obligations associated to the development.

- It was explained that there was still a lot of work to do but that the Council has taken some important steps forward in recent years. The results of these include a 28% increase in cycling; the implementation of new measures on key transport strategic corridors and a 26% reduction in daily through traffic in the city centre between 2004 and 2014.
- An officer felt that enforcement was a 'big stick' to get things moving, but that ultimately better infrastructure provides the required reliability. Public transport services need to be quick, reliable and convenient.
- **Diagram 7** sets out the percentage change relative to Cardiff travel trends by mode set against a baseline figure of 2006. During the 10 year period of this chart rail travel and cycling increased by 55% and 52% respectively. Walking increased by 21% while overall traffic levels only increased by 3%. The only negative result was that bus patronage fell by 3% across the 10-year period. A comment was made that the closure of the bus station had contributed to the reduction of bus patronage – Cardiff badly needs a good functioning bus station / transport hub to help reverse the current bus patronage trend, i.e. getting a new bus station / transport hub has to be a priority.

**Diagram 7 – Percentage Change for Cardiff Travel Trends 2006 to 2016**

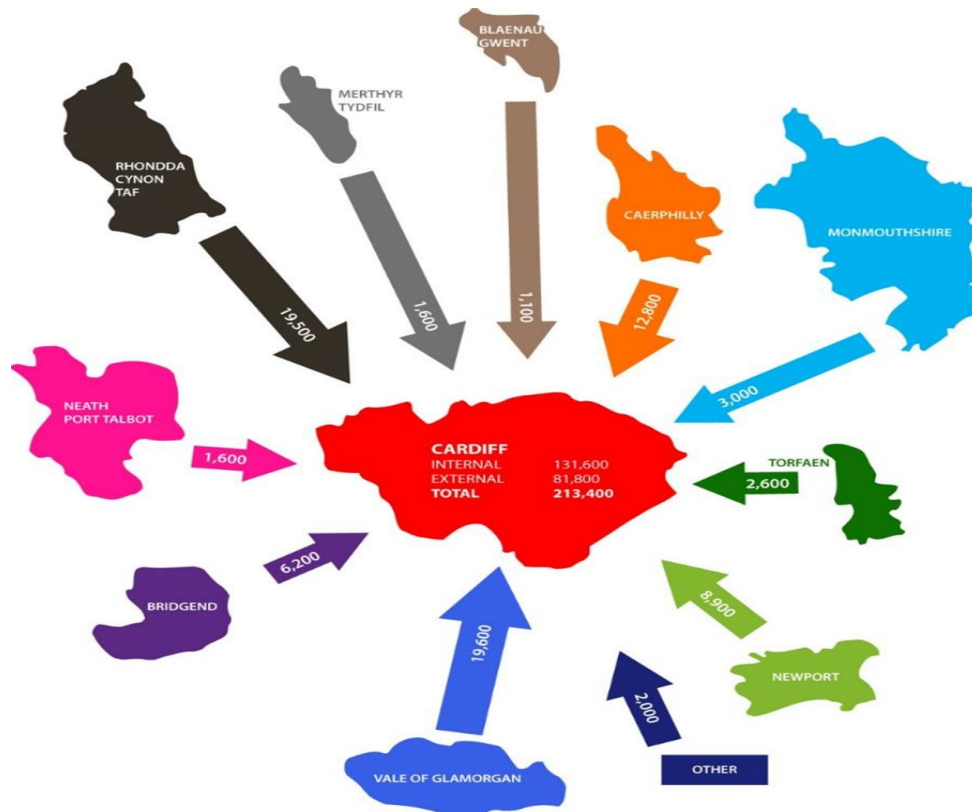


- During the presentation officers provided the following ‘Headline Statistics’ to set out the current picture of travelling into and around Cardiff on a typical day in 2016:
  - 107,800 vehicles entered and exited the city centre during a typical twelve hour period during 2016;
  - There were 55,300 city centre bus passengers (on a two-way journey) across a twelve hour period in 2014;
  - Each year the city centre attracts a footfall of approximately 40 million people in the pedestrianised retail area;
  - It is estimated that Cardiff’s population will grow by 23% between 2016 and 2039;
  - In 2016 39% of Cardiff’s workforce travel into the city from outside the local authority area;
  - Approximately 5,300 cyclists passed through the city centre during a typical twelve hour working day in 2016.
  
- A Member asked what the Council is doing to better manage residential parking. He felt that by using good planning and other parking mechanisms it was possible to drive behavioural change which in turn

would reduce congestion and air quality issues. Examples of where this might work well would include increasing residential parking to 75% limits and the continued roll out of 20 mph zones. An officer felt that this approach was working and that public parking capacity was slowly being squeezed out from the city centre through a mixture of policy and enforcement. A Council officer emphasised that more could be done to drive behaviour change by increased working with neighbouring local authorities.

- **Diagram 8** illustrates the commuter journeys into and out of the Cardiff local authority area during a typical twelve-hour working day in 2016. The data identifies that a total of 78,900 journeys were made into Cardiff each day (Vale of Glamorgan 19,600; Newport 8,900; Torfaen 2,600; Monmouthshire 3,000; Caerphilly 12,800; Blaenau Gwent 1,100; Merthyr Tydfil 1,600; Rhondda Cynon Taf 19,500; Neath / Port Talbot 1,600; Bridgend 6,200 and other 2,000). This is in addition to the 131,600 internal journeys.
- It was felt that Cardiff is now a 24/7 society and Cardiff Bus needs to think more proactively about the night time economy and how it services demand in this area. A Council officer explained that there is a plan to create a park & ride facility with a bus gate at Junction onto the A4232 and a rapid bus route into the city.
- Swansea City Council has created a Park & Ride facility next to the Amazon Fulfilment Centre on Fabian Way. It directs bus journeys into the city centre and uses a bus light activator to clear sections of the route so that buses can run to time, this has proved to be an efficient approach and has made services more reliable.

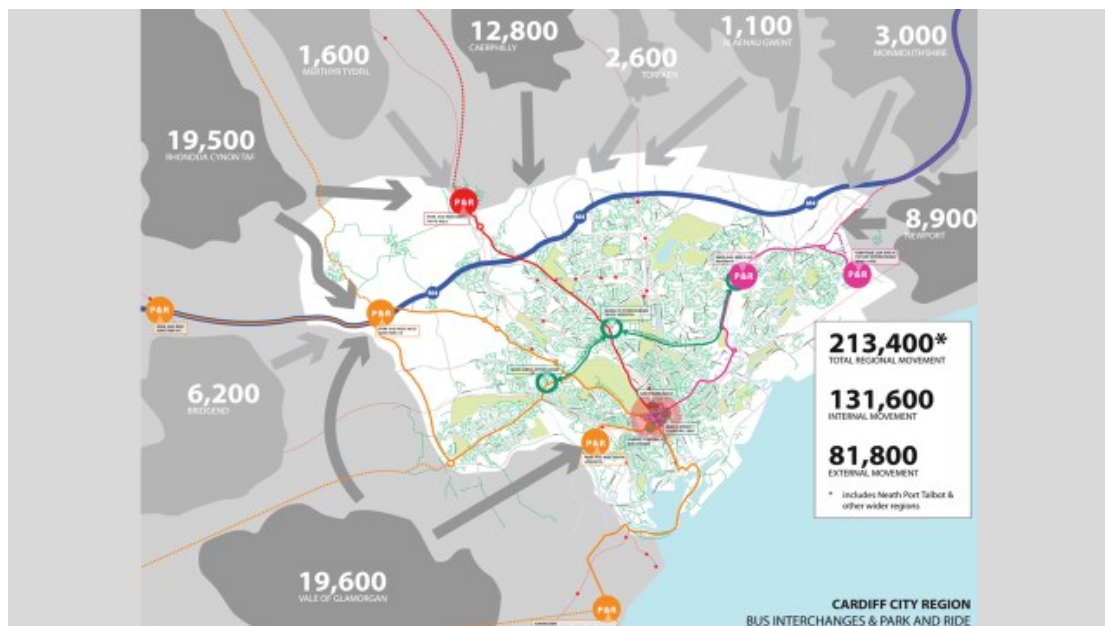
**Diagram 8 – Cardiff Local Authority Commuter Journeys 2016**



- The importance of using a common ticket on the new Metro system was stressed, i.e. a ticket that can be used across different companies and modes of transport (for example, bus and train).
- Places like the Netherlands franchise out bus and train routes, when in the United Kingdom journeys are commercially driven operations. In effect Wales runs a market driven approach where bus operators are able to develop their own core operation.
- A Member was of the view that Park & Ride will only ultimately work when it becomes very difficult to park in Cardiff City Centre.
- A Council officer stated the importance of developing every radial route around the city.

- A comment was made that competition on bus routes could be a good thing with companies successfully creating a series of new routes. Some operators are currently looking at developing cross city movements. Such thinking and healthy competition is good for the development of transport options in the city.
- It was explained that if we could get bus patronage to where it was 10 years ago we would quickly move to the 50:50 modal split position. The biggest issue that we have in Cardiff is the transport funding deficit.
- **Diagram 9** illustrates the current and proposed Park & Ride facilities relevant to the daily internal commuter journeys into Cardiff. It also identifies the potential future bus interchanges planned for the city.

**Diagram 9 - Current / Proposed Park & Ride Facilities Relevant to the Daily Internal Commuter Journeys**

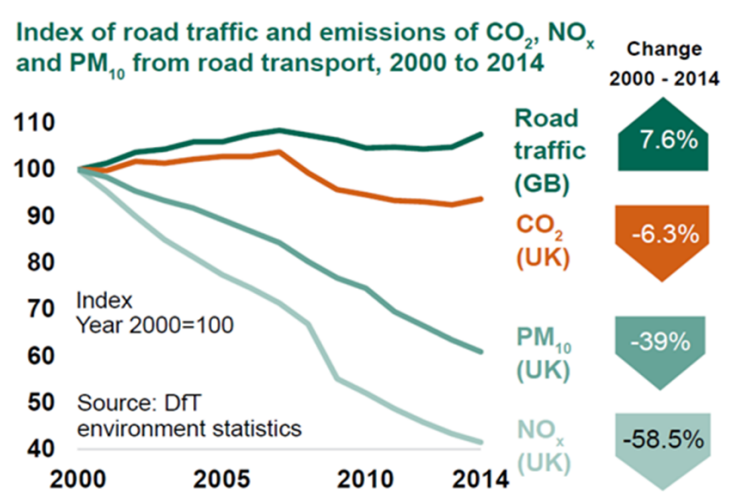


- The Council transport presentation reiterated that:
  - Road traffic emissions, in particular particulate matter and nitrogen dioxide, are the primary contributing factor to poor air quality in Cardiff;
  - Emerging scientific evidence shows air pollution exposure reduces life expectancy by increasing mortality and morbidity risk from heart

disease, and strokes, respiratory diseases, lung cancer and other conditions;

- Public Health Wales state: "...local-level health risks and impacts will vary considerably, not only influenced by differential air pollution exposures but also by individual and population-level susceptibilities. These factors may be 'intrinsic' (e.g. age, sex, genetics) and/or 'acquired' (e.g. income, education, housing, employment, service access, lifestyle/behaviour-related chronic illnesses). The triple jeopardy of air pollution, impaired health and social deprivation is said to compound problems by creating disproportionate and amplified disease burdens between and within regions."
- The presentation provided evidence from the Department for Transport that illustrated that emissions had fallen in recent years, however, for particulate air pollution and nitrogen dioxide there is no safe level of exposure. Any initiatives to reduce air pollution will have positive health benefits. **Diagram 10** illustrates the index of road traffic and emissions of carbon dioxide, nitrogen dioxide and particulate matter from road transport for the period 2004 to 2014. This illustrates that nitrogen dioxide and particulate matter have reduced significantly (58.5% and 39% respectively), while carbon dioxide emissions have only fallen by 6.3%. During the same period road traffic increased by 7.6%.

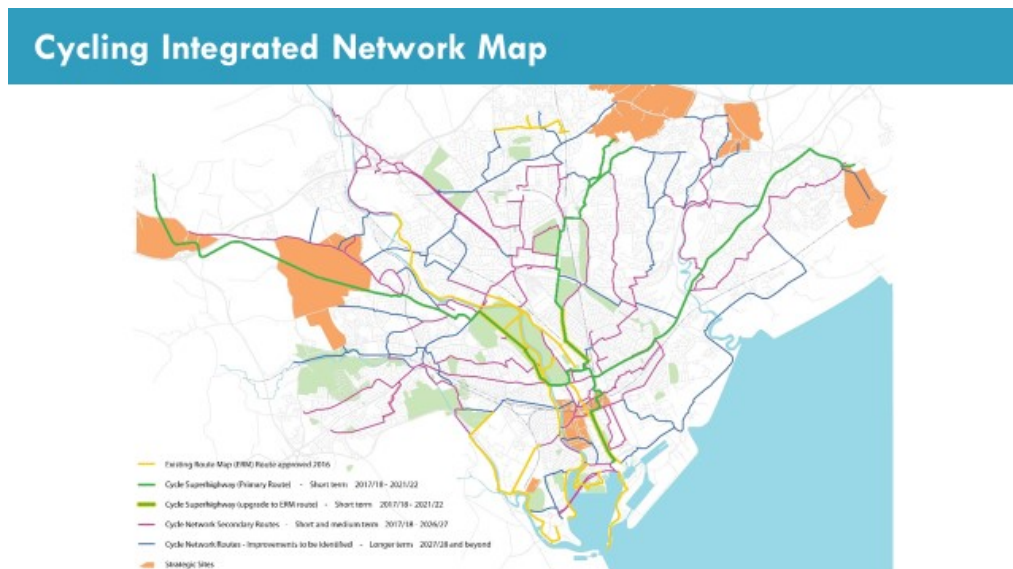
**Diagram 10 - Index of Road Traffic and Emissions from Road Transport for the Period 2004 to 2014**



- Officers explained that Cardiff's Local Transport Plan was approved by the Welsh Government in May 2015. Cardiff's Local Transport Plan sets out its main transport infrastructure proposals which will support this significant modal shift and recognises the need to improve air quality. Its programme prioritises:
  - The development of active travel networks to increase walking and cycling for local journeys;
  - The provision of cycling infrastructure;
  - The bus network;
  - Reduced speed limits;
  - Reducing congestion;
  - Improving transport efficiency and reliability;
  - Bus based park and ride.
  
- The presentation detailed a list of measures submitted to DEFRA for the United Kingdom Air Quality Plan for tackling roadside nitrogen dioxide concentrations in the Cardiff urban area (July 2017). These are taken from key plans and strategies, including the Local Development Plan, Local Transport Plan and the Cycling Strategy. These were summarised in the presentation.
  
- **Cycling Strategy & Integrated Network Map** – This is an ambitious vision to double the number of cycling trips by 2026, from a 9.2% modal share in 2015 to 18.4% in 2026. It includes:
  - The development of a comprehensive network of cycling infrastructure which is suitable for use by people of all ages and abilities;
  - Working with key partners from employers, retail and schools to ensure that appropriate cycling facilities are provided at destinations and to promote cycling;
  - The development of the Integrated Network Map which is a requirement of the Active Travel (Wales) Act 2013. This document plans and prioritises infrastructure improvements for walking and cycling;

- Proposals for two new cycle superhighways which will provide high quality cycle routes, segregated from pedestrians and motor vehicles on busy roads, connecting residential and employment sites.
- **Diagram 11** (below) sets out the plan for the Cycling Integrated Network Map for Cardiff

**Diagram 11 – Cycling Integrated Network Map**



- The presentation explained that Cardiff City Centre attracts hundreds of thousands of commuters and visitors each day from across the Cardiff City Region and further afield. Traffic flows on main routes to and through the city centre generate peak time congestion which causes delays to bus services and can make the area less attractive for pedestrians and cyclists. Increasing sustainable travel to and through the city centre are crucial to achieving improvements in air quality.
- Bus travel has an important role to play in reducing the number of journeys made by car. Developing bus priority measures on strategic bus corridors is essential in reducing bus journey times, improving journey time reliability and making bus travel a more attractive alternative to the car for a greater range of journeys. 400m of bus lane can give each bus a time advantage of five minutes or more over general traffic on the approach to junctions



and improve the ability of bus drivers to meet timetables (Cardiff 2014 Regional Bus Lane surveys). Lanes have been installed on a number of main roads into the city including the A470, A4119 and A48.

- While all contributions to the inquiry agreed that growing the existing cycle infrastructure was important it was stressed that creating good quality modern cycle lanes was very expensive, i.e. they cost £1 million per kilometre to build.
- A report was published in 2016 which stated Wales would need to spend £60 million per annum each year for the next 10 years to match the standard and relative scale of cycle lanes in the Netherlands. As previously stated developing a comprehensive cycle network is not a cheap option, achieving cycle lane parity with countries like the Netherlands would require huge central government subsidies and many years to deliver.
- A Councillor noted that we were a long way behind countries like the Netherlands and asked why this was the case? He was told that it was because they started working on the infrastructure in the 1970's and in relative terms we are at the start of our journey. The Dutch started to invest in cycling infrastructure in the 1970's because they had a very high cycling death rate for young children.

### **City Centre Transport Improvement Projects**

- Cardiff City Centre attracts hundreds of thousands of commuters and visitors each day from across the Cardiff City Region and further afield. Traffic flows on the main routes to and through the city centre generate peak time congestion which causes delays to bus services and can make the area less attractive for pedestrians and cyclists. Increasing sustainable travel to and through the city centre will be crucial to achieving improvements in air quality. Key measures will focus on sustainable transport improvements that will encourage mode shift and contribute to improving air quality levels.

- Trains in the Netherlands are half the price of the United Kingdom thanks to the rail subsidy – this is funded by central government.
- The Council presentation delivered to the task & finish exercise set out a number of priorities for bus travel in Cardiff, these included:
  - Developing a new bus interchange as part of the major redevelopment of Central Square;
  - Working with bus operators to identify and develop an expanded city bus network, including new cross-city and local routes;
  - Work with operators to increase the number of buses where bicycles can be taken on board, to encourage mixed active travel to be used as part of longer journeys;
  - Developing new bus park and ride facilities at M4 Junction 33 and other appropriate locations in Cardiff and neighbouring areas to reduce the number of cars driving into the city;
  - Making bus services faster and more reliable by providing bus priority measures on strategic bus corridors to help reduce bus journey times, improve journey time reliability and make bus travel a more attractive alternative to the car for a greater range of journeys;
  - Investigating opportunities for the development of a green technologies bus fleet.
- **Greener Bus Fleets** - Cardiff Council and Cardiff Bus have submitted an application to UK Government for £1.5million funding to retrofit buses within the Cardiff Bus fleet to reduce their emissions to Euro 6 compliance. The Council will continue to work with Cardiff Bus and other regional bus operators to continue making improvements in the composition of the bus fleets operating on the Cardiff road network. They will explore the use of greener bus types, such as hybrids, full electric and hydrogen. There has been discussion with Welsh Government officers around making new monies available for the development of greener bus fleets.

- It was suggested that the flow of bus lanes wasn't great and needed to be smoother to avoid causing a traffic backlog. Key routes need to have continuous bus lanes like the ones coming in from the Cardiff East Park & Ride.
- A Member stated that bus patronage across the United Kingdom was down and asked how we could reverse this trend? A suggestion to address this issue was the introduction an integrated ticket approach, something similar to the Oyster Card in London. To achieve this in Wales a regional approach would be needed and a network of transport partners would need to take a part in the initiative.
- A Cardiff Capital Region Metro has been proposed by the Welsh Government. It is expected to be a combination of rail-based and bus-based rapid transit routes linked through interchanges and using the same network brand and integrated ticketing system.
- 6% of journeys to work by Cardiff residents are made by rail. Passenger numbers across the city and the wider region have grown significantly in recent years. The Council works closely with key partners, including Welsh Government, rail operators and Network Rail, towards improving and developing the rail network. The new Wales and Borders rail franchise should deliver new rolling stock, increased capacity and frequencies to meet rising demand and allow for further modal shift to rail based journeys.
- It is hoped that cutting congestion by reducing the number of journeys made by car will bring air quality improvements as well as reducing costs and journey times for individuals and businesses. It also makes journeys made by sustainable and active modes of travel easier, for example, by making bus journey times more reliable and providing a more attractive environment for walking and cycling. By managing Cardiff's highway network more effectively, the Council hopes to make the best use of the existing highway in a way which promotes access by sustainable modes of travel.

- A 20 miles per hour limit was piloted in Cathays /Plasnewydd in March 2014. This was deemed successful and a wider future rollout of 20mph limits is underway in residential streets in areas around the city centre. The consensus is that lower speed limits in residential areas can:
  - Improve air quality in terms of particulate matter exposure;
  - Improve the liveability of the city by reducing car use for local trips;
  - Make it easier to cross roads and access local facilities – especially for children and the elderly;
  - Help to improve the environment for walking and cycling resulting in greater levels of physical activity;
  - The installation of 20 mph limits will complement the ongoing programme of school safety zones through Safe Routes to School and Safe Routes in Communities. These improvements at the local level support active and sustainable travel;
  - Air quality around schools, as well as the impact of driver behaviour and inconsiderate parking on schools and their local communities, are matters of concern. The Council (and other key stakeholders) all have a role to play in tackling these issues.
  
- Electric Vehicle Infrastructure & Car Clubs – The presentation identified that electric vehicle infrastructure and car clubs had a role to play in improving Cardiff's air quality. In particular it made the following points about this evolving technology:
  - It moves toward a shift from traditional fossil fuels for motorised transport to more sustainable forms of clean, renewable energy;
  - The United Kingdom government has a commitment to ending sales of new petrol and diesel cars from 2040;
  - The transition is largely private sector led through vehicle manufacturing markets, however, there is also a clear role for the Council in facilitating, championing and preparing for this transition;

- The Council is running a feasibility study which will review best practice, the market and funding streams which will inform a decision on the best option for the city;
  - Use of more environmentally friendly modes of transport including Low Emission Vehicles will be supported through provision of electric vehicle charging and the rollout of additional car club vehicles;
  - A pilot electric vehicle charging system is expected to be launched in Cardiff during 2017/2018;
  - Car clubs offer a flexible alternative to car ownership and can play an important role in an integrated transport network;
  - Car club provision in Cardiff is set to grow in the short term, helping to reduce the number of journeys made by car and giving access to new, low emission vehicles.
- During the session it was explained that the Council fleet needed to be continually upgraded to ensure that we have clean / low emitting vehicles. This responsibility should also be embraced by the other public sector partners (for example, Health Service, Police, Universities, etc...) and other major employers in the city.

**Part 2 - A Review of Cardiff's Current Air Quality** - Stuart Cole, Professor of Transport at the University of South Wales provided a view on the transport initiatives being proposed and delivered by the Council. In particular, he commented on how the proposals could contribute towards key policy objectives such as modal shift and sustainable travel.

### **Key Findings**

- Professor Cole agreed with all of the objectives set out in the Cardiff Council Transport Presentation, but emphasised that the important area to focus on now was delivery, for example, the it was important that the Council focused on the delivery of the new integrated transport hub.
- It was again explained that the major cause of urban pollution was the motor car – this was consistent with what all other witnesses had said. There is a specific problem at peak periods of the day or during major events.
- We need more bus lanes on strategic bus routes into and out of the city. These are needed to support a prompt reliable service which is ultimately what the public want. The key bus priority characteristics that will influence modal shift are reduced journey times and reliability of journey time.
- Bikes on buses are a good intention but are almost impossible to achieve. Lots of time was spent some time on Trans Cymru trying to achieve this, and it has been attempted on three occasions in England. Only the Nottingham service has partially worked as the approach causes delays on loading and unloading; the drivers and trade unions are not keen on the idea and there is a lack of space on the bus.
- The task group was warned that the amount of investment that was being proposed for the Metro was probably only sufficient for train line upgrade at the moment, however, the rail upgrade would result in the electrification

of heavy rail and this would quickly increase capacity. The introduction of trams was considered to be a practical option for densely populated areas of the city that have no rail service, for example, Ely, Heath; Caerphilly road; Newport road and parts of Cardiff Bay.

- To be successful we have to follow examples of places like the Netherlands and we have to create separate spaces for travel modes, for example, walking, cycling, bus / tram and motor vehicles.
- Professor Cole suggested that public transport access to Cardiff Airport needed to be improved if Cardiff is serious about its ambitions to be a major event city.
- Different parts of Wales have differing transport challenges, for example, urban areas are prone to congested roads, while accessibility is an issue in rural areas.
- The Welsh Assembly has brought many business to Cardiff making it an attractive city to live and work in – this success brings increased transport considerations with it which we have to address.
- There is plenty of private parking in the city centre and in recent years several very large car parks have been built. How do you deal with a large car park company?
- Previously the phrase ‘predict and provide’ has been used to describe what needs to be done to address transport issues. We are now at the stage where this needs to change to ‘provide and promote’, i.e. we don’t need to predict as we understand the issues.
- Little details are important, for example, Cardiff Bus doesn’t give change. All other providers do. Cardiff Bus insists on the correct fare, no one else does this.
- Having a single travel card which can be purchased by one transaction is important to improve public transport in Cardiff and the South East Wales

Region. A card that could be used across several different transport providers to cover the whole journey – it would make things easier and push large volumes of people onto our public transport systems.

Something similar to the Oyster Card.

- Park & ride works well if done properly. The trick here is to ensure that there are always buses on hand and that services are punctual. For example, the Park & Ride scheme in Oxford has been a success as they have made sure that there is always a bus waiting at the facility at peak periods. When drivers arrive at the Park & Ride site they are greeted with a bus waiting to take them to their destination – this makes them content and more likely to use the facility in future. They also run to time and are supported by good bus lanes. Cardiff has started introducing bus lanes on strategic routes – more of this needs to happen.
- The key Swansea bus routes use a transponder to trigger lights on key routes – this speeds up journeys. An example of this can be seen on Fabien Way between the new University campus and the city centre.
- Transport for London takes parking in bus lanes very seriously. Cameras are placed on the front of buses and the details of any vehicles blocking these lanes are recorded and a fine is immediately issued. This has had a dramatic effect on driver behaviour change. Average journey times have come down, services are reliable and the cost is the same or less than the corresponding car journey.
- Trans Cymru offer free travel access across Wales. Average patronage on these services is about 70% and these are mostly leisure journeys.
- The number of over 60's that have moved to public transport in Wales has increased by between 40% and 50%. This is mainly due to the fact that they have free bus travel.
- Train journeys in Wales are 52% cheaper in Wales than in other parts of the United Kingdom.



- The importance of creating interchanges that are able to attract people from more outlying areas was stressed.
- Cardiff's Integrated Transport Interchange – Cardiff very badly needs this to be completed. Why is it so late? This has cost the city in terms of growing the use of public transport.
- Initially when the old bus station was closed the Council issued maps to help people find their way around. These were invaluable, particularly for people visiting the city. Why aren't these issued any more? Could the Council reprint and start giving these away again. It is important to get better transport information to public transport (and potential) users. A Member stated that the Council tends to distribute information well at the start of a scheme, however, this then drops away after a while and our communication becomes poor.
- The task group were told that £12 million was a fairly accurate cost for an average size station – they need a large land development to support them which tends to increase costs.
- Cycle parking – to ensure that cycling take up improves we need to put in place lots of cycle parking facilities. In Copenhagen every hotel hires bikes and has bike parking facilities.
- It was felt that it is important to establish safe routes to stations – this could be paid for out of parts of the City Deal bid. Important to ensure that routes are safe to encourage people to use them.
- Once again there was more support for a single ticket option for the Cardiff and wider South East Wales transport network. The information collected from the use of a single ticket approach can be used to collect huge amounts of data for travel planning.
- Professor Cole explained that Utrecht and Cardiff are similar in size. Utrecht has 16 train platforms while Cardiff has eight. He stated that we need more platforms than we currently have.

## **Improving Cardiff's Air Quality - Meeting 4 – Transportation (2)**

### **- Tuesday 21st November 2017 – 4:00pm to 7:00pm**

**Air Pollution & Cardiff's Bus Services** – A round table discussion with Cardiff based bus services and associated stakeholders to consider the impact that bus services have upon Cardiff's air quality. This discussion included, but was not limited to the current level of emissions produced by bus services in Cardiff; the state of Cardiff's current bus fleet; current and proposed work to improve / upgrade Cardiff's bus fleet; the impact that a clean air zone could potentially have on Cardiff's bus services.

### **Key Findings**

- It is important that bus companies put forward a business plan about the positive contribution that they make towards reducing congestion and taking cars off the road. The bus providers emphasised that it is difficult for them to upgrade vehicles voluntarily and at a speed required as the financial assistance isn't available. Introducing new vehicles needs to be supported by a benefit to the business. This could involve fitted telematics, safer fuel initiatives as well as replacing vehicles.
- The bus providers explained that to just replace all older vehicles simply isn't viable. The Green Bus Fund which operates in England is currently in its 7<sup>th</sup> tranche, however, despite lobbying there is no equivalent fund in Wales.
- Cardiff Bus has applied for OLAF funding, but to date this has not been successful – the fund has been oversubscribed by over five times.
- A witness suggested that society is hung up on stopping people from coming in by bus and that the car is king. He added that we do need to look at far more financial assistance but we need to tackle day to day sustainable transport issues first. We need to make buses look more

attractive, we need to make it unpopular for people to use the car. A full bus can take 75 cars off the road.

- A witness explained that using a bus to get into Cardiff City Centre was a huge challenge if you were a wheelchair user. She also added that there are over 3,000 parking spaces in Cardiff City Centre, this number needs to be reduced – the parking spaces on Westgate Street are a particular problem. Other witnesses agreed with this and reiterated the importance of taking some of the car parks out of Cardiff City Centre.
- A witness explained that she lived in London and did not own a car; however, through a car club she had access to a car. She explained that the shift needed to be sustainable and reflect the needs for modern living.
- A witness explained that London has the infrastructure to support such an urban shift while many other parts of the United Kingdom did not. Improving route reliability is key – if journeys are quick and reliable then customers will make the shift.
- A bus provider representative explained that lots of funding has been taken out of bus services. The funding model has changed, buses now run as a business and are driven by the volume of where people actually want to go.
- A witness explained that making the bus services more popular would probably mean having to increase the prices of car parking and the potential introduction of a congestion charging zone.
- A witness stated that the quality of buses is increasing rapidly in Wales with £140 million being invested into new buses since 2010.
- It was explained that the cost to convert a Euro 5 bus into a Euro 6 was typically between £10,000 to £15,000 per conversion.
- It was suggested by a bus service representative that the creation of a clean air zone in Cardiff would result in the delivery of fewer bus services.

- A witness explained that the subsidy on rail in Wales is £6 per journey, while bus services only receive £1 per journey.
- A bus service representative suggested that Wales needed a policy to support a good fleet replacement cycle, i.e. ensuring that bus companies always buy the latest and best. This would go a long way towards reducing emissions. Such a policy would also need to be supported by a package of financial assistance.
- It was explained that other things being equal Cardiff Bus is potentially able to replace ten old vehicles with new ones every year. A subsidy is needed to increase the percentage of fleet running on new technology.
- A witness asked if Cardiff Council could help with funding as the Welsh Government had decided against a green bus fund in Wales. He suggested that DEFRA had made funding available in England - £30 million has already been allocated to local authorities and a further £100 million is available for new investment. Denbighshire was awarded some funding for electric buses in 2017 from the government's 'Low emission bus scheme'. Electric buses typically cost 2.5 times the cost of regular petrol or diesel buses.
- In the last financial year London received £1.1 billion for investment in bus services, while the rest of England received a further £2 billion. Wales received £92 million (split into amounts of £67 million and £25 million). In bus investment terms Wales is the poor relation.

**Air Pollution & Cardiff's Taxi Services** – A round table discussion with Cardiff based taxi services and associated stakeholders to consider the impact that taxi services have upon Cardiff's air quality. This discussion included, but was not be limited to the current level of emissions produced by taxi services in Cardiff; the state of Cardiff's current taxi fleet; current and proposed work to improve / upgrade Cardiff's taxi fleet; the impact that a clean air zone could potentially have on Cardiff's taxi services.

## Key Findings

- An Uber representative explained that there are pressing and important challenges facing areas in the United Kingdom in terms of air quality. Cardiff is one city that has been identified on the list where action needs to happen. Council's are having to implement clean air zones – this is a trend that we are seeing across the country. Uber has made the following clean air pledge:
  - *By the end of 2019 every car available on uberX in London will be 100% hybrid or fully electric with no diesel vehicles on the app;*
  - *They are starting in London but aim to meet the same standard (100% hybrid or fully electric cars on uberX with no diesels on the app) across the UK by the end of 2022;*
  - *More than half the miles on uberX journeys in London are already in hybrid or fully electric cars, but we want to go much further with a goal for every vehicle using the app in London to be electric in 2025;*
  - *They are also launching a diesel scrappage scheme aimed at removing 1,000 of the most polluting cars from London's roads. The first 1,000 people in London to scrap a pre-Euro 4 diesel vehicle and provide an official scrappage certificate will receive up to £1,500 of credit to spend on Uber or uberPOOL rides as they encourage Londoners to get into a shared car to connect with public transport. Londoners can register*

*their interest here and will be able to apply through the scheme from October 2017.*

### **Setting up a Clean Air Fund**

- *In order to achieve these ambitious goals Uber will create a dedicated Clean Air Fund to allow licensed drivers who use their app across the UK to access up to £5,000 towards the cost of upgrading their car to a hybrid or fully electric vehicle.*
- *Over the life of the fund, it is expected that drivers will claim more than £150m to help transition to a greener car. Uber is currently in discussions with potential third-party administrators of the fund.*
- *Uber kickstarted the fund in October 2017 with a £2m investment. 35p will be added to every ride taken through the app in London – every penny of which will be donated to the dedicated and ring-fenced fund. An amount will also be added to rides in other UK cities over the next year.*
- *uberPOOL trips will be excluded from the 35p addition as passengers are already opting to share their journey with someone else heading the same way. In London more than 400,000 people regularly use uberPOOL to travel from A to B.*
- *Uber-branded rapid chargers have also be installed in central London which will initially be dedicated for use by drivers of electric vehicles who use the Uber app.*
- 65% of miles driven on the Uber app are on petrol or LV. The biggest challenge facing most United Kingdom cities to address the air quality issue is putting new infrastructure in place, for example, public charging points. Uber ran a trial in one United Kingdom city with 50 Nissan Leaf cars and 90% of the drivers identified the biggest challenge as not having enough off-street parking where they could charge the vehicles.

- Uber is chasing OLAF funding for its fleet in major cities across the UK, for example, Glasgow and Edinburgh are keen to drive this agenda forward – such schemes make vehicles cheap to buy or rent, i.e. the new technology is viable with grants.
- Infrastructure – taxi firms are really looking for support and certainty to drive forward with the purchase of low emission vehicles. The ideas and technology are available, they just need help in rolling these out.
- It was stressed that in order to increase the uptake of new low emission vehicles a carrot and stick approach would need to be taken. You need a grant to make the vehicles financially viable as they are very expensive at the moment.
- Making loans available to purchase new sustainable vehicles has to be affordable. The changes need to be phased in for the new drivers – buying hybrid vehicles isn't currently an option in the second hand market so all purchases would need to be new.
- A taxi firm representative explained that there is an issue in Cardiff around the use of the 'Prestige List' (also known as the 'Exceptional Conditions Policy'). It is not fit for purpose as many drivers are claiming that older vehicles are 'prestige vehicles'. The very wide definition of a 'prestige vehicle' means that it is difficult to reject an older vehicle from the list. This means that older vehicles can still taxi on the back of this list – these tend to be higher polluting vehicles which potentially have an impact on Cardiff's air quality.
- To improve the quality of the taxi fleet in Cardiff local standards need to be introduced that force drivers to make a change. Once they understand the direction of travel then they will have to invest in greener and less polluting vehicles. This can only be achieved once the results of the Welsh Government consultation into taxi services is published.

- A witness explained that there are 2,200 licenced taxis in Cardiff, 406 of these are over 10 years old. The policy around the prestige list (Exceptional Conditions Policy) needs to be revisited and updated. Setting new emissions standards would be a good way of lifting the quality of the fleet. The powers for changing taxi legislation in Wales has recently been devolved to the Welsh Government. They are currently undertaking a consultation into the current taxi regulations in Wales and are due to provide feedback at some point in 2018. All Welsh local authorities have contributed to this consultation exercise by completing and submitting a consultation response – these will all be considered before announcing any changes.
- A taxi service representative explained that the Welsh Government consultation into taxi standards in Wales has been a breath of fresh air. It is much needed as the industry needs a clean-up. Moving forward as an industry everything has to focus on efficiency. Financial considerations is the main driver for most taxi drivers and the majority of taxis in Cardiff are owned by owner drivers.
- A Member asked if the taxi companies would help in raising awareness with drivers on a range of key issues such as air pollution. He was told by a taxi company representative that taxi companies could be great drivers for this information and that they would be happy to do this, particularly if the Council got a grip of the current regulations.
- One taxi company representative explained that they were aware of the changes and that when they replace existing vehicles they are ensuring that they are replaced with low emission fleet. Another taxi company representative explained that running low emission disabled access vehicles wasn't currently viable.
- A Council officer explained that the Council's response to the Welsh Government taxi consultation made that point about disabled access vehicles and raised a number of other issues. He felt that a now would be



a good time to review the wider taxi licensing conditions and that this could include disabled access vehicles.

- A taxi company representative explained that government funding needed to be put in place to encourage taxi drivers to switch to low emission vehicles. Support has been provided for taxi upgrades in other parts of the United Kingdom, for example, Birmingham and Scotland. Easy access to refuelling infrastructure also needs to be put in place.
- A witness explained that the taxi industry has successfully evolved many times over the years – these proposed changes will be no different and the industry will adapt to any new proposals.
- A taxi firm representative explained that taxi companies are now able to provide hydrogen kits to its drivers that are Arriva approved for the cost of £500 including installation. These are proven to significantly reduce emissions.
- A comment was made about one taxi company who when renewing their fleet generally replaced older vehicles with the new Toyota Avensis. It was explained that staying technology neutral is important when taking vehicle investment decisions. There needs to be at least a consistent Euro 4/6 standard for taxis applied across Wales. This will really help and will be supported by natural vehicle changeover.
- A Member stated that it is important to open up the debate between bus and taxi companies about the issue of taxis blocking bus lanes. The bus companies are complaining that taxis are regularly blocking lanes and slowing down services. He wanted to know if the message around blocking bus lanes was being clearly communicated to taxi drivers.
- Some of the representatives from the taxi companies were aware of there being an issue around Greyfriars Road in Cardiff, i.e. a bus lane was regularly being used as a drop off point. In response a comment was made that there is a need for a rank or drop off point in this part of the city.

It was explained that there are approximately 1,100 Hackney licences in Cardiff and only 70 rank parking spaces. The issue for many taxi drivers is where are they able to park?

- A Council officer explained that the Council's Moving Traffic Offences Service were asked if any Fixed Penalty Notices had been issued against taxi drivers for parking in bus lanes, however, none had. They stated that the Council is able to revisit this issue, however, it needs evidence to support taking any action. It was suggested that no Fixed Penalty Notices had been issued because Moving Traffic Offences are not specifically looking for the problem. A taxi company representative suggested that if this was an issue then it was something that Council needs to review using its Civil Parking Enforcement and Moving Traffic Offences teams.
- A taxi firm representative stated that the benefits for all taxi drivers being able to use bus lanes – he felt that the decision to allow them to use the bus lanes was a positive thing and felt that a harder approach needed to be taken against individuals who regularly broke the rules around 'banking'.

**Part 3 Society of Motor Manufacturers** – Sukky Choongh - Campbell from the Society of Motor Manufacturers attended the meeting to brief the task group on the view of the Society of Motor Manufacturers on managing air pollution.

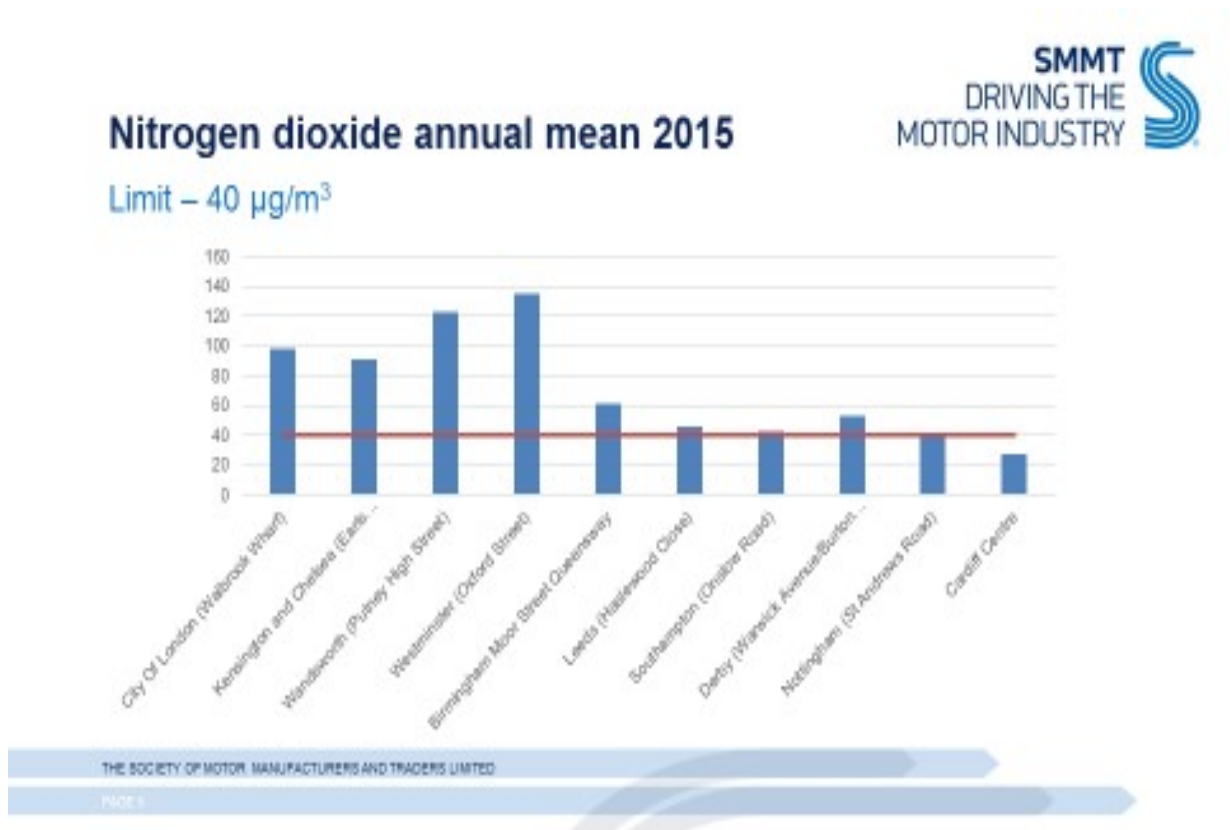
### **Key Findings**

- The Society of Motor Manufacturers & Traders presentation started by setting out the scale of the United Kingdom automotive sector for the start and end of the period 2006 to 2016, the data was as follows:
  - Turnover - £50.4 billion in 2006; £77.5 billion in 2016.
  - Value Added - £9.5 billion 2006; £22 billion 2016.
  - Vehicles Exported – 1,242,312 in 2006; 1,354,216 in 2016.
  - Vehicles Manufactured Annually – 1,649,789 in 2006; 1,816,622 in 2016.
  - Jobs in Automotive – 851,000 in 2006; 814,000 in 2016.
  - Jobs in Manufacturing – 205,000 in 2006; 169,000 in 2016.
  - Engines Manufactured – 1,442,085 in 2006; 2,545,608 in 2016.
  - New Cars Registered – 2.34 million in 2006; 2.69 million in 2016.
- National Air Quality Plan – the presentation outlined the government’s ambitions as:
  - End the sale of conventional diesel and petrol vehicles by 2040;
  - Clean Air Zones – original five cities to develop plans, plus an additional 29 local authorities to produce new plans (March and December 2018);
  - Funding - £255 million Implementation Fund and new Clean Air Fund which would cover mitigating actions;
  - Consultation to be launched in Autumn 2017 on mitigation measures (retrofit, discounts, car clubs, subsidised public transport and scrappage);

- New labelling and consumer information requirements to be developed.
- The presentation touched on the proposals for a diesel related United Kingdom scrappage scheme - the consultation for the diesel scrappage scheme was due to be launched in the autumn of 2017. It was anticipated that the aim of the scrappage scheme would be to target support at those that are most likely to be impacted by measures to improve air quality. The government has stated that they are open to ideas from stakeholders through the consultation on how some of the challenges to implementing a scheme could be overcome.
- The presentation touched on 'Clean Air Zones' and explained that the Government will take forward as previously announced plans to introduce Clean Air Zones. Clean Air Zones will be mandated in five United Kingdom cities (Birmingham, Leeds, Nottingham, Derby and Southampton) with a 2019 implementation timeline envisaged. A further 29 local authorities have been identified as requiring to take action due to persistent exceedances of the annual mean objective limit for nitrogen dioxide. Secondary legislation requiring these authorities to implement a Clean Air Zone is still to be passed. Emission standards for Clean Air Zones remain as previously planned with cars/vans at Euro 6 (diesel) and Euro 4 (petrol) and HGVs/buses at Euro VI. Vehicles which meet these minimum emission standards will be able to enter or move within the zone free of charge. Fully electric or hydrogen fuel cell ULEVs will also be able to enter or move within zones free of charge. Government has stated that charging zones should only be used where local authorities fail to identify equally effective alternatives, i.e. as a last resort.
- Clean Air Zone plans will only be approved by government if local authorities can demonstrate that:
  - It is likely to cause nitrogen dioxide levels in the area to reach legal compliance within the shortest time possible;

- The effects and impacts on local residents and businesses have been assessed, including on disadvantaged groups, and there are no unintended consequences; and
  - Proposals that request Central Government funding support demonstrate value for money.
- **Client Earth** – The Presentation explained that the recent Client Earth legal action against the United Kingdom Government had succeeded, however, it had not mandated the following:
  - The five local authorities referenced in the case have not been mandated to introduce clean air zones;
  - 45 local authorities exceeding the nitrogen dioxide limit are not required to do anything;
  - No action is required in Wales.
- It is anticipated these might be addressed in the third Client Earth legal action due to take place against the United Kingdom Government in 2018.
- The presentation included **Diagram 12** that set out the nitrogen dioxide annual mean for 2015 for a number of areas in London and compared these against the annual mean in Cardiff City Centre. It is clear from the data that Cardiff City Centre is by far the lowest of the sites identified and the only one under the nitrogen dioxide limit. Westminster (Oxford Street) was the highest at 135 – almost four times higher than the Cardiff value. It should be noted at this point that the Cardiff City Centre value was taken from the 24 hour City Centre ambient background tracking site in Frederick Street which is in a pedestrianised area. The London values are based on roadside recordings that are adjacent to the public highway.

Diagram 12 – Nitrogen Dioxide Annual Mean 2015

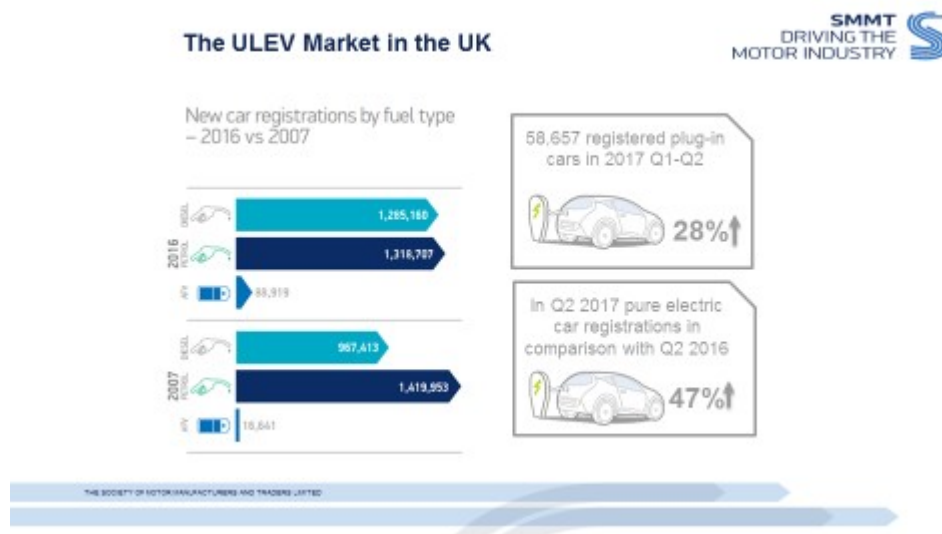


- The presentation identified the four types of electric and ultra low emission vehicles currently available in the United Kingdom, these were:
  - **Battery Electric Vehicles (BEVs)** - A battery electric vehicle is a type of electric vehicle (EV) that uses chemical energy stored in rechargeable battery packs. BEVs use electric motors and motor controllers instead of internal combustion engines for propulsion. They derive all power from battery packs and thus have no internal combustion engine, fuel cell, or fuel tank. BEVs include motorcycles, bicycles, scooters, skateboards, rail cars, watercraft, forklifts, buses, trucks and cars.
  - **Extended – Range Electric Vehicles (E-REVs)** – AN E-REV, or Extended-Range Electric Vehicle, offers all of the benefits of a plug-in hybrid, but with the promise of even greater efficiency. Think of an E-REV as an electric car, but with a generator on board to stop the batteries from getting flat. The idea is that you can recharge an E-

REV's batteries from a socket at home or work, and hopefully the car's range will be sufficient for most journeys. But if it isn't, the petrol engine just kicks in and works as a generator, keeping the battery at a minimum charge level until the next mains charge can top it up.

- **Fuel Cell Electric Vehicles (FCEVs)** – A fuel cell electric vehicle (FCEV) is a type of electric vehicle which uses a fuel cell, instead of a battery, or in combination with a battery or supercapacitor, to power its on-board electric motor. Fuel cells in vehicles generate electricity to power the motor, generally using oxygen from the air and compressed hydrogen.
- **Plug-in Hybrid Electric Vehicles (PHEVs)** - A plug-in hybrid electric vehicle (PHEV) is a hybrid electric vehicle that uses rechargeable batteries, or another energy storage device, that can be recharged by plugging it in to an external source of electric power as well as an on-board internal combustion engine and generator.
- **Diagram 13** was included in the presentation and sets out the new car registration for diesel, petrol and AFV in the years 2007 and 2016. It is clear to see that there has been a significant increase in AFV's since 2017. 58,657 plug in cars were registered in quarter 1 – 2 of 2017 which represents a 28% increase. In quarter 2 2017 pure electric car registrations were up by 47% when compared against Quarter 2 2016.

## Diagram 13 – Changes in the United Kingdom ULEV Market



- It is estimated that 15% of vehicles in the United Kingdom will be electric by 2021.
- The presentation then considered the experiences of other cities in developing a clean air strategy and reducing air pollution, the areas covered were:
  - **Manchester** – The planning for the approach to be taken has been delivered in Manchester by Transport for Greater Manchester as six of the local authorities required to deal with the clean air issue are within the Greater Manchester area (Manchester, Rochdale, Stockport, Trafford, Bury, Oldham, Salford, Tameside and Wigan). It is being driven by the Mayor for Manchester Andy Burnham who has publically stated that publically that he will not charge drivers to use the road. Planned initiatives include an electric bus trial with Volvo; a ‘Go Ultra Low’ event with Europcar; they are very keen to increase the number of ULEVs in the city and they are looking to showcase an event next summer around the National Clean Air Day. Manchester has an established tram system - which helps.
  - **Leeds** – Leeds launched an informal public consultation on Clean Air Zones in November 2017. The critical issue in Leeds is that the non-



compliant areas currently have 75% through traffic, i.e. the bulk of the problem isn't caused by local resident traffic. To help deal with this improvement works for traffic flow are being planned which should be completed in 2022. The main local bus operator has committed to only use Euro VI diesel by 2020. They are also in the process of accessing funding to help convert local taxis and are looking to secure a site for an alternative re-fuelling station. They are looking to work with local dealerships to help increase educational awareness on Clean Air Zone requirements and to help promote the uptake on ULEVs. Leeds was one of the first five cities in the England to be given £1 million for taxi improvements.

- During this part of the meeting it was suggested that one national bus company was passing older buses across to Cardiff / Wales because certain English cities have now increased emission standards.
- **Derby** – In Derby the main areas of exceedance are caused by the M1 corridor. As with most other exceedance areas, cars are the greatest source of emissions. Derby has undertaken research into census data to identify the residents most likely to upgrade their vehicles. They have also used the planning and development process to install electric vehicle charging points. Derby has a non-retrofit policy and are looking to arrange an event to promote Ultra Low Electric Vehicles in the city. The Leader of the council is an ex-taxi driver and has been reluctant to do anything that will charge drivers or adversely affect the economy in anyway. They are very keen to work with dealerships to promote the benefits of electric vehicles and the potential impact of a clean air zone. They are keen to access the JAQU funding which is potentially able to provide each clean air zone authority £1m for electric Hackney carriage taxis.
- **Nottingham** – They are in the early stages of writing their plan. The main area on non-compliance is the inner ring road with the private vehicles contributing to 83% of the emissions. DEFRA has advised they should implement a Class D Clean Air Zones by 1st January

2020. Additional measures include the implementation of trams, biogas vehicles and electric buses. They are looking to convert to a 100% electric taxis fleet by 2025. They have a workplace parking levy in place. This has raised £44 million since its introduction and currently generates a £9 million income each year for investment into Nottingham's transport infrastructure.

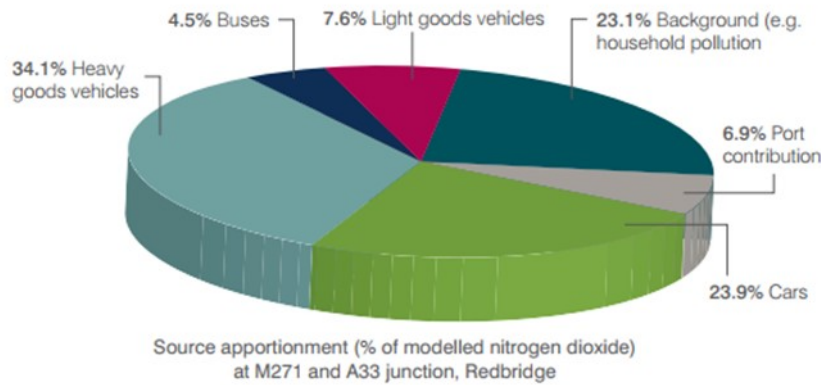
- **Bristol** – They are looking to implement the most stringent Clean Air Zone to deter cars from entering the city centre. The first Clean Air Zone feasibility study was deferred due to Client Earth contact, there is a need for a new AQAP and they need to deliver a completed Clean Air Zone feasibility study. It estimated that 60% of vehicles drive into the city from outside Bristol. They are looking to achieve the 'Go Ultra Low' (GUL) city status, and plan to install a large number of EVCPs. They have the ambition of upgrading the entire taxi fleet to electric vehicles. In doing this they are applying for help with upgrading their taxi and bus fleets.
- **Bath** – The city is trying to introduce a number a freight interventions, and to this end DHL are supporting this initiative by trying to acquire an alternative to the Smith electric truck. Source apportionment shows diesel to be the greatest contributor to air pollution, and the most polluted place is a strategic road with high volume of freight. They have recently added a combined natural gas re-fuelling station to the list of potential options for implementation. They are looking to introduce electric taxis into the fleet. Bath is keen to become a test area for connected & autonomous vehicles (CAV's). Bath also considers it important to spread the message of sustainable vehicles by working with dealerships, i.e. they ultimately sell cars and so it is probably a good idea to develop their sales pitch to support sustainable fuel vehicles.
- **Southampton** – Southampton has a large port which makes a large contribution to air pollution. The PCM model doesn't recognise other AQMAs. They have an Enterprise car club which is reluctant to move to

ULEVs. Southampton would like their taxi fleet to become EVs.

**Diagram 14** sets out the main pollution sources in Southampton, this shows that the port contributes to 6.9% of the pollution, with heavy goods vehicles accounting for the single largest pollution contribution at 34.1%.

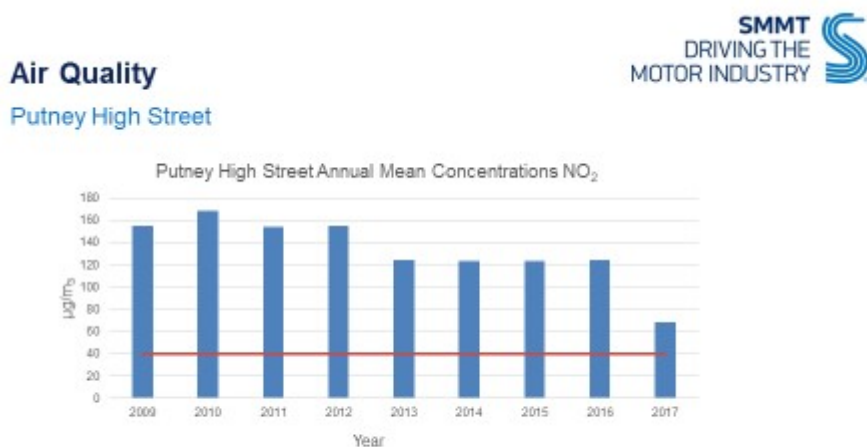
**Diagram 14 – Causes of Pollution in Southampton**

**Causes of pollution in Southampton**



- Due to exceptionally high air pollutions caused by NO<sub>2</sub> emissions a ‘Clean Bus Corridor’ has been introduced on Putney High Street. This now means that only vehicles achieving Euro 6 standards or higher can access the route. As can be seen on the **Diagram 15** this has significantly reduced nitrogen dioxide concentrations.

**Diagram 15 – Air Quality – Putney High Street**



- The Society of Motor Vehicle Manufacturers representative made a number of suggestions on the next steps for Cardiff's Clean Air Strategy, these included:
  - Encouraging the uptake of Ultra Low Electric Vehicles;
  - Develop a recharging infrastructure for electric vehicles in Cardiff;
  - Bus fleet upgrade;
  - Taxi fleet upgrade;
  - ULEV incentives, for example, parking, bus lane use;
  - Procurement – build the use of using vehicles that use sustainable fuels into the procurement process to ensure that the Council and public bodies convert as well the key parts of the supply chain;
  - Planning and Development – use active planning and development to encourage sustainable travel;
  - Encourage and expand car clubs;
  - Promote car sharing across the local authority and with its partners;
  - Introduce the 'Mobility as a Service' (MaaS) concept into Cardiff – i.e. this combines options from different transport providers into a single mobile service, removing the hassle of planning and one-off payments;
  - Freight – develop schemes to divert heavy goods vehicle transport out of key areas of the city;
  - Communications – clearly communicate the message of what is happening and more importantly why it is happening;
  - Lead by example – take control of the situation, deliver the required changes and other bodies and individuals will follow your example.
  
- It was suggested that the Council should work with a commercial partner to introduce electric charging points into public spaces. They are experienced in delivering this type of infrastructure whilst most local authorities aren't.

## **Improving Cardiff's Air Quality - Meeting 5 – Planning, Development & Other Pollution Sources - Thursday 23rd November 2017 – 11:30am to 2:45pm**

**Part 1 - Planning & Development** - Councillor Caro Wild, Cabinet Member for Strategic Planning & Transport and officers from the City Operations Directorate were invited to attend the meeting to discuss the role that planning & development has on Cardiff's air quality.

### **Key Findings**

- An officer stated that the Planning Service has numerous interfaces with air quality issues, and that they work closely with the Air & Noise Team within Shared Regulatory Services.
- Cardiff's Local Development Plan has been adopted and sets out Cardiff's growth plan until 2026. The site planning includes future transport infrastructure which will have a large impact on air quality in the city. One of the fundamental aspects of the plan is to maintain or improve air quality in the city.
- The Planning Service is going through the long task of developing new supplementary planning guidance and is able to create additional guidance to support the planning process where a specific need is identified. New supplementary planning guidance has recently been published on green infrastructure, managing transport infrastructure. These were presented to Council in November 2017.
- A Planning Officer explained that air quality could be reviewed as a potential topic for a supplementary planning document and but that it needed a policy hook from the Local Development Plan.
- Cardiff deals with the largest number of planning applications in Wales – it also deals with the most complicated by type. The Air Quality Team within

Shared Regulatory Services are regularly contracted to act as a technical consultee for these planning applications.

- A Member felt that dealing with air quality issues was sometimes a tick box exercise. A Planning Officer disagreed saying that today it was a far more regulated and highly technical process than had previously been the case.
- A Member stressed the importance to consider the wider (further afield) knock on effects of air quality issues caused by new developments, for example, building a new housing estate could cause air pollution issues at a road junction several miles away. In response it was explained that larger developments now have to be supported by an Environmental Impact Assessment. Such documents now look at the impacts caused over a much wider area.
- A Member explained that objections were put in for a specific Cardiff site over wider traffic problems. There was no new road to support the work required and the planning department was not minded to ask the developer for a new one. He felt that for such large sites we should be telling the developer that one is required, not asking or having the debate.
- It was explained that thorough assessments are undertaken and considered for all sites. The process involves deciding if a development should proceed based on a balance of factors, not just one or two. A development can proceed within parameters of acceptable harm. The task of the Planning Service is to challenge and then debate on the background of professional advice.
- A Member commented that large new sites created large levels of traffic during the construction phase and that this should be factored into the planning decision. A Planning Officer replied by saying that the bigger the site the more traffic, etc.... This is addressed through the master planning process, for example, sites are designed with more internal trips to keep traffic / travel within the site; there is significant investment in public

transport. Lots of thought is applied in getting under the skin and detail of the development.

- It was stated that the Planning Service had offered good collaboration and support to the development of the Clean Air Strategy.
- A Member agreed that the process of internalising developments was important and that it needed to work to cope with the scale of growth in the city and wider city region. A Planning Service Officer explained that good planning is not just about onsite provision, it should also focus on offsite contributions, for example, transport infrastructure.
- Planning obligation contributions have been large in Cardiff in recent years, for example, one site has attracted a planning obligation payment of £250 million.
- Trigger points should be applied to certain traffic levels, for example, if traffic increases in certain points then developers would become liable. Ensuring that good transport planning is put in place is crucial.
- A Member explained that a bus gate was put in place at a Cardiff site without there being any discussion with the bus companies. No one actually understood if there would be sufficient demand to make the route viable. Without financial support no bus company would take on the route.
- The strongest tool that the Council can use to ensure that developments deliver the required infrastructure is planning obligation. It is important to be as strict as possible when applying this. Front loading of planning obligations is also important when developing transport infrastructure – this provides an option to get bus subsidies in from the start.
- A Member asked if we have supplementary planning guidance that relates to electric cars and supporting provision. She was told that technology is changing really quickly, for example, things seem to change on an annual basis. This means that the relevant supplementary planning guidance will need to be reviewed each year.

- A Member asked if the Council should take the risk of keeping up with technology. It was explained that policy integration is a huge issue and striking a sensible balance in this area is very challenging. The Wellbeing of Future Generations means that the Council is now obliged to evidence that the planning process satisfies such need.
- National Planning Policy Wales is updated every year to ensure that it follows the needs of the Wellbeing of Future Generations Act. The Council follows and updates its policies to ensure compliance with the Act.



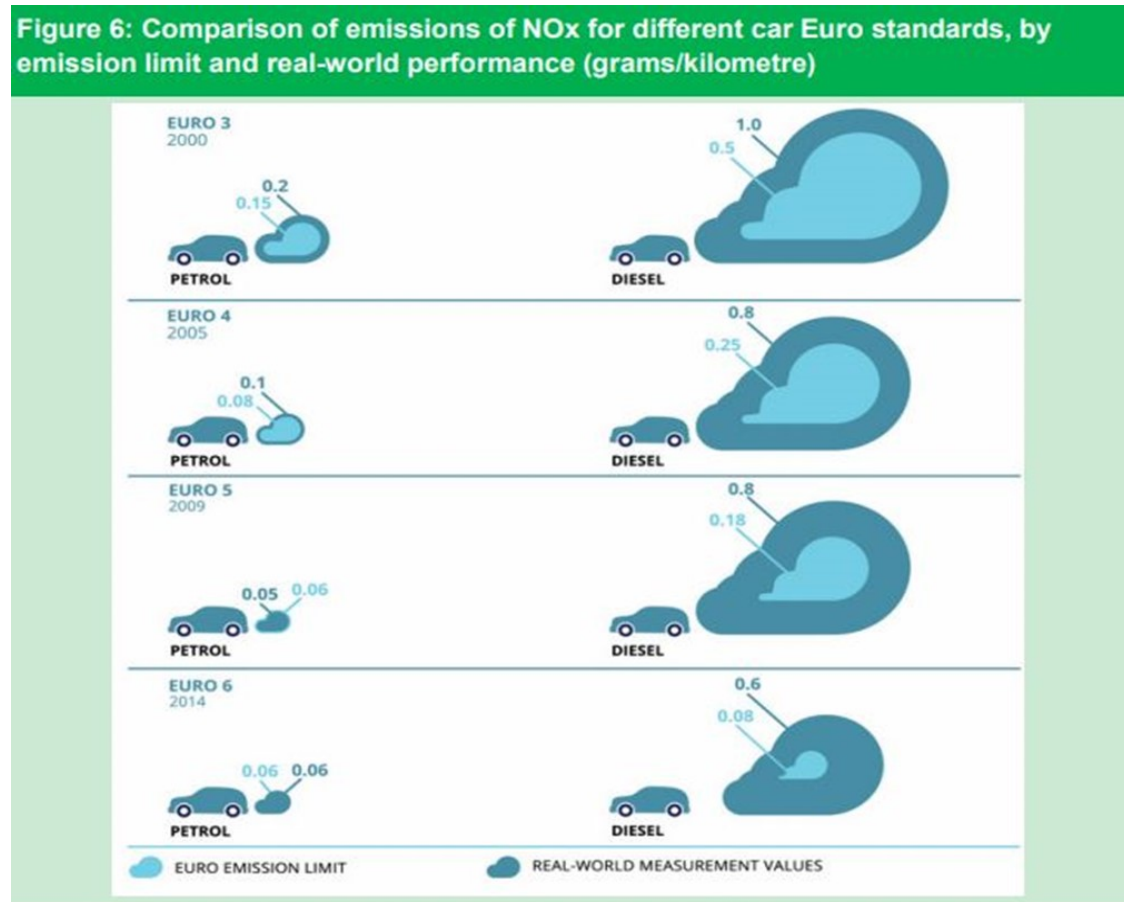
**Part 2 - Dr Clare Beattie - Associate Director at Air Quality Consultants Ltd** – Dr Clare Beattie was invited to attend the meeting to comment on the important characteristics of a clean air strategy and discuss the opportunities and challenges that exist for the Council as it develops ‘Cardiff’s Clean Air Strategy’.

### **Key Findings**

- Local Air Quality Management should be delivered through a systematic review of air quality against health based air quality ‘Objectives’ and that where necessary ‘Air Quality Management Areas’ would be required. Action Plans required where objectives are not met.
- EU Requirements - Welsh Ministers are responsible for meeting ‘Limit Values’ in Wales and failure in this area could result in potential fines for non compliance. Such assessments are undertaken on a different basis to LAQM (national modelling – PCM (Pollution Climate Mapping Model)).
- As explained by previous witnesses it was stated that nitrogen dioxide is the dominant pollution issue in Wales and that limit levels are set at a constant level of 40 mg.
- The presentation explained that the Welsh Government has recently produced the Well-being of Future Generations (Wales) Act 2015 - air quality clearly has an impact of well-being. Poor air quality impacts on health in Wales and so it needs to be addressed to comply with such legislation. The Welsh Government has recently introduced an average population exposure to nitrogen dioxide national indicator which Cardiff has to report on and comply with. By July 2018 consultation on Clean Air Zone Framework for Wales will need to be assessed in relation to whether other measures could achieve compliance more quickly. Welsh Government will need to work with Cardiff Council (and any other LAs) on this consultation and all other Welsh local authorities.

- Other Relevant Issues – Dr Beattie commented on a number of other relevant issues around air quality, these included:
  - That objectives and limit values are measured as an annual mean;
  - Several parts of Cardiff with Air Quality Management Areas are impacted on the ‘Street Canyon’ effect. Tall buildings create a canyon effect and hold the pollution in a confined area preventing dispersion;
  - Complex chemistry of nitrogen dioxide;
  - Drop off in concentrations away from road for nitrogen dioxide and other forms of pollution are quite rapid;
  - Congestion increases emissions - stop/start driving significantly increases the level of vehicle emissions;
  - HGVs/ Buses – these produce greater emissions per vehicle;
  - Gradients will increase emissions – although Cardiff is fairly flat which is a positive for air pollution levels in the city;
  - Real world emissions – especially diesel.
  
- **Real World Emissions – Diagram 16** provides a comparison of emissions of nitrogen dioxide for different car Euro standards, by emission limit and real – world performance. It is clear from the diagram that nitrogen dioxide emissions are significantly higher for diesel than petrol for each of the four Euro categories, and that actual emissions from vehicles when driven in a real world environment (and not under laboratory conditions as used for the Euro limit standards) are significantly higher than the prescribed Euro standard values. The diagram illustrates that in terms of nitrogen dioxide emissions, diesel engines present a far more significant threat to health than their petrol equivalent.

**Diagram 16 - Comparison of emissions of Nitrogen Dioxide for different car Euro standards (diesel & petrol), by emission limit and real world performance**



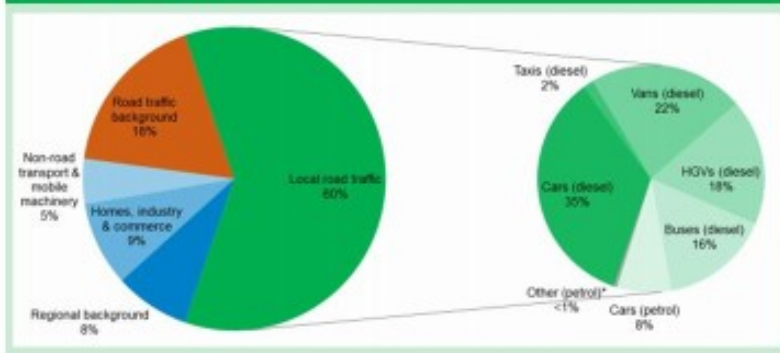
Source: Adapted from a report by the European Environment Agency<sup>25</sup>.

- Diagram 17** sets out the United Kingdom national average nitrogen dioxide roadside concentration apportioned by source of nitrogen dioxide emissions 2015. The diagram illustrates that 60% of nitrogen dioxide is generated by local road traffic – from this 60%, 93% is generated from diesel vehicles (cars (diesel) 35%; Taxis (diesel) 2%; Vans (diesel) 22%; HGV's (diesel) 18%; Buses (diesel) 16%). This means that as a United Kingdom average in 2015 55.8% of all nitrogen dioxide emissions was generated by diesel vehicles.

## Diagram 17 - United Kingdom national average NO<sub>x</sub> roadside concentration apportioned by source of NO<sub>x</sub> emissions 2015

### Sources

Figure 3: UK national average NO<sub>x</sub> roadside concentration apportioned by source of NO<sub>x</sub> emissions, 2015



Source: PCM modelling provided by Ricardo Energy & Environment (2017)

Note: 'Local road traffic' in the large pie chart is the estimate of the proportion of local NO<sub>x</sub> roadside concentrations contributed by traffic on that road and is shown in greater detail in the smaller pie chart. 'Road traffic background' is the estimate of NO<sub>x</sub> concentrations contributed by traffic on other roads.

\* Other (petrol) is made up of petrol vans and motorcycles.

HGVs = Heavy Goods Vehicles.



- The presentation touched on the Client Earth High Court cases to date and the impact that this has had on dealing with air pollution in the United Kingdom. In particular the presentation made reference to:
  - The Client Earth High Court cases relate to the Defra National Air Quality Plan, which ClientEarth considered had only taken 'minimum steps' to achieve the EU Limit Value.
  - In November 2016 the High Court concluded that modelling of when the Limit Value will be met was based on overly optimistic vehicle emission factors in future years. It also identified that the Defra National Air Quality Plan was not sufficiently ambitious to meet the Limit Values by the 'soonest date possible'.
  - In November 2017 a further legal action against the Government was announced. This also included taking the Welsh Government to court for failing to meet their obligations in Wales.

- **Clean Air Zone Feasibility Work** – it was explained that most of the local authorities who have a requirement to consider implementing a clean air zone are at an early stage of the process, i.e. are involved in the planning or are actually undertaking a feasibility study. DEFRA has set out prescriptive reporting requirements for English local authorities with 2020 Limit Value exceedances. JAQU (Joint Air Quality Unit – Defra and DfT) is providing considerable financial support to English local authorities in planning for and implementing clean air zones. It was felt that Wales needed to utilise this existing experience and that the resource allocation for Wales for carrying out this work was still unclear.
- The presentation made some suggestion on how to go about creating a Clean Air Strategy in Cardiff, in doing so she explained that:
  - It would need a ‘Steering Group’ of relevant Council officers and other key stakeholders – this should include the Welsh Government;
  - Extensive traffic and air quality modelling would be required to identify the scale of the problem in the city;
  - A list of options would need to be identified for dealing with the issue, this should include a range of Clean Air Zone scenarios (size of area? the type of vehicles to include?);
  - It would be important to engage political involvement at the earliest possible opportunity.
- It was suggested that a Clean Air Strategy for Cardiff should include:
  - A detailed evaluation of options impacting on air pollution in Cardiff and not just air quality;
  - A detailed business case setting out the option(s) chosen for the Clean Air Strategy and why these had been selected;
  - Prioritisation of measures – i.e. those that need to be delivered first to achieve the Limit Values as quickly as possible;
  - Consideration of consultation/ engagement with the public and other key stakeholders;
  - An ‘Implementation Plan’ for the Clean Air Strategy’;

- A defined monitoring approach to ensure that the chosen initiatives are being properly implemented;
  - Key elements / wider measures worth building into the Clean Air Strategy should include 'Smarter Travel', 'Low Emission Vehicles and Infrastructure', 'Traffic Management', 'Planning Frameworks' and 'Communication'.
- The challenges facing the Council in developing the Clean Air Strategy were highlighted as:
  - A Clean Air Strategy will need to cover the identified Air Quality Objectives and deal with addressing the EU Limit Value requirements;
  - Working through the lengthy processes of feasibility work, gaining approval and public / political acceptability;
  - The funding position in Wales is still unclear for developing a Clean Air Strategy and dealing with the implications of potentially introducing a Clean Air Zone;
  - Many aspects of the work that needs to be delivered is outside of local authority control;
  - Brexit and all of the uncertainty that this presents.
- The opportunities presented to the Council in developing the Clean Air Strategy were identified as improved health; a more agreeable city centre environment; the development of a collaborative approach for dealing with the issue.

**Part 3 - Natural Resources Wales – Air Quality Monitoring** – An air quality officer from Natural Resources Wales was invited to attend the meeting to explain the role that the organisation has in monitoring and compliance around air quality in Cardiff and across Wales.

### **Key Findings**

- The Natural Resources Wales role can be broadly categorised as adviser, regulator and evidence gatherer/provider. Within this remit they have a number of duties including:
  - They ensure that the industrial facilities comply with EU requirements on Wales and the United Kingdom (for example, Air Quality Directives, Habitats Directive, the National Emissions Ceiling Directive and the Industrial Emissions Directive, Domestic and UK requirements such as the Environmental Permitting Regulations, the Air Quality Standards (Wales) Regulations, the UK Air Quality Strategy and the Countryside and Rights of Way Act and the Well-being of Future Generations (Wales) Act).
  - They support local authorities in improving local air quality, including the provision of ambient air quality modelling, advice and guidance.
  - They coordinate ambient air quality monitoring for incidents that can have an impact on air quality.
  - They provide air quality modelling, analysis, guidance and advice services to support permitting, conservation and compliance activities.
  - They are not generally responsible for monitoring or assessing ambient air quality.
  - They are the advisor to the Welsh Government - air quality is a devolved matter, and the Welsh Government is responsible for their

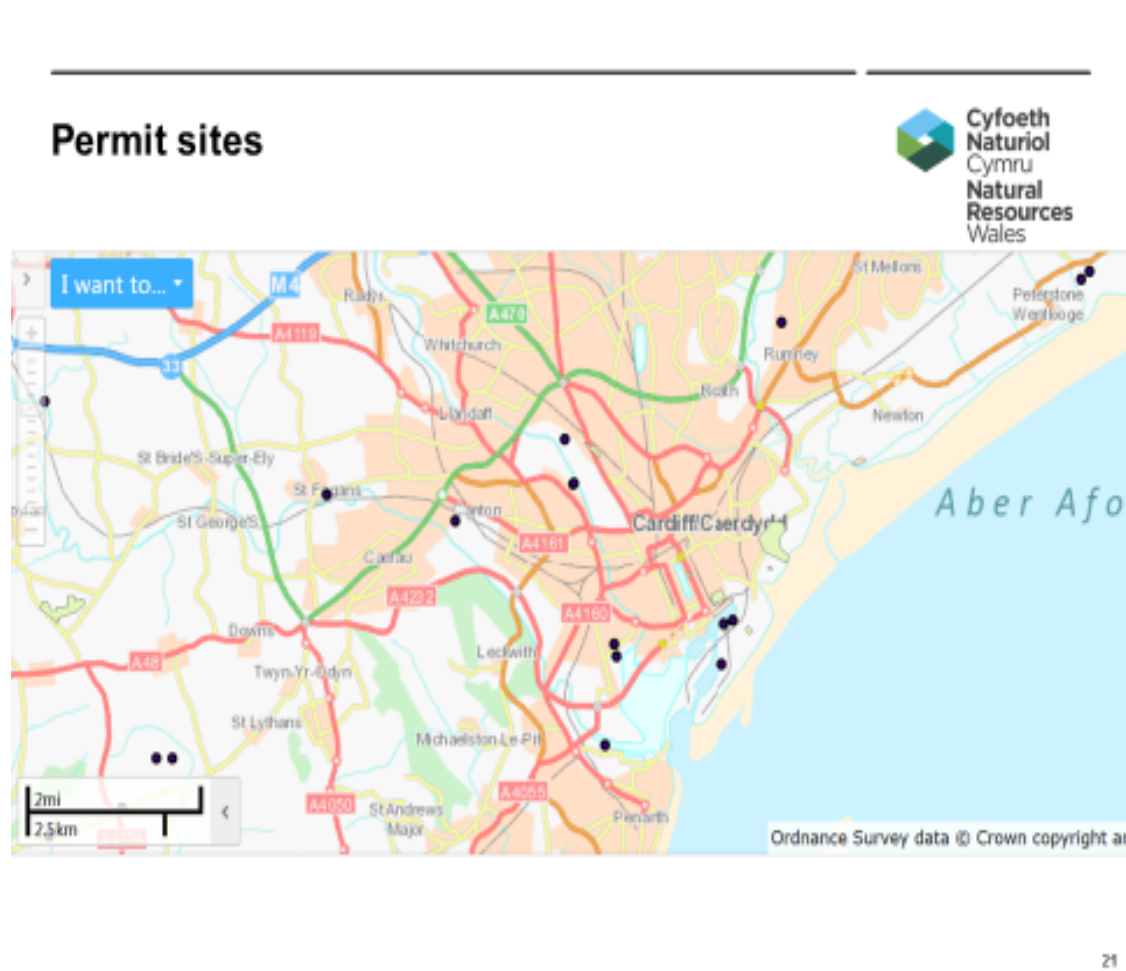
own air quality policy and legislation. The UK government leads on international and European legislation.

- Natural Resources Wales is the principal environmental advisor to the Welsh Government. They support the Welsh Government in its duty to achieve air quality limit and target values set in European Directives and domestic regulations. They also support its duty to minimise the harmful effect of air pollution on human health and the environment. They provide the Welsh Government with advice, guidance and evidence.
- Natural Resources Wales is committed to working with local authorities and playing its part in Local Air Quality Management. They continue to agree improvements with local authorities for the installations they regulate that contribute significantly to breaches of an Air Quality Strategy objective.
- Natural Resources Wales provides local authorities with information that identifies the current releases from industrial installation(s); any assessments on the effect of the releases from the installation on local air quality; any plans already in place that will deliver future improvements for local air quality; any equipment or operational changes that could deliver improvements for local air quality.
- The monitoring and compliance arrangements in place to measure air quality includes:
  - **Stack monitoring** - Large combustion plant (LCP) and waste incineration plant (covered by WID/IED) are required to take stack monitoring. For example, permit at Viridor requires continuous monitoring (CEMS) for Oxides of Nitrogen (NO and NO<sub>2</sub> expressed as NO<sub>2</sub>), Particulate Matter TOC, HCl, SO<sub>2</sub>, CO. Such data has to be provided every hour or half hour.



- **Ambient monitoring** - When it is necessary, installations will be asked to carry out stack or ambient air quality monitoring as a permit condition or compliance check.
- **Diagrams 18 & 19** set out the sites that Natural Resources Wales routinely monitors for air quality standards in Cardiff and the wider South Wales Region. An officer from Natural Resources Wales explained that Cardiff in particular did not contain a high concentration of industrial facilities that needed constant monitoring and that there were no recent examples of emissions breaches in the city.

**Diagram 18 – Cardiff Permit Sites Monitored by Natural Resources Wales**



## Diagram 19 – South Wales Permit Sites Monitored by Natural Resources Wales



- Natural Resources Wales has the following enforcement powers at its disposal, the main one that they use is the Environmental Permitting (England and Wales) Regulations 2016.

## **‘Improving Cardiff’s Air Quality’ - Meeting 6 – Sustainable Fuel for Vehicles - Wednesday 6th December 2017**

**Part 1 - Council Approach to Sustainable Fuel for Vehicles** - Councillor Michael Michael, Cabinet Member for Clean Streets, Recycling & Environment and officers from the City Operations Directorate / Economic Development Directorate were invited to attend the meeting to discuss the work that the Council is doing to support the delivery of sustainable vehicle fuel within the Council and across Cardiff as a whole.

### **Key Findings**

- The presentation set out why the Council needs to act in terms of developing low emission transport in Cardiff. It addressed six key points including:
  - **Poor Air Quality** – this contributes to 40,000 premature deaths per year in the United Kingdom. Cardiff is in breach of EU limit values, with diesel fuel related emissions being the largest contributor to Cardiff’s problem.
  - **Carbon Reduction** – There are national and city wide targets for carbon reduction across the United Kingdom. Transport accounts for 24% of emissions nationally. The Welsh Government is pushing for a carbon neutral public sector by 2030.
  - **Cost** - Fossil fuels are an ever increasing cost to the Council and citizens. Fuelling the Council fleet cost £1.5m in 2016/17.
  - **Demand/Supply Standoff** - Market confidence needs to grow in low emission transport. High consumer cost and an uncertainty/slow emerging supplier market slows down potential growth. Strategic leadership and “intelligent customer” actions needed are needed to

help push things forward. This underlines the Council role as an “early adopter” and strategic player.

- **Cardiff’s Competitive Position** – It was explained that Cardiff should have a strong competitive position in pushing forward low emission transport, for example, it presents a ‘World Class City Offer’; it is a city at the forefront of technology and it is a city that facilitates a cleaner smarter quality of life.
- The Cabinet Member stressed the importance of taking a lead in this area, i.e. upgrade the standards within our fleet and to act as an enabler for things like public electric charging infrastructure. He also commented on the potential benefits of dealing waste on a South Wales Regional basis, for example, he felt at the time that it would be great to have a waste collection vehicle that ran on sustainable fuel (electric or hydrogen), however, there didn’t appear to be an appropriate vehicle in the market to meet this ambition. As a consequence he felt that a waste collection vehicle using sustainable fuel would not feature in the next procurement exercise, but hoped it would happen in the one after that.
- Background studies have been commissioned to help understand the Council’s role, opportunity and key points of impact in terms of developing and supporting sustainable fuel infrastructure.
- A Member explained that £4 million had just been made available for electric charging infrastructure in Wales. An officer explained that he was off to a meeting the following day to discuss the potential implication for Cardiff from this fund.
- Members commented and agreed that it was essential to build sustainable fuel vehicle options into future procurement strategy. The Cabinet agreed with this and felt that it should now be easier to do this as all fleet procurement is delivered through Central Transport Services.

- £50,000 in the 2017/18 budget was allocated to fund a study into how Cardiff supports and delivers electric charging infrastructure in the city.
- The Cabinet Member explained that as a general rule of thumb hydrogen currently works better for larger vehicles and electric is more efficient for smaller vehicles. An officer then explained that there is strong hydrogen expertise in South Wales, for example, at the Baglan hydrogen centre and University of South Wales.
- An officer explained that it is important to acknowledge that in the short, medium or long term there is no single silver bullet to solve this problem. Cardiff needs to embrace the complete range of technologies available.
- Five examples of best practice in terms of using sustainable fuels in the United Kingdom were mentioned in the presentation, these were:
  - **Dundee City Council** – they have introduced electric vehicle charging infrastructure across the city (15 rapid chargers & 50 fast chargers); converted 81 Council vehicles to electric); created electric vehicle charging “hubs” and a pool car scheme; they have converted the main taxi fleet to electric (81 vehicles). To help achieve this they have received £3m in financial support from the EU, the United Kingdom Government and the Scottish Government. They were ‘Highly Commended’ in the United Kingdom cities ‘Go Ultra Low’ scheme.
  - **Fife Council** – they were cited as a best practice example as they are trialling hydrogen waste vehicles and using renewable energy assets to generate hydrogen as a fuel for the vehicles.
  - **Greater Manchester Combined Authority** – They have made bids to the ‘Green/Clean Bus Fund’; they are implementing 200 electric vehicle charging points as a part of a ‘Plugged in Places” initiative; they are aiming to set stricter emission standards for taxis operating in the area.
  - **Nottingham City Council** – They have rolled out electric vehicle charging infrastructure across the city; they have converted the Council fleet to electric; they have introduced a ‘Low Emission Zone’ and they are now operating compressed Natural Gas Buses. This has been

achieved thanks to £6 million of United Kingdom Government financial support. Nottingham City Council were winners of the United Kingdom cities 'Go Ultra Low' scheme.

- **Mayor of London Assembly** – They have created 'Low Emission Zone exemptions'; introduced an 'Ultra Low Emissions Zone plan'; all new buses introduced in London are either hydrogen or electric; they have introduced an extensive range of car clubs and electric vehicle charging points.
  
- The presentation went on to explain the main opportunities available to Cardiff in terms of growing the use of low emission or sustainable fuels, the actions that it needs to take and why we need to deliver the actions. These included:
  - Cardiff is the capital of Wales and as such it should take a 'Leadership role' in growing the use of low emission or sustainable fuels;
  - Cardiff is a population and business centre. It has the critical mass to stimulate uptake of low emission or sustainable fuels;
  - The Council is in a strong position to control and influence the introduction of sustainable fuel infrastructure. Also given its size it can act as an early adopter in terms of converting its large fleet and build the use of sustainable and low emission fuel into its procurement process and the procurement supply chain;
  - The Council has close working links with Cardiff Bus, Cardiff's taxi companies and other partner public sector organisations (for example, Health Service, Police Force, Universities, etc.);
  - They have the responsibility of managing the public highway and major development sites across the city;
  - The Council is able to support and deliver local energy supply opportunities that can be used to produce sustainable energy and create circular economies. Local sustainable / renewable energy

examples include the Lamby Way Solar Farm, Viridor Energy from Waste Facility and the Tidal Lagoon;

- South Wales has significant levels of hydrogen fuel expertise, for example, at the University of South Wales and several manufacturing sites across the region. In addition to this, the South Wales Steel Industry has huge potential for capturing hydrogen as a waste product and then reusing it as a sustainable vehicle fuel;
  - Do-nothing is not an option. Improving air quality to achieve compliance with EU limits without some type of clean air zone was unlikely and that without the growth of sustainable / low emission fuels it would be even more difficult.
- The presentation set out a 'Strategic Vision' that the Council needed to deliver to act as a catalyst for change, this included:
    - Facilitating and speeding up a pathway to zero emission transport;
    - Proactively addressing Air Quality Challenges;
    - Using procurement power to provide market confidence;
    - Accessing grants to proactively kick-start infrastructure provision;
    - Engaging with and supporting local innovation;
    - Exploring beneficial business models on supply and generation;
    - Securing the best Circular Economies for the City and for Wales.
  - The presentation then provided three slides that set out short, medium and long term actions that the Council needed to take to drive the clean / low emission fuel agenda forward. These are set out in **Diagrams 20, 21 & 22**.

Diagram 20 – Short Term Strategic Actions

STRATEGIC ACTIONS		Short Term		
		Action	Evidence	Progress
		<b>Fleet Procurement</b> Gradual conversion to ULEV vehicles	<ul style="list-style-type: none"> <li>Pool cars and small vans – already cheaper on a whole of rental life analysis but requiring associated charging infrastructure</li> <li>HGVs - less mature market still needs piloting approach</li> </ul>	<ul style="list-style-type: none"> <li>Testing 2 EV vans</li> <li>Corporate target around fleet emissions</li> <li>Draft Procurement strategies pointing towards inclusion of ULEV vehicles</li> </ul>
		<b>EV Charging Infrastructure</b> Install more publically available Charging Points	<ul style="list-style-type: none"> <li>Growing consumer demand</li> <li>Market needs support in dense urban areas</li> <li>OLEV Funding available</li> </ul>	<ul style="list-style-type: none"> <li>Detailed feasibility study commissioned</li> <li>Preparing for bid to OLEV</li> </ul>
		<b>Understand the Council's Energy Supply Role</b>	<ul style="list-style-type: none"> <li>Renewable projects - business models significantly enhanced with Council Fleet as a potential customer</li> <li>Unclear governance and delivery models around on-street sale of electricity</li> </ul>	<ul style="list-style-type: none"> <li>Already using innovative solar to supply EV's</li> <li>Modelling impact on Solar Farm proposal</li> <li>EV study looking at issues to do with sale/supply</li> </ul>

	Vehicle Price (€)	EV Cost	Electric Vehicle	Conventional Motor Car	Range / Cost
Car	5	€ 27,342	€24,816	-	€ 2,524
Small Vans	7	€ 28,877	€18,708	-	€ 10,169
Large Vans	7	€ 28,242	-	€ 38,218	€ 9,976
Tipper Vans	7	€ 27,664	-	€ 41,791	€ 14,127
Truck/Trailer	12	€ 118,411	-	€134,827	€ 16,416




  


Diagram 21 – Medium Term Strategic Actions

STRATEGIC ACTIONS		Medium Term		
		Action	Evidence	Progress
		<b>Cardiff Bus</b> Understand current investment approach and identify more ambitious opportunities for Hydrogen, electric and CNG vehicles	<ul style="list-style-type: none"> <li>Best Practice in London, Manchester, Nottingham and elsewhere</li> <li>English Schemes have benefitted from funding not available in Wales</li> </ul>	<ul style="list-style-type: none"> <li>Significant carbon and emissions reductions already achieved</li> <li>Needs further and longer term strategy to address Carbon Neutrality and Air Quality agendas</li> </ul>
		<b>City Growth</b> Explore opportunities for ULEV infrastructure as part of new development proposals (LDP sites, Park and Ride, Metro, etc)	<ul style="list-style-type: none"> <li>Clear and increasing demand.</li> <li>Relates to general SD design principles</li> <li>Cost effective business models (viability)</li> <li>CIL item?</li> </ul>	<ul style="list-style-type: none"> <li>Developing SPG</li> </ul>
		<b>Taxis</b> Explore incentives and licencing levers to favour ULEV Incl Council Taxi Use strategies	<ul style="list-style-type: none"> <li>Working in Dundee and elsewhere</li> <li>Needs level playing field in licencing (UBER risk)</li> </ul>	<ul style="list-style-type: none"> <li>Residential areas with high incidence of licenced taxi drivers targeted for on-street EV charging points</li> <li>Explore ULEV criteria for CCC taxi use contracts</li> </ul>

Hydrogen Bus - London

Dundee EV Taxi rank



**Diagram 22 - Long Term Strategic Actions**

Longer Term		
Action	Evidence	Progress
Clean air Zones	<ul style="list-style-type: none"> <li>WG stats</li> <li>UK Govt response</li> </ul>	<ul style="list-style-type: none"> <li>Air Quality Strategy considering this</li> </ul>
Develop Fully Integrated Hydrogen Strategy	<ul style="list-style-type: none"> <li>Fife pilot scheme</li> <li>London Bus Pilot Scheme</li> <li>WG – circular Economy aspiration</li> <li>UK and EU innovation funding programmes</li> </ul>	<ul style="list-style-type: none"> <li>Dialogue with Shell</li> <li>IUK hydrogen project ( now closed)</li> </ul>
Electric Vehicles to Grid and Energy Storage Provision	<ul style="list-style-type: none"> <li>Potential enhanced business case and citizen benefit</li> <li>UK and EU innovation funding programmes</li> </ul>	<ul style="list-style-type: none"> <li>Local Electricity Distributor (WDP) developing strategy</li> </ul>
Electric Vehicle hubs providing a social purpose	<ul style="list-style-type: none"> <li>Dundee experience</li> <li>WG directive on EV inclusion in 21<sup>st</sup> Century Schools Programme</li> </ul>	

- The task & finish group were pleased to see that the slides provided an outline plan and structure for driving forward the development and growth of sustainable / low emission fuels in Cardiff. Seeing a series of actions, supporting evidence and progress to date across the short, medium and long term was encouraging and seemed like the basis for a sound Low Emission Transport Fuels Strategy.
- The presentation concluded by explaining that the Council is currently in the process of delivering an Electric Vehicle Feasibility Study. The scope of the study is to:
  - Review the electric vehicle market including – electric vehicle charging infrastructure providers; demand for electric vehicle charging & charging types and developing technology.

- Review 'Best Practice' including - Technology in the UK and abroad; potential links to other projects (e.g. car clubs, renewable fuels, fleet, parking sensors, smart living principles etc.); enforcement.
- Consider a range of infrastructure technology, including types of charge point; connection types; charge speed and site suitability; system architecture.
- Consider Energy requirements including - power availability by location and power requirements by charging technology type.
- Consider installation issues, including potential locations and feasibility assessment placement considerations; maintenance and warranty.
- Review costs, including capital (excluding delivery and installation) and revenue (indicative).
- Consider funding options and availability including - OLEV and commercial partnership options;
- Consider commercial/operational models including - an understanding of business models around direct sale of energy through on street charging points;
- Consider the procurement - options appraisal and recommendations emerging;
- The development of a Draft Action Plan.

## Improving Cardiff's Air Quality - Meeting 7 – Clean Air Zones & Scrutiny Research - Tuesday 12th December 2017

**Part 1 - Scrutiny Research** – Gladys Hingco from Scrutiny Research attended to brief Members through the findings of her research into the implementation of 'Clean Air Zones' and the emission standards of Cardiff's public sector fleet.

### Key Findings

- The Environment Scrutiny Committee commissioned a research report to identify current initiatives and arrangements that selected cities have adopted to achieve improvements in air quality. The report focused on initiatives and measures introduced by selected local and transport authorities to reduce levels of nitrogen dioxide emissions and Particulate Matter (PM10). In the UK, this research examined the work in improving air quality in London and its Boroughs as well as initiatives that were implemented in the cities of Nottingham and Manchester. More specifically the report focused on best practice initiatives in implementing Low Emission Zones; the procurement of clean cars and transport; the use of economic incentives and disincentives such as congestion charging, parking management approaches and improvements in modal shift. The document is titled 'Improving Air Quality Initiatives – Best Practice Examples' and is attached to this report as **Appendix 5**. This section of the report highlights the key findings identified in this piece of research.

### European City Ranking

- The European City Ranking report examined various initiatives to improve air quality in European city capitals. In 2015, their evaluation work reviewed initiatives in 23 key cities in Europe. The city which has achieved the highest ranking for improving air quality for that year was Zurich, closely followed by Copenhagen, Vienna and Stockholm. Although the City

of London ranked 7<sup>th</sup> in 2015, this latest ranking is a significant improvement from the previous review in 2011. **Diagram 23** shows the ratings and achievements of the twelve highest ranked cities in 2015.

**Diagram 23 - Top twelve ranked European cities in terms of delivering initiatives for managing air quality in 2015**

City	Overall Mark	Emission Reduction Success	Low Emission Zones and bans of High Emitters	Public Procurement	Non-Road Mobile Machinery	Economic Incentives	Mobility Management and Modal Split	Promotion of Public Transport	Promotion of Walking and Cycling	Participation and Transparency
Zurich	A+ (89%)	++	0	++	++	+	++	+	+	++
Copenhagen	A (87%)	+	0	++	+	+	++	++	++	+
Vienna	A (84%)	++	0	+	+	+	++	++	+	+
Stockholm	B+ (80%)	0	0	0	+	++	+	++	++	+
Berlin	C (76%)	0	++	++	+	0	+	0	0	+
Helsinki	A-C (71%)	++	0	0	--	0	++	++	+	0
London	A-C (71%)	-	0	+	+	+	0	++	+	0
Paris	A-C (71%)	--	+	)	-	+	++	+	++	+
Stuttgart	C (71%)	0	++	+	--	+	+	+	0	+
Amsterdam	D+ (69%)	+	-	0	-	+	0	+	++	+
Graz	D+ (69%)	0	0	0	0	0	0	++	+	+
Dusseldorf	A-D (7%)	0	++	0	0	-	0	0	+	+

- Diagram 23** sets out the top twelve ranked European cities in terms of delivering initiatives for managing air quality in 2015. Zurich is the best performing city and scores 89% - the overall mark is based on it performing well in areas such as emission reduction success; low emission zones and bans on high emitters; public procurement; non-road mobile machinery; economic incentives; mobility management and modal split; promotion of public transport; promotion of walking and cycling; participation and transparency. The only United Kingdom city to feature in the top twelve is London which scored 71%. It is clear from the table and following evidence that the best performing cities have been working to improve air quality for some time and that they have invested considerable resources into managing the air quality problem. In comparative terms these are wealthy cities - the list (excluding Frankfurt) contains five of the largest financial centres in Europe. German, Austrian and Danish cities are dominant in the list accounting for six of the twelve places – these are

countries that have received strong support from central government to improve air quality standards. In short, achieving quick improvements is expensive and generally requires financial support from central government.

- In reducing PM10 and nitrogen dioxide emissions, the Scrutiny Research report cited that the cities of Helsinki Zurich and Vienna had made significant improvements in this area. In Helsinki, the reduction in these pollutant indicators was partly attributed to the implementation of the low emission zone, while in Zurich this partly attributed to regulations around emission standards for old and new vehicles.

### **Low Emission Zones**

- Low Emission Zones are often introduced to reduce particulate matter (PM10 and PM2.5) and nitrogen dioxide emissions. Minimum emission standards are set within these areas for vehicles that wish to enter the zone. Such schemes operate by regulating the entry (ban, restrict, charge) of highly polluting vehicles into the area.
- So far it is reported that there are as many as 225 active or planned low emission zones in Europe. In the United Kingdom, there are only two low emission zones, the biggest covering most of the Greater London area. In Europe, the cities of Stuttgart and Berlin are reported as leading practice in implementing Low Emission Zones. 55 of the 225 low emission zones are in Germany – principally because central government has prioritised the matter, issued clear guidance and provided financial support.
- The LEZ s in Berlin and Stuttgart as with others in Germany are also referred as Green Environmental Zones. These environmental zones only allow traffic for vehicles bearing a green environmental badge i.e. vehicles that meet the minimum EURO 4 or better emission standards. This stricter regulation has been in force since January 2017. The restriction to traffic apply all the time irrespective of whether the levels of air pollution are higher or lower at any one time. Vehicles that drive as well as stop and

park in an environmental zone without a valid environmental badge, will be fined 80€ plus an additional 25 € to cover administrative fees.

- It is also planned that traffic restrictions for diesel vehicles will be introduced in selected German cities including Berlin, Hamburg, Munich, Leipzig and Stuttgart by 2018. These “diesel restriction zones” or “blue environmental zones” and is intended to regulate traffic of diesel vehicles depending on their emission rate of nitrogen dioxide.

### **Low Emission Zone – Berlin**

- The environmental zone in Berlin covers 88 km<sup>2</sup> and was introduced in 2008. Significant reductions were seen in the level of PM<sub>10</sub> and nitrogen dioxide following the introduction of the measure. Reports have cited that the introduction of the scheme had no measurable impact on traffic flows in Berlin. However, this scheme is credited for speeding up the turnover of vehicle fleet towards more cleaner vehicles and is regarded as a significant factor to the change in composition of vehicles in the area.
- The Berlin Low Emission Zone restricts entry by only allowing vehicles with EURO 4 or better emission standards into the area. All vehicles entering the city need to display a green environmental badge – failure to adhere to this will generate a non-compliant fine of 80€ plus an administrative charge 25 €. In addition to this Berlin is planning to introduce “diesel restriction zones” or “blue environmental zones”. The results to date measured against the baseline figures have achieved reductions in PM by 58% and nitrogen dioxide by 20%. There has been no measurable impact on traffic flows in Berlin following the introduction of the Berlin Low Emission Zone, but there has been an increased vehicle turnover in favour of cleaner or low emission vehicles. In 2012 around 96% of diesel cars and approximately 85% of all trucks had a green sticker.

### **Low Emission Zone & Congestion Charging - Milan**

- Milan has adopted a combined Low Emission Zone and congestion charging. The measure was trialed in 2008 and was fully implemented in

2012. The scheme in Milan differs to the environmental zones in Germany in charging petrol and diesel cars entering the zone. Entry to the zone is forbidden for pre-EURO gasoline vehicles and for pre-EURO, EURO1 and EURO2 diesel vehicles. The entry fee for vehicles that meet emission standards is €5. The restriction applies every working day (Monday-Friday) from 7:30am-7:30pm with shortened hours on Thursdays from 7:30 am to 6:30 pm to encourage weekday shopping activities. The area is free to access (no charge) on weekends and public holidays. The payment allows users to travel for the whole day in the charged area. Electric vehicles, hybrid vehicles, bio-fuel natural gas vehicles and scooters, public utility vehicles are exempted from the charge.

- The implementation of the measure in Milan led to significant reduction in PM10 (~19%) and nitrogen dioxide (~14%) levels. The scheme also led to a significant reduction in traffic volume with the average number of vehicles that entered Area C declining by 34%. The number of polluting vehicles entering the area also declined by 49%. The number of cleaner vehicles entering the area has increase from 9.6% to 16.6% of total vehicles entering the area.

### **Low Emission Zone - London**

- In London, the Low Emission Zone was introduced 2008. Unlike the low emission zone in Milan and Berlin, this measure only applies to all heavy goods vehicles greater than or equal to 3.5. tonnes (for example, diesel lorries, buses, coaches, motor caravans, motorised horseboxes, larger vans, minibuses and other specialist vehicles) so that cars and motorcycles are not affected by this regulation. From 2012, heavier goods vehicles including busses have to meet Euro 4 emission standards and Euro 3 for heavier vans and mini buses. All heavy goods vehicles in these categories that do not meet the required emissions standards have to pay a daily charge. The charges range from £100 - £200 depending on vehicle category and weight. The low emission zone covers most of the Greater London area. It operates 24 hours a day, every day of the year, including weekends and public holidays. Charging days run from midnight to

midnight. Similar to the impact of low emission zone in other cities in Europe, the scheme in London has also led to reduction in PM10, nitrogen dioxide and black carbon. It is estimated that this Low Emission Zone has reduced emissions of PM10 by 1.9% (28 tonnes) and nitrogen dioxide by 2.4% (26 tonnes).

### **Ultra Low Emission Zone - London**

- The Ultra Low Emission Zone was planned to be introduced in 2020 but will instead come into force in Central London in April 2019. The Ultra Low Emission Zone will replace the “toxicity charge” T-charge, that was recently introduced. The Ultra Low Emission Zone will cover the same area as the Congestion Charging Zone in London. It is also planned that in 2020, Ultra Low Emission Zone could be further expanded to cover nearly all of Greater London for heavy polluting buses, coaches and lorries. Starting April 2019, all vehicles will need to meet exhaust emission standards (Ultra Low Emission Zone standards) or pay a daily charge when travelling in central London. With the implementation of this measure, the minimum Euro standard for Motorcycles is Euro 3 and for petrol cars and light utility vehicles not exceeding 500 kg, the minimum standard will be Euro 4. For diesel cars and vans, Euro 6 and for lorries and busses the requirement is Euro VI. The daily charge for non-compliant smaller vehicles is £12.50 and £100 for buses and lorries. These charges are in addition to the congestion charges in London and the Low Emission Zone requirements.

### **London Toxicity Charge & Zero Emissions**

- The London Toxicity Charge or T-charge came into force on 23 October 2017. The charge was introduced to further improve air quality within the capital and to prepare Londoners for the Ultra Low Emission Zone that will be introduced in 2019. The T- charge costs £10 per day and is payable on top of the London Congestion Charge and applies to all vehicles that do not meet the current emission requirements within the zone. For petrol and diesel vehicles the minimum standard required is Euro4 and Euro 3 for motorised tricycles and quadcycles. There are no charges for motorcycles.



- It is also intended by Transport for London that the entire road transport system in London will be zero emission by 2050 at the latest. Zero emission zones will be introduced in Central London and town centre zero emission zones from 2025, with a view of achieving this zero emission zone for inner London by 2040 and a London-wide zone by 2050.

### **Low Emission Neighbourhoods - London**

- Another scheme that has been introduced via the Mayor of London's Air Quality Fund is the Low Emission Neighbourhood. This is defined as an area-based scheme that includes a package of measures delivered within a specific area and is focused on reducing emissions and promoting sustainable living locally. This scheme is currently being implemented in five areas across different Boroughs in London. This scheme is focused on areas of high exposure to high pollution which can be reduced through local measures, and locations with high trip generation. The measures associated with Low Emission Neighbourhoods are less suited to areas where the high pollution levels are restricted to a single road, especially if through-traffic is a large source of emissions. Key to the success of Low Emission Neighbourhoods is the partnership and involvement of the local community, businesses and the local authority to jointly identify and deliver a common set of goals. The Mayor of London has provided £1m in funding to each of the five Low Emission Neighbourhoods to support the measure and a range of initiatives.

### **Marylebone Low Emission Neighbourhood**

- The partnership between Westminster City Council and local stakeholders, including businesses, landowners and residents gave rise to the Marylebone Low Emission Neighbourhood. The Low Emission Neighbourhood implements a range of innovative projects to improve air quality throughout the area including encouraging behavioural changes that directly reduce emissions. This includes projects that involve working with major landowners to improve emissions from buildings, better management and reduction of freight movement and service vehicles

entering the area, for example, by consolidation of deliveries and use of shared supplier scheme. The scheme also implemented on street parking charges that mean vehicles are charged according to their emissions level when parking in on-street pay and display and residents' bays. This measure intends to encourage use of electric vehicles and discourage more polluting vehicles. The Council has also commenced the trial for a 50% parking surcharge for all diesel vehicles in certain locations in area (for example, in the Hyde Park, Marylebone and Fitzrovia areas typical parking charges increased from £4.90 to £7.35). The Low Emission Zone is also working with the taxi industry to improve the management of taxi ranks through the use of parking sensors that provide taxi drivers with real time information of the location of available taxi rank spaces. The Low Emission Neighbourhood scheme is also working with taxi drivers and local hospitals to reduce unnecessary vehicle idling in the Westminster and Marylebone area. Air Quality champions were recruited to encourage drivers to stop vehicle idling and inform them of its harmful effects. They will be empowered to enforce unnecessary vehicle idling via a penalty charge notice. The scheme will also include a pilot to provide on-street electric vehicle charging points, a schools emissions engagement scheme and focus on children's play activity through temporary street closures.

### **Manchester Air Quality Strategy**

- The Transport for Greater Manchester has developed the Greater Manchester Low-Emission Strategy and Greater Manchester Air Quality Action Plan – their approach was identified as best practice at the UK Clean Air Day 2017. These identify key priority areas and commitments in improving local air quality. A key priority is to increase the take up of electric vehicles and alternative fuel vehicles. The authority hopes to achieve this by providing incentives and by setting emission standards and restricting vehicle access to specific areas. It is also committed to increasing the number of publically available charging points (with an initial implementation of 200 and an aim to eventually reach 700) and increasing the number of low emission vehicles within the public sector via joint procurement schemes. Transport for Greater Manchester will work with

licensing authorities to standardise the minimum emission requirements of the vehicles that are allowed to operate and the standards that will operate in future years. The strategy is also committed to reducing freight emissions by shifting freight to Urban Distribution Centers'. This will allow loads to be broken down for final delivery via low emission vehicles. It is also planned that local consolidation centers will be set-up so that courier services and small deliveries are coordinated to avoid multiple delivery providers from visiting same premises. The strategy also supports the take-up of zero emission transport refrigeration and will promote anti-idling policies with freight transport companies. Transport for Greater Manchester will work with bus companies to ensure that they sign-up to targets for improving emission standards and in implementing practical measures such as the deployment of buses with the lowest emission in areas with the highest pollutant concentrations. The Transport for Greater Manchester will also continue to work with bus operators to roll out the bus electrification scheme, to encourage the use of new technology (such as geofencing control systems and exhaust abatement technology) and to support a driver training initiative for drivers of hybrid buses.

- Transport for Greater Manchester will also explore the feasibility of establishing a Low Emission Zone in the Greater Manchester area, as well as the implementation of the 20mph zones in areas where this will have significant impact on emissions. Finally, Transport for Greater Manchester will work with the planning authorities to develop common guidance and toolkit for assessing proposals to support the identification of appropriate mitigating measures, for example, electric vehicle charging points, access to public transport or sustainable transport.
- Other initiatives included in the action plan are to set ULEV specifications for all car club vehicles; to work with licensing authorities (across the Greater Manchester area) to standardise the minimum emission requirements of taxi vehicles and the retrofitting of yellow school buses.

## **Procurement and Retrofitting of Vehicle Fleet**

- One of the key measures that many cities are working on is to improve emission standards of their fleet is through the retrofitting of older vehicles with diesel particulate filters and investment in vehicle fleets that use electric and sustainable fuels. Leading in practice is the city of Berlin which has adopted a policy for using green air technology. More than 50% of diesel vehicles are equipped with particulate filters or meet the Euro V/EVV standard. Similarly, the city of Copenhagen aim to make its public transit carbon neutral. So far, the city has acquired 255 electric vehicles and has attained its goal that 85% of the municipality's own vehicles are electric, hydrogen or hybrid powered. The city of Zurich has introduced regulations that require the strictest Euro standards for new vehicles and have also planned for the extensive retrofitting of its older vehicles. The city is working to increase usage of electric vehicles in its sustainability plans. The cities of Zurich and Copenhagen provide a host on financial incentives and infrastructure to support the use of electric vehicles through reduced taxation or exemptions from vehicle tax and increasing availability of charge points.

## **Congestion Charging Zones**

- Some cities have implemented congestion charging schemes to restrict the number of vehicles entering a specified area to reduce traffic volume and improve environmental conditions including air quality. Such a scheme was introduced in Stockholm in 2006 in the form of congestion tax. The tax applies to cars, lorries and buses while there are exemptions for emergency vehicles, buses, diplomatic vehicles, disabled persons vehicles, military vehicles, hybrid or electric cars, motorcycles and mopeds. The amount charged varies depending on the time of day that the driver enters or exits the congestion tax area. Generally, the cost is higher during periods when traffic is heaviest. Unlike other congestion charging schemes, the scheme in Stockholm charges vehicles on both entry and exit of the affected area. A limit is set (£9.35 or 10.54 Euros) for the amount that a vehicle can be charged per day. The charges do not apply

on Saturdays, Sundays, public holidays or the day before public holidays, in the month of July, nor during the night-time period (18:30 - 06:29). The vehicle owner is expected to pay the charges at the end of the next month. The scheme served as an effective stimulus for the adoption of alternative fuel cars. Following the introduction of the measure, the number of alternative-fuel cars increased from 3% in 2006 to 15% in 2009. The exemption was abolished in 2009 as the authority believes that the scheme had filled its role as a facilitator for market introduction. On the whole the scheme led to a reduction in traffic level (22%) and the reduction in congestion has led to increased in reliability of travel time and travel times have declined substantially inside and close to the inner city. The reduction in traffic also led to reduced emissions of between 10-15% across different types of emissions. There was also no adverse impact on retail as was initially feared. The number of passengers in the transit system has also increased because of the scheme.

- A key obstacle to congestion charging is often the support and acceptability of the scheme. The experience in Stockholm is an example in a change in the attitude and support of the public on issue or a measure that needed acceptance and support. In this case the attitude changed from fairly hostile to overwhelmingly positive. The experience in Stockholm supports the hypothesis that “familiarity breeds acceptability”, i.e. that once a system is in place, support will generally increase or build up as the benefits and advantages of the scheme become more evident.

### **London Congestion Charging**

- The world’s first congestion charging scheme was introduced in Central London in 2003. It aims to reduce congestion and encourage motorists to use other modes of transport. The daily congestion tariff is £11.50. This daily charge allows motorists to drive around, leave and re-enter the charging zone as many times as required in one day. The charge is in operation Monday to Friday from 07:00-18:00 and does not apply at weekends, Bank Holidays, public holidays or the period between Christmas Day and New Year’s Day, when traffic levels are lighter. The

charges generate a significant source of revenue for Transport for London that is then invested to improvements to the bus network in London. Although the revenue from the scheme make a significant contribution towards the London Bus network, questions have been raised whether this is a cost effective way of generating the money for investment in transport improvement and infrastructure. Similar to the experience in Stockholm, the ring fencing of income proceeds for improvements in transport facilities and infrastructure has increased its acceptability. Following the introduction of the scheme, there was decline in the level of automobile traffic, however the long-term impact of congestion charging to traffic levels have yet to be established. Studies have reported that the measure changed people's travel patterns in London and have increased the use of buses (14%) and the underground system. The introduction of the scheme also resulted in significant increase in traffic speeds within the zone and peak period congestion has also declined. Although the measure has brought many benefits, the system is not considered optimal because the fee charged is not based on how many miles a vehicle is driven within the charging area and is not time-variable as the fee is not higher during the most congested periods and lower during less congested periods.

- There are certain exemptions for the London Congestion Charging scheme, these include:
  - Cars or vans (not exceeding 3.5 tonnes) which emit 75g/km or less of carbon dioxide and that meet the Euro 5 standard qualify for a 100% discount;
  - Any car registered as new on or after 1 January 2011- Euro 5 standard;
  - Vehicles that are powered by 'electric', hydrogen or are defined as a 'plug-in hybrid'.
- The scheme has brought in a significant source of revenue for the Transport for London Authority, for example, £190m in 2004/5 and £268m in 2007/8. Questions have been asked about the cost effectiveness for

generating the money for investment in transport improvement and infrastructure. The scale of initial investment required was quite high and the operating costs have been reported as being approximately 40% of total revenue.

### **Singapore's Electronic Charging**

- Singapore adopted a congestion charging scheme in 1975, referred to as an Area Licensing Scheme which required vehicles to have a special license to operate within specific areas. In 1998, the scheme was replaced by Electronic Road Pricing. This new system introduced electronic toll collection, electronic detection, and video surveillance technology. The in-vehicle unit communicates with detectors when passing under gantries and the respective charge is deducted from the driver's cash card. The amount varies by time of day (rush hour is two to three times more expensive), type and size of vehicle (taxis and passenger cars according to engine capacity, goods vehicles and buses and others) and the type of road (arterial and expressways).

### **Parking Management Schemes**

- Parking management is used as a travel reduction strategy in many cities in Europe and the US. The reductions in car travel will reduce traffic congestion and will reduce transport emissions. Various parking schemes have been adopted to dis-incentivise motorists from taking private vehicles in their commute into the city. In Rotterdam, the parking scheme adopted by the Erasmus Medical Centre in Rotterdam required employees to pay for parking according to arrival time and gives credit for every kilometre not travelled by car if employee decides to take public transport.
- Improving user information as part of parking management will allow motorists to identify parking locations and prices so they can choose the best option for each trip. Some cities make use of advance parking management systems that provide motorists with real-time information to help them quickly find a parking space. Since 2011, the San Francisco Municipal Transportation Agency has implemented a comprehensive

smart parking system to help manage congestion. The system is demand responsive whereby rates may vary by location, by time of day and day of the week. With this scheme, parking rates would vary incrementally, depending on time of day and availability of spaces. In areas and at times of the day where it is difficult to find a parking space, rates will increase incrementally. However, in areas where open parking spaces are plentiful, rates will decrease until some of the empty spaces get filled.

- Some local authorities in the UK use charging for parking to help with their CO<sub>2</sub> reduction objectives. Richmond upon Thames Borough Council charges residents for parking permits according to the CO<sub>2</sub> emissions of the vehicle. The Council is considering extending this principle to charges at parking meters and in car parks. Edinburgh City Council has proposed to introduce a similar CO<sub>2</sub>-related charge for residents parking permits.
- Nottingham City Council introduced the Work-place Parking Levy in 2012. It was intended that the Work-place Parking Levy scheme would serve as an incentive for employers to manage their workplace parking provision and encourage commuters to use public transport on their journey to work. The scheme generates significant revenue for the Council that is ringfenced to finance improvements in transport infrastructure and air quality in the city. The scheme works as a levy for employers who provide parking spaces for its employees. The local authority collects a charge for each parking place used by employees, certain types of business visitors, and pupils and students. The employer decides whether or not they would pass the charge on to their employees. Each employer that provides more than 10 parking spaces for its employees is required to obtain an annual licence for the maximum number of liable places they provide. The current charge for each workplace parking for this financial year 1 April 2017 to 31 March 2018 is set at £387. The Work-place Parking Levy generates around £9 million pounds a year for the City and since its implementation has generated over “over £44 million of revenue” with “100% compliance of liable employers”. The scheme is low cost to run as the operating costs only take up around 5% of the total revenue. It is considered more cost



effective scheme than the London Congestion Charge. The London Congestion Charge raises more money in absolute terms than the Work-place Parking Levy; however, it is regarded as less efficient due to more than 40% of total revenue taken up by operating costs. So far, the revenue from the Work-place Parking Levy has successfully leveraged £400m funding from central government to finance major transport infrastructure developments and improvements.

### **Reduction of Speed Limits**

- Cities can also impact on air quality by reducing speed limits. Vehicle emissions are at its lowest at 30-50 km/hr. A number of cities have adopted 30 km/hr speed limits in residential areas (Zurich and Copenhagen) while Paris envisages reducing the 50km per hour limit to 30km/h across the central district in the future.
- The aim of the Clean Air Zone research was to identify current initiatives and arrangements that selected Cities have adopted to achieve improvements in air quality and review a range of documents available on-line.

### **Stockholm Congestion Charging**

- All vehicles are required to pay the congestion tax in Stockholm. Exemptions are applied for electric cars, hybrid vehicles, mopeds and motorcycles. The amount charged varies depending on the time of day that the driver enters or exits the congestion tax area. The cost is higher when traffic is heaviest. Charges are applied to vehicles both on both entry and exit of the affected area – the scheme has set a maximum charge of 10.54 Euros. Charges do not apply Saturdays, Sundays, public holidays or the day before public holidays, in the month of July, nor during the night time period (18:30 - 06:29).
- The impact of the scheme has been positive with a 22% reduction in traffic levels; an increase in reliability of travel time; declining travel times;

reduced traffic emissions; no adverse impact to retail & business and an increase in patronage of public transport.

- The task & finish group also commissioned a second Scrutiny Research report titled 'Public Sector Vehicle Fleet in Cardiff – Comparative Figures'. A copy of this document is attached to this report as **Appendix 6**. The research was commissioned to look into the fuel and emission characteristics of vehicle fleets that are being operated in the Cardiff area by various locally based public sector bodies.
- The public sector bodies included for this research were Cardiff Council, Cardiff & Vale University Health Board, South Wales Fire & Rescue, South Wales Police Authority and Natural Resources for Wales. The findings of the research provided comparative information on the number, fuel type and age public sector vehicles that are currently in use.
- Key findings identified in **Appendix 6** include:
  - The organisations surveyed reported that they had 1,210 vehicles that were operating across Cardiff. This was broken down as – Cardiff Council 732; South Wales Police – 273; University Health Board – 120; Natural Resources Wales – 58; South Wales Fire & Rescue Service 27.
  - 1,137 from the total of 1,210 public sector vehicles reported as being used in Cardiff were diesel operated vehicles – this equates to approximately 94%.
  - Approximately 65% of the vehicles owned by the surveyed public sector organisations were registered between 2013 and 2017, i.e. they are less than five years old.
  - Only two of the public sector organisations surveyed were able to provide data on the Euro emissions ratings of their vehicles. Approximately 82% of Cardiff Council's vehicles were rated as Euro 5 or Euro 6.

**Part 2 – Developing a Clean Air Zone in Cardiff** – Councillor Caro Wild, Cabinet Member for Strategic Planning & Transport was invited to attend the meeting to discuss the feasibility of creating a clean air zone in Cardiff. He was supported by officers from the City Operations Directorate and Shared Regulatory Service.

### **Key Findings**

- It was explained that the Council had held a meeting with representatives from the Welsh Government and DEFRA around addressing air quality issues in Cardiff. The meeting focused on what needed to happen next in terms of assessing the situation, modelling various air quality improvement options, the technical approach that needed to be followed and undertaking a feasibility study. In addition to this they discussed the need for additional resources to deliver the work as what was being proposed was far from business as usual. The task group was told that discussions had been positive and that they were awaiting a letter from the Welsh Government confirming the actions that need to take place and how these will be funded.
- It was stressed that timescales were very challenging and so exercises like an options analysis and a feasibility study would probably need to take place at the same time.
- The feasibility study would focus on options around delivering a clean air zone or low emission zone in Cardiff, while the options analysis would consider how much progress could be achieved 'within the shortest time possible' by developing options like active travel, parking measures, sustainable travel, electrical charging and planning.
- The task group were informed that they would be provided with a copy of the letter once it arrived. The task group was also told that there wasn't much that the Council could do until they received the letter, other than

carry out some 'soft market testing' to establish the type of support available to deliver the work and the companies in the market with the relevant expertise.

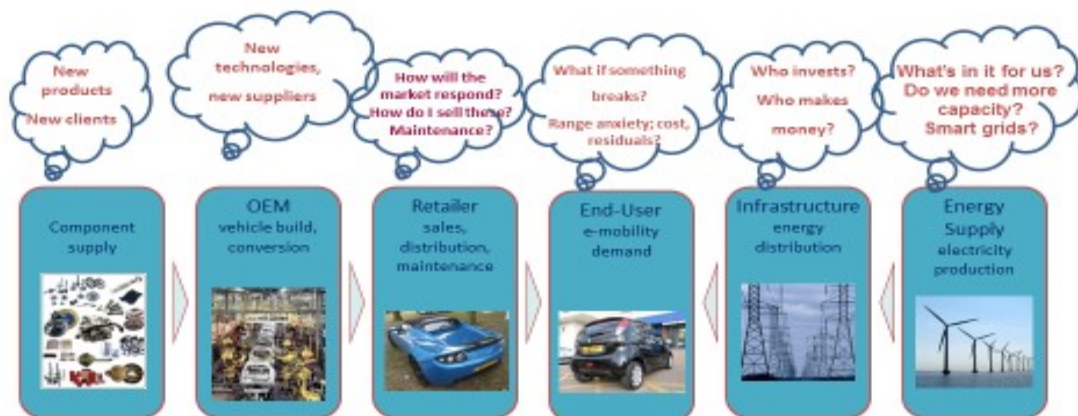
## 'Improving Cardiff's Air Quality' - Meeting 8 – Sustainable Fuel for Vehicles & Cardiff BID - Wednesday 20th December 2017

**Part 1 - Dr Paul Nieuwenhuis from Cardiff University** – He was invited to brief the task group on the continually evolving market for sustainable vehicle fuel and the potential impact that this could have on cities like Cardiff. This included a discussion on key areas such as growing infrastructure, scaling the use of new fuels and the introduction of associated technologies.

### Key Findings

- The presentation started by explaining that electric vehicles are older than either petrol or diesel cars and the first ones date back to the 1840's. It then questioned why they had not taken off and provided a number of suggestions explaining why this was the case. Some of the explanations provided are set out in **Diagram 24**.

**Diagram 24 – Risks at all stages along the value chain**



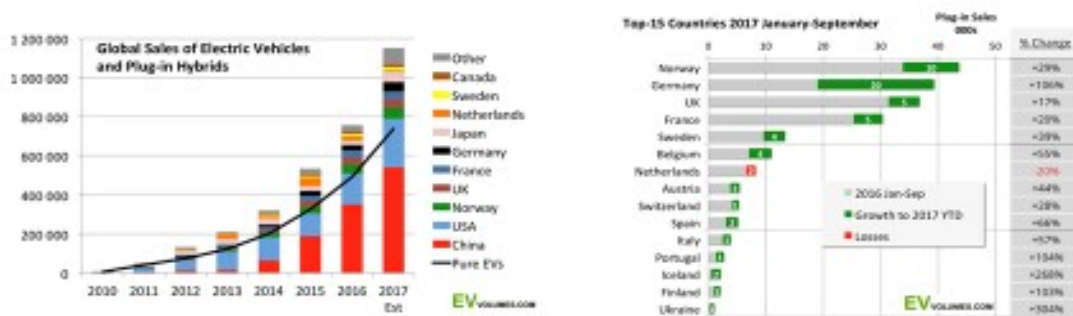
*Risks at all stages along the value chain that impede transition from IC to EV*

- It was explained that the car industry doesn't really talk to oil / fuel industry. The new model is very different from the previous combustion approach in that renewable energy can be produced everywhere and you don't need to be an oil or fuel company to produce fuel for low emission vehicles – this will become a complete game changer across the value chain. For example, fuel production will be possible from a much wider range of suppliers (including potentially the car manufacturers).
- The battery in a vehicle is worth half the value of the car, for example, if the car costs £30,000 then the battery would cost £15,000 to produce. Until the battery (or fuel cell) costs fall then this evolving technology will need to be subsidised.
- The first car to reach 100 miles per hour was a steam vehicle; the first car to reach 100 kilometres per hour was an electric car.
- Electric charging will never be as quick as petrol, diesel or hydrogen. A rapid charge will typically take 20 to 30 minutes, but the trip range will be no more than 100 miles. Hydrogen fuelled vehicles can be fuelled in less than a minute and have a 300 mile plus range.
- Recent growth in the global sales of electric vehicles and plug in hybrids has been very quick. In 2017 approximately two thirds of the sales of such vehicles were in China and United States. The United States has two separate emissions standards, the United States National Standard and the California Standard. The California Standard is much stricter, however, in recent years other states have started moving across to this new standard and the desire to reduce vehicle emissions increases.
- **Diagram 25** illustrates the sharp increase in electric vehicle and plug in hybrid sales between 2010 and 2017 (estimated). Sales increased from virtually none in 2010 to 1.2 million in 2017 (estimated). **Diagram 25** also includes a secondary chart that illustrates the top 15 European countries in terms of electric vehicle plug in sales for the period January to September

2017. It is clear from the diagram that sales increased rapidly in all but one country (the Netherlands). Norway was responsible for the greatest number of sales, while Germany saw the biggest percentage increase (20%). The German increase is attributed to the roll out of low emission zones across the country, clear Central Government policy / financial support and the Volkswagen diesel scandal.

**Digram 25 – Increasing trends in electric vehicle sales**

**Recent years have seen a massive increase in EV sales:**

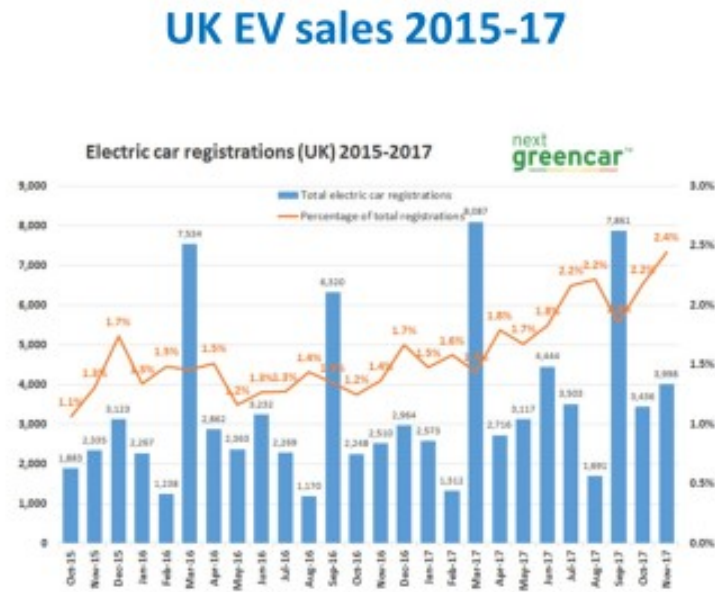


Paul Nieuwenhuis EVCE 2017

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- The country with the highest overall market share for low emission vehicles is Norway, this is probably due to the fact that they have been subsidising such vehicles for many years. The United Kingdom also offers incentives for low emission vehicles, for example, £5,000 is available towards the purchase of a new low emission vehicle and they are exempt of road tax.

**Diagram 26 – United Kingdom Electric Vehicle Sales 2015 to 2017**



Source: Society of Motor Manufacturers and Traders, November 2017.



Paul Nieuwenhuis EVCE 2017

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- Diagram 26** illustrates the growth of electric vehicle sales in the United Kingdom relative to overall registration for the period October 2015 to November 2017. Over the period electric vehicle registrations as a percentage of total registrations increased from 1.1% in October 2015 to 2.4% in November 2017. It was explained that a 5% market share (estimated to be reached in 2020) is the magic number in terms of starting to achieve economies of scale.
- In terms of taking a reality check it is important to remember that take up of electric vehicles in the public sector is crucial to help drive demand, and that electric vehicles still need to be a part of an incentive-driven market. Norway is the market leader in terms of overall percentage of people using electric vehicles - they have approximately 20 years experience of private electric vehicle use. Like all electric vehicle markets, the Norwegian market is incentive-driven, for example, electric vehicles are able to enter Oslo for free; they are allowed bus lanes; they can access free parking; free charging points are supplied and there is no sales or road tax. Tax on



a car purchase in Norway is typically 45% - there is no tax on an electric vehicles.

- Electric charging cables can be a health and safety issue, for example, there is a trip potential attached to the cables and the power coming down a charging line can be considerable (particularly for a Tesla vehicle).
- Dr Nieuwenhuis went on to suggest a number of possible air quality improvement options for Cardiff, these included:
  - **Public Charging Points** - Currently Cardiff only has private charging points in car parks (for example, NCP and IKEA) and dealerships (for example, BMW, Nissan, Renault). There are no public charging points - just a few would raise profile of electric vehicles and show support.
  - **Convert Council Fleet to Electric Vehicles** - Expensive initially; the running costs lower; most of Cardiff would be well within range; there would be an air quality benefit. An increasing number of private fleets (for example, DHL & UPS) are moving to electric vehicles.
  - **Convert Cardiff Bus to Electric or Fuel Cell buses** – They currently don't have any, so only having one show case bus would be a good start. They would contribute to a significant air quality improvement, for example, BYD e-buses are in operation in London; fuel cell buses have been in operation for years in Vancouver, Perth, Chicago, Amsterdam, London & Reykjavik.
  - **Promote Electric Taxis** - Public charging points could attract electric taxis, for example, as seen in Dundee. This would help air quality improvement.
  - **Attract Electric Vehicle Car Club** – For example, Autolib and Car2Go. The advantage here is that they will cover most of the cost, provided infrastructure needs are met. A note of caution here, they are generally more justifiable in cities larger than Cardiff.

- **Ban Internal Combustion Vehicles from the City Centre** – This would be a longer term option, so no immediate impact. It could be used as an opportunity to gradually expand the pedestrianised zone in the city centre.
  - **Seriously Promote Cycling & E-bikes** - Cheapest option, but takes away road space from cars, trucks, buses. E-bikes are the world's most common form of electric vehicle.
- Some early local authority installers of electric vehicle charging points have come unstuck at the rapid development of the technology, for example, the charging plugs used have become outdated and are no longer suitable for use on the modern electric vehicles.
  - BYD-ADL are the biggest manufacturer of e-buses in the world and operate an e-bus in London. They are close to the point of mass-producing this type of vehicle. A BYD-ADL e-bus is twice the cost of a regular petrol or diesel bus.
  - The batteries for electric vehicles have become efficient, however, making and disposing of the battery has a very high cost implication.
  - The Munich programme that was launched in 1999 used a BMW powered liquid hydrogen vehicle which was designed as a demonstrator model to illustrate how the technology could be used. Vancouver has a trolley bus that is powered on electric – Cardiff used to have a similar tram system.
  - There are no low emission buses in Wales. On several occasions during the meeting it was felt that Cardiff Bus would be an ideal candidate for a low emission bus – either electric or hydrogen fuelled. Introducing a hydrogen bus could act as a catalyst to support the introduction of the first hydrogen refuelling centre in Cardiff.
  - Two interesting quotes relating to electric vehicles were provided during the presentation, these were:

- *“The petroleum spirit cab will never be a practical proposition in large towns” - (Hospitalier, 1898, quoted in Nieuwenhuis, Cope and Armstrong (1992)The Green Car Guide, p88).*
- *Before 1900 most taxis in big cities were horse-drawn or EV. By 1900 1 in 3 cars sold in the US was an EV; many of these were taxis!*
- Several examples of cities using electric taxis were quoted during the meeting, for example, the BYD taxi in Brussels and the Tesla taxi that is used in Stockholm. Closer to home the city of Dundee in Scotland now run their entire taxi fleet on electric.
- Other suggestions made that could increase the introduction of low emission cars into the city included:
  - To raise public profile of any of your measures currently being delivered;
  - Or to inform colleagues about the same measures;
  - Inviting Green Fleet to do a launch event or an information event in Cardiff. Similar events have taken place in Dundee, Manchester, Bristol... Such events can help raise awareness on low emission vehicles and act as a catalyst to launch other private and public investments in this type of technology.
- The presentation explained that a major shift is taking place in terms of the type of vehicles that we use, examples included:
  - The shift towards using renewables to generate energy and fuel...;
  - This shift means that EVs make even more sense;
  - It is anticipated that access to electricity will be greater than to petrol and diesel;
  - And Wales is well placed as a potential renewable energy powerhouse.
  - Hydrogen is already used to store energy from renewables at times of peak supply but low demand in Germany.

- With Welsh renewables this is also an option and could potentially make Wales a clean hydrogen fuel hub – this is perfect for Welsh firm Riversimple.
- It was explained that Wales is potentially a Low carbon powerhouse because:
  - It is perfect for on shore and off shore wind; not bad for solar; good for micro-hydro and excellent for tidal. Many years after coal, Wales could once again become an energy exporter.
  - But a strategy is needed to build the necessary infrastructure (wind, tidal) and to promote the dispersed rural energy solutions (solar, micro-hydro). Key steps include attracting investment in EV/H2; ensuring that EV charging infrastructure is put in place and promoting / supporting new business models.
- 80 million cars a year are produced worldwide. In the long term this is not environmentally sustainable and so future vehicles will need a longer lifespan. Disposal will also be an issue as the battery is the big polluter.
- New battery technology allows for rapid battery charging. As we have not implemented any electric charging infrastructure in Wales there is no legacy to update or replace, this could be an advantage.
- Five years ago there were three separate charging systems and no crossover to allow all electric vehicles to share common charging points, this problem has reduced and common charging solutions have become available. The main divide now appears to be Japanese and non-Japanese charging solutions.

**Part 2 - Professor Alan Guwy from the University of South Wales** – he briefed the task group on use of hydrogen as a sustainable fuel for vehicles. This included discussion on recent developments in the field; the Baglan Hydrogen Centre and key challenges and opportunities facing this evolving technology.

### **Key Findings**

- The University of South Wales Hydrogen and Fuel Cell Research & Development scheme addresses a range of energy and transport challenges, these include:
  - Production of hydrogen – electrolysis, biological, thermochemical;
  - Hydrogen storage – novel storage materials;
  - Fuel Cells – PEM, SOFC and Microbial;
  - Hydrogen vehicles and fuelling infrastructure;
  - Recovery of hydrogen from industrial streams;
  - Hydrogen and an integrated gas and electricity system;
  - Hydrogen and Fuel Cell economics and environmental Impact.
- In 1839 William Grove invented the gas voltaic battery, the first fuel cell. Reversing the electrolytic separation of water, he recombined oxygen and hydrogen to produce electricity and water. William Grove is a Welshman from Swansea. His invention was the forerunner of the modern fuel cell. William Grove's experiments were conducted within 5km of the University of South Wales Hydrogen Research Centre.
- Hydrogen for Energy Storage Research & Development - The University has a major applied research & development programme investigating hydrogen by electrolysis. It is also developing industrial scale alkaline and PEM electrolysis test beds (1550kW) with a focus on interaction with renewable electricity production.

- The University of South Wales collaborates with industrial partners in prototype testing and product development. In addition to this the University of South Wales has solid oxide electrolysis and biochemical electrolysis laboratories at the Pontypridd campus. These facilities are used to explore the options of converting electricity to hydrogen and providing short and long term energy storage.
- Electricity Network Constraints – The United Kingdom target is for 15% of all energy to come from renewable sources by 2020. In addition to this there is an EU target of 27% of all energy from renewables by 2030, but not clear how United Kingdom exit from the European Union will affect the United Kingdom target. Connecting new generation changes power flows on network, and so variable renewable electricity generation can challenge the stability of the electricity network, for example, voltage rise due to current flowing across resistance in wires, or thermal constraints from resistive heating due to current flowing across the resistance. This has presented a major challenge to new renewable generation as networks need to be upgraded to accept the increased current flows.
- Electrolysis of Excess Renewable Electricity - Hydrogen as storage solution to overcome electricity network constraints. Known as 'power-to-power' it relies on rapid response electrolysis and fuel cells for regeneration of electricity.
- Hydrogen Recovery and Enhancement – The ~University of South Wales has extensive industrial and academic experience in steam reforming and adsorption / membrane separation systems. It acted as a test reformer at the Port Talbot Hydrogen Centre following a collaboration with Shell. In doing this it researched the complex syngas streams and biogas/bioliquids produced as by products from the steelworks, particularly investigating how this process can be used to maximise hydrogen production.
- Hydrogen and Fuel Cell Vehicle Research & Development - The University of South Wales has supported industrial hydrogen vehicle development and deployment for 10 years. Hydrogen refuelling stations at Port Talbot

and Pontypridd have been developed as a result of such work. This expertise has been used to provide advice for the development of Honda Swindon and Bristol hydrogen refuelling stations.

- The Riversimple car (which is linked to the University of South Wales project) can be refuelled in less than a minute – it has the capacity to hold 1 kg of hydrogen fuel. The vehicle is capable of covering over 300 miles on one kilogram of hydrogen. The Baglan Hydrogen Centre produces 80 kg of hydrogen a day using renewable energy (from a relatively small number of solar panels). This means that each day the plant produces enough hydrogen to power the Riversimple vehicle for over 24,000 miles – or 8.76 million miles a year (the equivalent to more than eleven trips to the moon and back).
- **UK Government Vision & Support for Fuel Cell Vehicle Deployment -** Recognising the role of transport in reducing emissions, the United Kingdom Government's vision is that by 2050 almost every car and van in the United Kingdom will be an ultra-low emission vehicle. This puts the United Kingdom at the forefront of their design, development and manufacture, making it one of the most attractive locations for ULEV-related inward investment in the world. The United Kingdom Government believes that Hydrogen fuel cell vehicles (FCEVs) will feature alongside plug-in hybrid and battery electric vehicles in delivering zero carbon dioxide emissions at the tail pipe.
- **Creating a United Kingdom Hydrogen Refuelling Infrastructure – H2 Mobility** is a collaboration between the United Kingdom Government and industry to evaluate and plan the development of hydrogen refuelling stations in the United Kingdom. The 2013 evaluation led to a phased plan for the introduction of hydrogen stations and hydrogen volume requirements to support FCEV deployment. The wider aim is for full coverage of the country in 2030's.

- The presentation provided the following information about hydrogen refuelling stations in the United Kingdom:
  - 14 existing hydrogen refueling stations in UK close to most (not all) major centres of population
  - 6 Stations at University sites, supporting R&D and demonstration – capacity generally <24kg/day
  - 8 industrial stations with higher capacity 50-100kg/day
  - Half of the existing hydrogen stations have on-site production (mostly electrolysis)
  - Port Talbot, Sheffield and Swindon stations are mostly fed by renewable electricity (Projected FCEV sales and Hydrogen Station deployment in UK wind and solar).
  
- **Projected FCEV sales and Hydrogen Station deployment in United Kingdom** - Projections assume convergence of vehicle costs, i.e. FCEV prices are same as petrol or diesel vehicles by 2030. It is predicted that early stations will be small, but stations will increase in size as demand grows.
  
- The presentation questioned the future of hydrogen production and asked if it would be achieved through a centralised or distributed production approach? In doing this the presentation identified that:
  - Existing United Kingdom industrial hydrogen market is approximately 690,000 tonnes per year;
  - Production is generally from hydrocarbon reforming and as an industrial by product;
  - Markets include chemical and petrochemical, metals, electronics and food industries;
  - Distribution is mostly on-site or 'over-the-fence' by pipeline (c.94% of demand);
  - c.6% is distributed via (road) tube trailers;
  - < 0.1% of total market is currently used for vehicle application;



- Potential shift towards smaller scale, on-site production of hydrogen to suit the growth of hydrogen refuelling stations;
  - Unlikely to replace all centralised production but economics will dictate the spread of distributed hydrogen stations;
  - Anticipated dominant technology of electrolysis for refuelling station production, but may also include de-centralised reforming;
  - Projected hydrogen demand for vehicles is 254,000 tonnes per year by 2030. This is a significant growth from the existing quantity of distributed hydrogen production of < 1,000 tonnes per year.
- Creating a Market for 'Green' Hydrogen – United Kingdom Government recognise that meeting 2050 decarbonisation targets will require innovative approaches, including hydrogen for energy and transport sectors.
  - The presentation commented on the following United Kingdom Hydrogen Refuelling Stations:
    - **Sheffield & London Teddington ITM Power** - Originally built in 2009, the Sheffield site was upgraded in 2015 to house an 80kg/day refuelling station with 350 bar and 700 bar capability. The London station is also a 80kg/day and facility and opened in May 2016. Production is on-site by an ITM PEM electrolyser, which is fed by a 225kW wind turbine (Sheffield) and grid electricity (London). The Sheffield station is situated near to the M1 motorway and is supported by the European H2EME project, which aims to deploy 200 FCEV in Europe by 2019 - including partner projects in 10 European countries The London Station is part of the European funded HyFive project.
    - **H2 Aberdeen** - Opened in 2015, the Aberdeen refuelling station is the first hydrogen bus refuelling station in the UK to have onsite production. Three onsite alkaline electrolysers can produce up to 400kg/day. As well as ten fuel cell buses, the site also fills fuel cell and hydrogen combustion engine vans. The development cost £19million

and was funded by EU, UK and Scottish governments. Further enhancements are planned in the area in 2017.

- **Swindon - Honda** – It was originally built in 2011 by BOC Linde on Honda's Swindon manufacturing site. It was funded by the regional business agency and initially the station relied on imported hydrogen, but was capable of refuelling at 350 and 700bar The hydrogen refuelling station was upgraded in 2014 to include full on-site production via electrolysis which is fed by solar PV cells at the factory. Access to the station is currently being improved to allow third parties and the public to use the facility. Honda operate FC fork lift trucks on the site and Swindon Council and Commercial Group regularly refuel their hydrogen vans at the site.
- **Introduction of Fuel Cell Electric Vehicles to the UK** - Major Auto companies have started to introduce Fuel Cell Electric Vehicles in limited numbers into the United Kingdom. The Hyundai ix35 Fuel Cell Electric Vehicle was the first commercial fuel cell vehicle introduced to the United Kingdom in 2014 and the Toyota Mirai was first sold commercially in the United Kingdom in 2015. Sales increased in 2016; however, overall numbers were small. It is hoped that sales will increase in 2017 due to United Kingdom Government support schemes. The Honda Fuel Cell Vehicle Clarity was introduced into the United Kingdom market in 2017. Daimler have joined forces with Ford, Nissan and Renault in a joint development programme and anticipate new Fuel Cell vehicle launch in 2017, with costs competitive with comparable to battery electric vehicles.
- **Independent or Smaller Vehicle Manufacturers Fuel Cell Electric Vehicles & Hydrogen Vehicles with Internal Combustion Engines** - Non original equipment manufacturers are developing and selling hydrogen vehicles to the United Kingdom market. These are both fuel cell vehicles and hydrogen combustion vehicles, often buses or commercial vehicles rather than passenger cars. Examples include:

- Van Hool have provided ten fuel cell buses to Aberdeen and two to London to go with previous fuel cell buses in the capital;
  - Revolve is a small independent United Kingdom company with expertise in hydrogen engine vehicle development. They have delivered hydrogen/ diesel dual fuel refuse trucks to Fife council in Scotland as well as a significant number of hydrogen vans throughout the United Kingdom;
  - Independent United Kingdom vehicle developers Riversimple have a strong vehicle design pedigree together with a mission for environmentally friendly mobility. Riversimple's Rasa is a two-seater, lightweight fuel cell car in prototype phase;
  - Microcab is also an independent fuel cell car developer, working in partnership with Coventry University. The Microcab H2EV with a 3kW horizon fuel cell is the latest development and has been deployed in limited numbers;
  - United Kingdom Fuel Cell developer Intelligent Energy has worked with Lotus and the London Taxi Company for a limited run of fuel cell taxis.
- **Creating a Hydrogen Gas Network** - Over 80% of the UK population use natural gas from a national pipeline network to heat, cook and provide hot water. The H21 Leeds City Gate project is an ambitious plan to progressively convert part of the low and medium pressure gas network in large United Kingdom cities to pure hydrogen. The objective is to decarbonize the network at minimal additional cost to consumers, whilst allowing for additional energy storage. Since 2002 there has been a major iron mains replacement programme, upgrading the network to polyethylene, which is compatible with hydrogen at medium pressure and below. The H21 Leeds City Gate project initially focuses on conversion within the city and suburbs of Leeds. The planned scale means that the hydrogen is to be produced by reforming natural gas combined with carbon capture and storage.
  - After the presentation discussion continued and the following key comments and observations were made:

- Wales does not have a clean air strategy and to drive improvements forward it probably needs one;
- Significant financial support will be required to grow the number of hydrogen vehicles and infrastructure in Wales and across the United Kingdom as a whole;
- The grid is not currently large enough to accommodate all of the renewable energy generated in the United Kingdom; this means that without effective storage a large amount of potential renewable energy is lost. Converting the renewable energy to hydrogen when grid capacity is reached seems to be a very effective way of capturing and storing this excess energy;
- The major car manufacturers have a foot in both camps in terms of hydrogen and electric vehicles. In fact some are even developing vehicles that run on electric but have a small hydrogen back up fuel tank;
- Due to Scottish Government investment Scotland is much further forward than Wales in terms of clean air and renewable energy initiatives;
- Converting renewable electricity into hydrogen currently has a conversion rate efficiency of between 60% and 70%;
- Germany hopes to be using 700 hydrogen-powered buses by 2025;
- A hydrogen bus would be a good idea for Cardiff; however, it would be expensive and need supporting infrastructure in the form of a hydrogen-refuelling centre (which would also be expensive);
- Mid Wales would be an ideal location for a hydrogen train;
- Hydrogen is a safer fuel than petrol or diesel. The tanks are the expensive part in the vehicles and are made from a range of metals – they are also bullet proof to stop the hydrogen from leaking – having a bullet proof tank is a practical and not a safety issue. The quantity of precious metals used in the built of a hydrogen fuel tank is no more than the quantity used in a catalytic converter in an average petrol or diesel vehicle.

- At the end of the session Professor Guwy summarised the United Kingdom position in terms of hydrogen fuel development and implementation as:
  - The United Kingdom is moving to include Hydrogen and Fuel Cell solutions to address affordable, reliable and clean energy issues;
  - Hydrogen's potential to overcome electricity system constraints is a key focus, for example, using it as a backup storage facility alongside the national grid;
  - The United Kingdom is moving from a planning phase to deploy hydrogen and fuel cell vehicles and is financially supporting this introduction;
  - The network of hydrogen refuelling stations in the United Kingdom is strengthening with larger, accessible stations providing hydrogen at 700 and 350bar, often produced on-site;
  - Major vehicle manufacturers are starting to see the United Kingdom as a viable market for fuel cell cars;
  - The United Kingdom's aim is to encourage investment in manufacturing in the sector for international organisations as well as smaller United Kingdom;
  - There is a growing opportunity for Japanese vehicle and component manufacturers to do business in the hydrogen and fuel cell field in the United Kingdom;
  - The electron to hydrogen conversion rate is typically between 60% and 70%;
  - With an electric battery you have to take the whole of life costs into consideration, i.e. essential to include the production and disposal costs into the equation. Hydrogen fuel cells are simply complex metal boxes that store hydrogen and can be reused;
  - Wales is a long way behind Scotland in terms of supporting green energy and fleet initiatives. Wales should watch the market and back both electric and hydrogen options in the short term.

**Part 3 - Adrian Field, Executive Director from the Cardiff BID (For Cardiff)**

– He met with the task group to discuss the views of the Cardiff business sector on air quality in the city and the potential impact of creating a clean air zone.

**Key Findings**

- There has been no consultation to date with the BID or its members on the Clean Air Strategy and the potential introduction of a clean air zone in Cardiff. The BID would welcome the opportunity to be a part of any consultation exercise and would appreciate being updated on the development of the clean air strategy.
- Adrian Field has been with the Cardiff BID since January 2017. In that time they have not received any queries or complaints about air quality in the city centre.
- The BID is pleased that the new Next Bike Scheme is being rolled out in Cardiff and support the initiative. It was felt that offering the major employers in the city a discounted membership might work well and stimulate use of the scheme – the BID members employ a significant number of people entering and leaving the city centre every day.
- BID has eight ambassadors who are able to work with the 750 BID members to pass on and communicate on any air quality related issues.
- It was felt that more could be done to encourage BID members and their staff to use the park & ride facilities offered by the Council. To reduce traffic into the city and ensure commuting is more comfortable for staff and business owners the BID has worked with Cardiff Bus to offer levy payers reduced costs on the Cardiff East Park and Ride service. A BID park & ride pass is available for £450 per annum, that's less than £2 a day for parking and bus travel and helps free up invaluable parking and driving space in the city.
- The BID is pleased and supportive with the new Next Bike Scheme that is being rolled out by the Council. They are also running the 'Abandoned Bike Removal Project' which includes amongst other things includes work

on identifying and delivering new bike storage facilities in the city. Sustrans has provided support and endorsed this project. They would be keen to work with the Council to help identify suitable hosting sites in the city centre for the new Next Bike scheme as they feel they are gaining a good understanding for potentially available sites in the city. They view improved cycle parking as an important issue and one that will help increase cycling participation in the city.

- Over July and August 2017 the BID asked businesses to complete a bicycle survey so that they could understand the issues that BID employees were having with bike storage and parking to gauge demand for further stands. It became clear that abandoned bikes are a significant issue in the city. Cardiff BID, in partnership with Cardiff Council and the South Wales Police, undertook a removal operation of these abandoned bikes. That took place on Tuesday 29th August.
- Adrian Field had dealt with BID's in London where congestion and air pollution was an issue. One idea that he felt had worked well for these BID's was a pledge for all staff working for BID companies to avoid having personal deliveries in at work. This it was thought had been a success as it had reduced the volume of small delivery vehicles entering an already overcrowded area – it has been estimated that 40% of deliveries in a typical city centre area are to staff.
- The task group was told that adding click and collect schemes to key transport locations worked well in London. Similar facilities could be introduced at Park & Ride facilities and in the new integrated transport hub.
- BID would welcome and support a car free day in the city and could task its eight ambassadors to help promote the event across the city centre.
- During the discussion it was felt that Cardiff BID members could be encouraged to develop more flexible working habits to help reduce congestion, for example, greater promotion of the car sharing scheme, home working where practical and possible, flexible ticket pricing (rail & bus) to spread the volume of traffic normally experienced at peak travel times.

- The BID would be happy to lobby for additional train carriages across the South East Wales region. Train journeys into Cardiff from the wider South East Wales region are normally full, providing more capacity it is felt would encourage more people to use this form of transport and take cars off the road.
- It was felt that using 'stock transfer sites' at the edge of the city would help keep heavy goods and other types of delivery vehicles out of the city centre. The stock could then be transferred onto a low emitting vehicle (for example, electric) before transferring it into the city centre. This would reduce emissions. The BID would be an excellent tool for supporting a debate on such an initiative, with the collective buying power of all the members providing necessary economies in scale in terms of logistics. Such a scheme could be delivered through a BID wide procurement.
- Next Bike – offer a deal to the BID members for discounted use of the scheme or a corporate membership. This would provide many of the larger companies (for example, Admiral) with the opportunity to engage with the scheme and experience the benefits. If it was a positive experience then the larger companies might eventually see the benefits of sponsoring the scheme.
- It was agreed that collectively the BID membership represented a significant pool of knowledge, talent and experience – something that the Council should support and work very closely with. Members felt that a significant amount of congestion and pollution coming into and out of the city was caused by BID member employees and the customers that they support. With this in mind the task group felt that there would be value in running a BID wide focus group or 'brainstorming' session with a large range of BID representatives. This would involve setting out the current issues facing the city in terms of air quality and then challenging the group to identify potential solutions. This it was felt would add a different dynamic and angle to solving the air quality problem and hopefully identify new and innovative solutions.
- Run an event and car free day where certain roads were closed. It would be interesting to tie this in with a major event to help understand how we



might better manage travel congestion in the city. Car free days on lesser polluted roads, this it was felt would be an ideal opportunity to promote cycling and walking in the city. It was also felt that employers should be encouraged to introduce a car free day, similar to the one applied by the Council.

- Run a consultation on private parking facilities to identify how much is used in Cardiff and to understand the impact that a parking levy might have on businesses and congestion / air quality in the city.

## WITNESSES TO THE INQUIRY

During the inquiry the task group was grateful to the following witnesses who provided verbal evidence or written contributions:

- Councillor Michael Michael, Cabinet Member for Clean Streets, Recycling & Performance
- Councillor Caro Wild, Cabinet Member for Strategic Planning & Transport
- Councillor Susan Elsmore, Cabinet Member for Social Care, Health & Well-being
- Gary Brown, Operational Manager – Assets, Engineering & Operations
- David Lowe, Operational Manager - Operations
- Jane Cherrington, Operational Manager – Strategy & Enforcement
- Simon Gilbert, Operational Manager – Development Management, Strategic & Place Making
- Paul Carter, Head of Transport
- Gareth Harcombe, Commercial Manager – Energy & Sustainability
- Gladys Hingco, Researcher – Scrutiny Services
- Richard Jones, Fleet Manager, Commercial Services
- Tim Walter, Senior Planning Officer
- Craig Lewis, Specialist Services Officer– Environment (Enterprise and Specialist Services), Shared Regulatory Services
- Jason Bale, Team Manager – Environment (Enterprise and Specialist Services), Shared Regulatory Services
- Helen Picton, Operational Manager, Enterprise & Specialist Services, Shared Regulatory Services
- Dr Huw Brunt – Public Health Wales
- Dr Tom Porter - Consultant in Public Health Medicine, Cardiff & Vale Local Public Health Team
- Stuart Cole, Professor of Transport, University of South Wales

- Huw Williams, Emeritus Professor of Transport and Spatial Analysis, Cardiff University
- Sukky Choongh- Campbell, Society of Motor Manufacturers
- Peter Renwick – Premier Taxis
- Ryan Owen – Dragon Taxis
- Kieran Harte – Uber
- Desmond Broster – Dragon Taxis
- Dr Claire Beattie – University of the West of England
- Gareth Mole - Cardiff Bus
- Margaret Everson - Bus Users Cymru
- John Pocket – Confederation of Passenger Transport
- Roger Herbert – Welsh Government
- Martin McVay – Welsh Government
- Steve Lloyd Brennan – New Adventure Travel
- David Conway – Stagecoach Bus
- Dr. Ji Ping Shi, Senior Technical Specialist, Air Quality Modelling and Risk Assessment Team Leader, Natural Resources Wales
- Professor Alun Guwy, Head of the Sustainable Environment Research Centre, University of South Wales
- Dr Paul Nieuwenhuis, Centre for Automotive Industry Research & Electric Vehicle Centre of Excellence, Cardiff University
- Adrian Field, Executive Director, Cardiff BID (For Cardiff)
- Will Lane – Shared Regulatory Service

## LEGAL IMPLICATIONS

The Scrutiny Committee is empowered to enquire, consider, review and recommend but not to make policy decisions. As the recommendations in this report are to consider and review matters there are no direct legal implications. However, legal implications may arise if and when the matters under review are implemented with or without modification. Any report with recommendations for decision that goes to Cabinet / Council will set out any legal implications arising from those recommendations. All decisions taken by or on behalf of the Council must (a) be within the legal power of the Council; (b) comply with any procedural requirement imposed by law; (c) be within the powers of the body or person exercising powers on behalf of the Council; (d) be undertaken in accordance with the procedural requirements imposed by the Council e.g. standing orders and financial regulations; (e) be fully and properly informed; (f) be properly motivated; (g) be taken having regard to the Council's fiduciary duty to its taxpayers; and (h) be reasonable and proper in all the circumstances.

## FINANCIAL IMPLICATIONS

The Scrutiny Committee is empowered to enquire, consider, review and recommend but not to make policy decisions. As the recommendations in this report are to consider and review matters there are no direct financial implications at this stage in relation to any of the work programme. However, financial implications may arise if and when the matters under review are implemented with or without any modifications. Any report with recommendations for decision that goes to Cabinet/Council will set out any financial implications arising from those recommendations.

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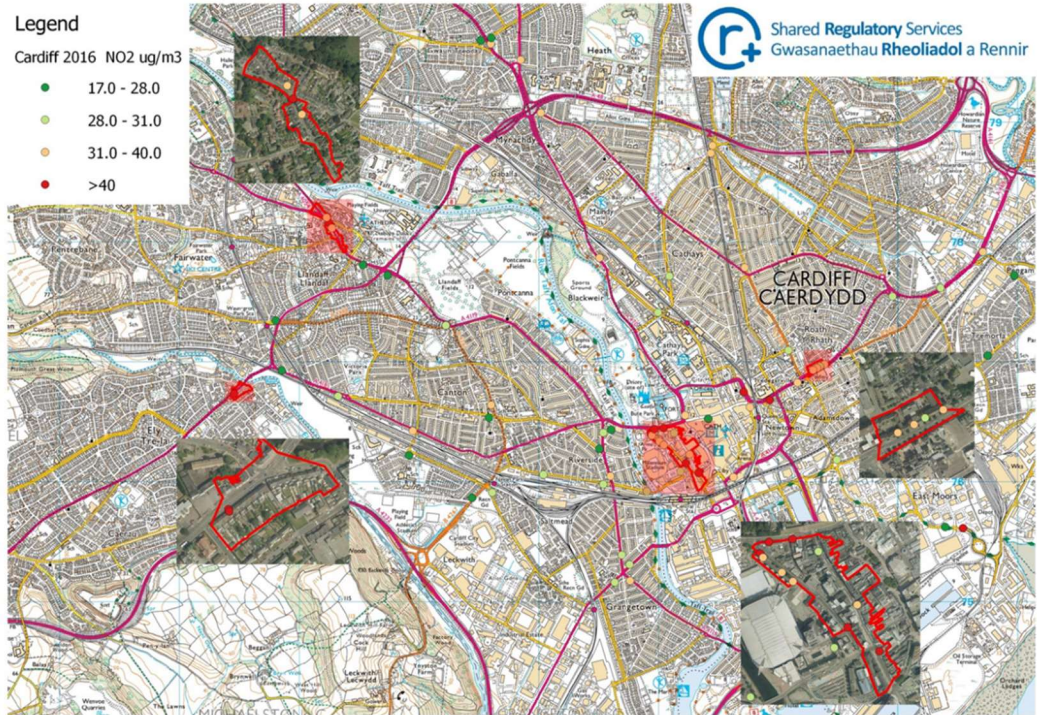
Email: [scrutinyviewpoints@cardiff.gov.uk](mailto:scrutinyviewpoints@cardiff.gov.uk)

[www.cardiff.gov.uk/scrutiny](http://www.cardiff.gov.uk/scrutiny)

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# Appendix 1 – Cardiff's Air Quality Management Areas

## Map of Cardiff's four Air Quality Management Areas



## Map of the Stephenson Court Air Quality Management Area





**Appendix 1 – Cardiff's Air Quality Management Areas**

**Map of the Ely Bridge Air Quality Management Area**

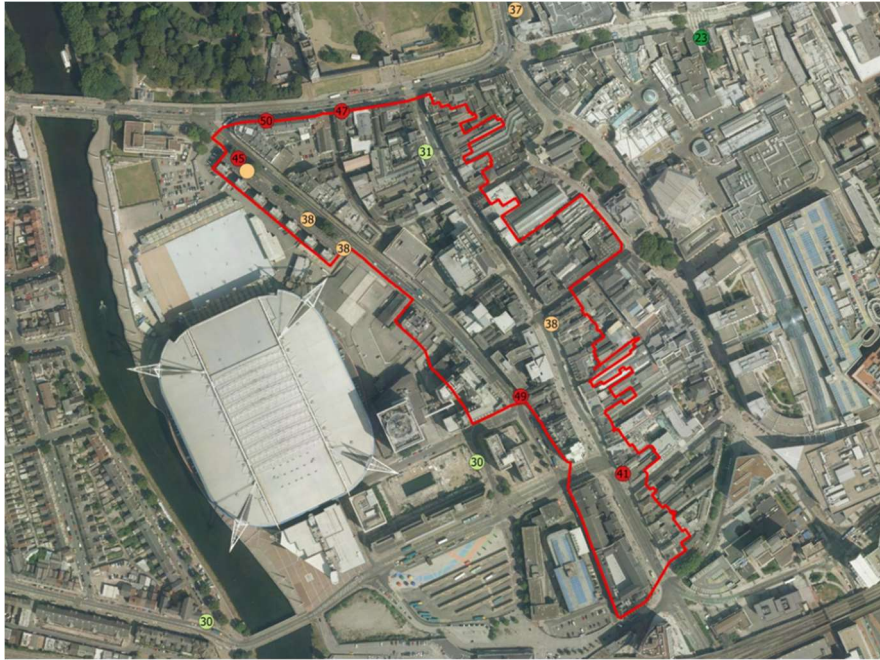


**Map of the Llandaff Air Quality Management Area**



## Appendix 1 – Cardiff's Air Quality Management Areas

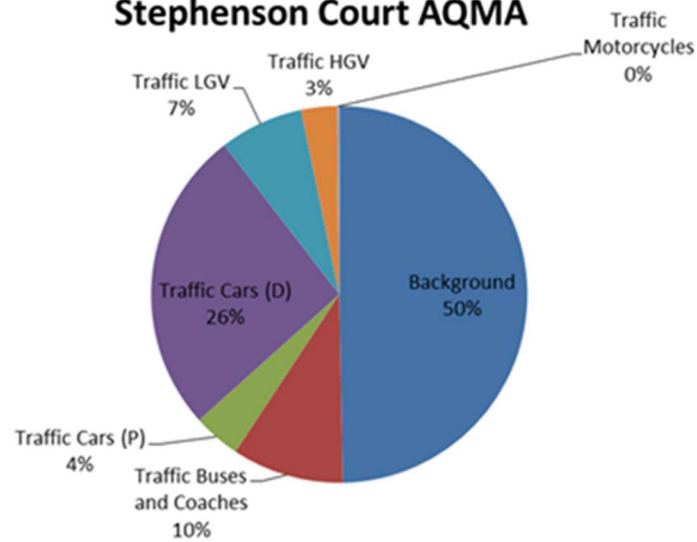
### Map of the City Centre Air Quality Management Area



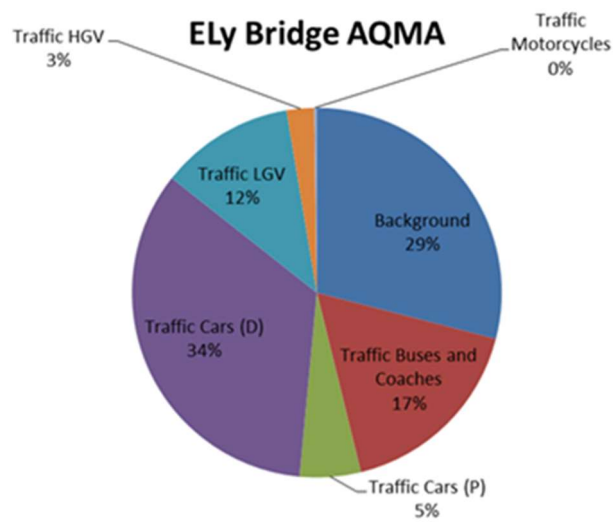


**Appendix 2 – 2016 Nitrogen Dioxide source apportionment analysis for each of Cardiff’s four Air Quality Management Areas**

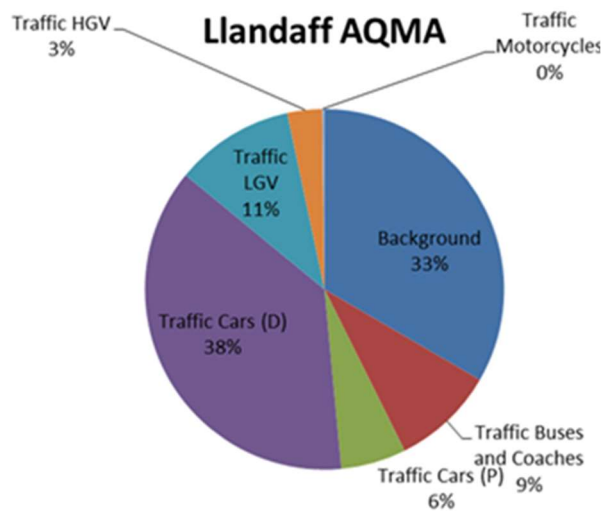
**Stephenson Court AQMA**



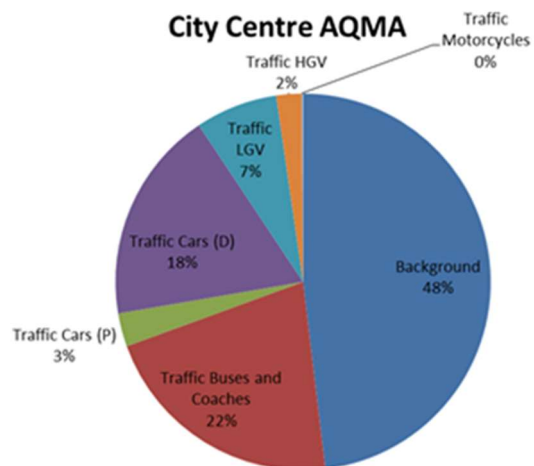
**Ely Bridge AQMA**



**Llandaff AQMA**



## Appendix 2 – 2016 Nitrogen Dioxide source apportionment analysis for each of Cardiff's four Air Quality Management Areas



## Appendix 3 – Euro Emissions Standards

<b>Emissions standard</b>	<b>Applied to new passenger car approvals from:</b>	<b>Applied to most new registrations from:</b>
Euro 1	1 July 1992	31 December 1992
Euro 2	1 January 1996	1 January 1997
Euro 3	1 January 2000	1 January 2001
Euro 4	1 January 2005	1 January 2006
Euro 5	1 September 2009	1 January 2011
Euro 6	1 September 2014	1 September 2015 - but see important note below

### Euro 1 (EC93)

**Implementation date (new approvals):** 1 July 1992

**Implementation date (all new registrations):** 31 December 1992

The first Europe-wide euro emissions standards were introduced in July 1992 and the regulations weren't anywhere near as stringent as they are today. That said, the fitment of catalytic converters became compulsory on all new cars, and Euro 1 required the switch to unleaded petrol.

Back then, only hydrocarbons and nitrogen oxide were tested, along with particulate matter in the case of diesel engines. Over the years, the regulations have become stricter and the limits lowered.

#### **Euro 1 emissions standards (petrol)**

CO: 2.72g/km

HC + NOx: 0.97g/km

#### **Euro 1 emissions standards (diesel)**

CO: 2.72g/km

HC + NOx: 0.97g/km

PM: 0.14g/km

### Euro 2 (EC96)

**Implementation date (new approvals):** 1 January 1996

**Implementation date (all new registrations):** 1 January 1997

## **Appendix 3 – Euro Emissions Standards**

Euro 2 reduced the limits for carbon monoxide and the combined limit for unburned hydrocarbons and nitrogen oxide, as well as introducing different levels for petrol and diesel engines.

### **Euro 2 emissions standards (petrol)**

CO: 2.2g/km

HC + NOx: 0.5g/km

### **Euro 2 emissions standards (diesel)**

CO: 1.0g/km

HC + NOx: 0.7g/km

PM: 0.08g/km

## **Euro 3 (EC2000)**

**Implementation date (new approvals):** 1 January 2000

**Implementation date (all new registrations):** 1 January 2001

Euro 3 split the hydrocarbons and nitrogen oxide limits for petrol and diesel engines, as well as adding a separate nitrogen oxide limit for diesel vehicles. The warm-up period was removed from the test procedure.

### **Euro 3 emissions standards (petrol)**

CO: 2.3g/km

THC: 0.20g/km

NOx: 0.15g/km

### **Euro 3 emissions standards (diesel)**

CO: 0.66g/km

HC + NOx: 0.56g/km

NOx: 0.50g/km

PM: 0.05g/km

## **Euro 4 (EC2005)**

**Implementation date (new approvals):** 1 January 2005

**Implementation date (all new registrations):** 1 January 2006

### **Euro 4 emissions standards (petrol)**

CO: 1.0g/km

THC: 0.10g/km

## **Appendix 3 – Euro Emissions Standards**

NOx: 0.08g/km

### **Euro 4 emissions standards (diesel)**

CO: 0.50g/km

HC + NOx: 0.30g/km

NOx: 0.25g/km

PM: 0.025g/km

### **Euro 5**

**Implementation date (new approvals):** 1 September 2009

**Implementation date (all new registrations):** 1 January 2011

The big news for Euro 5 was the introduction of particulate filters (DPFs) for diesel vehicles, along with lower limits across the board. For type approvals from September 2011 and new cars from January 2013, diesel vehicles were subject to a new limit on particulate numbers.

DPFs capture 99% of all particulate matter and are fitted to every new diesel car. Cars meeting Euro 5 standards emit the equivalent of one grain of sand per kilometre driven.

### **Euro 5 emissions standards (petrol)**

CO: 1.0g/km

THC: 0.10g/km

NMHC: 0.068g/km

NOx: 0.06g/km

PM: 0.005g/km (direct injection only)

### **Euro 5 emissions standards (diesel)**

CO: 0.50g/km

HC + NOx: 0.23g/km

NOx: 0.18g/km

PM: 0.005g/km

PN [# /km]:  $6.0 \times 10^{11}$  /km

### **Euro 6**

**Implementation date (new approvals):** 1 September 2014

**Implementation date (most new registrations - see important point below table above):** 1 September 2015

### **Appendix 3 – Euro Emissions Standards**

The sixth and current incarnation of the Euro emissions standard was introduced on most new registrations in September 2015. For diesels, the permitted level of NO<sub>x</sub> has been slashed from 0.18g/km in Euro 5 to 0.08g/km.

A focus on diesel NO<sub>x</sub> was the direct result of studies connecting these emissions with respiratory problems.

To meet the new targets, some carmakers have introduced Selective Catalytic Reduction (SCR), in which a liquid-reductant agent is injected through a catalyst into the exhaust of a diesel vehicle. A chemical reaction converts the nitrogen oxide into harmless water and nitrogen, which are expelled through the exhaust pipe.

The alternative method of meeting Euro 6 standards is Exhaust Gas Recirculation (EGR). A portion of the exhaust gas is mixed with intake air to lower the burning temperature. The vehicle's ECU controls the EGR in accordance with the engine load or speed.

#### **Euro 6 emissions standards (petrol)**

CO: 1.0g/km

THC: 0.10g/km

NMHC: 0.068g/km

NO<sub>x</sub>: 0.06g/km

PM: 0.005g/km (direct injection only)

PN [# /km]:  $6.0 \times 10^{11}$ /km (direct injection only)

#### **Euro 6 emissions standards (diesel)**

CO: 0.50g/km

HC + NO<sub>x</sub>: 0.17g/km

NO<sub>x</sub>: 0.08g/km

PM: 0.005g/km

PN [# /km]:  $6.0 \times 10^{11}$ /km

## Appendix 4

### Air Quality in Wales

#### The national context

- Taking further action to improve air quality in Wales is a key priority in the Welsh Government's National Strategy, *Prosperity for All*. In 2018, the Welsh Government will develop and consult on a new Clean Air Plan for Wales, including a Clean Air Zone framework.
- The UK currently meets the legal limits for almost all pollutants but faces significant challenges in reducing levels of nitrogen dioxide (NO<sub>2</sub>).
- Non-compliance with EU legal limits for NO<sub>2</sub> across the UK and Europe is associated principally with high vehicle emissions in urban areas. This is due both to the significant growth in vehicle numbers and to European vehicle emission standards not delivering the expected reductions in emissions of nitrogen oxides (NO<sub>x</sub>) from diesel vehicles.
- In the event of exceedances of EU legal limits, air quality plans produced by Member State governments are required to set out appropriate measures to attain compliance in the soonest time.
- New evidence received from Defra in early 2017 showed compliance with EU legal limits for nitrogen dioxide in Wales will take longer than the 2015 UK Air Quality Plan had previously predicted. Defra's modelling now predicts non-compliance in Cardiff until 2023.
- The Welsh Government therefore set out further remedial measures to accelerate the pace of compliance in Wales. These were published in July 2017, within a new UK Air Quality Plan: <https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017>.
- We need all levels of measure, local and national, to deliver compliance in the soonest time possible, requiring close joint working with Local Authorities and others.
- The need for urgent action is not just about compliance with law; the essential reason for action is the health of our citizens.
- The Welsh Government is working with Cardiff Council to help the Council bring its area within the legal limits in the soonest possible time and to protect the health of people over a wider geographical area.

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- The Welsh Government is also working with Local Authorities to strengthen air quality provisions in Planning Policy Wales to prevent new problems from arising.

### Clean Air Zones

The latest modelling undertaken by Defra identified areas across the UK that may need to implement a Clean Air Zone to achieve compliance in the shortest time. One area identified in Wales, for which, based on current projections, a zonal approach would accelerate compliance, is in Cardiff. The Welsh Government anticipates a Clean Air Zone, with vehicle access restrictions, could be implemented in Cardiff during 2021 or earlier if possible, thereby achieving compliance by 2022 or sooner.

Implementation of a Clean Air Zone will need to be subject to further assessment and ongoing work with Cardiff Council to understand whether alternative local measures could achieve compliance more quickly. Where alternative local measures are suggested, to be effective they must be capable of achieving compliance within the same amount of time, or sooner, than a Clean Air Zone with access restrictions. This further assessment will need to be based on local as well as national data modelling relating to both air quality and transport. The modelling will be followed by a thorough options assessment, local consultation, planning and implementation. The actions up to the point of implementation should complete during 2019.

The Welsh Government intends to consult on a Clean Air Zone framework for Wales as soon as possible and in any event no later than the end of April 2018.

### Legislation

Under domestic legislation, specifically the Environment Act 1995 and associated regulations, the local air quality management (LAQM) regime requires Local Authorities to review and assess air quality in their areas against objectives and standards for a range of averaging periods for a number of air pollutants. Assessment of air quality is focused on locations where members of the public are regularly present and where there is exposure to the pollutant in question over the timescale for which the air quality objective is defined. Under LAQM, Cardiff Council has declared four air quality management areas for non-compliance with the annual average air quality objective for NO<sub>2</sub>. The Council has produced an action plan for only one of these areas to date, but has advised the Welsh Government that the Council's new Clean Air Strategy and Action Plan, expected in draft by the end of March 2018, will incorporate actions covering all four air quality management areas as well as the city as a whole.

The Well-being of Future Generations (Wales) Act 2015 ("the WFG Act") requires public bodies in Wales, including the Welsh Government and Local Authorities, to carry out sustainable development. This is the process of improving the economic, social, environmental and cultural well-being of Wales by taking action, in accordance with the sustainable development principle, aimed at achieving the



## Appendix 4

seven national well-being goals. Specifically, public bodies in Wales must act in a manner which seeks to ensure the needs of the present are met without compromising the ability of future generations to meet their own needs.

One of the national well-being indicators under the WFG Act is average population exposure to NO<sub>2</sub> (<https://statswales.gov.wales/catalogue/environment-and-countryside/air-quality>). This has been calculated at a Local Authority as well as a national level, and indicates that Cardiff Council has the highest average concentration of NO<sub>2</sub> where people live of any Welsh Local Authority,

Statutory guidance issued by the Welsh Government in June 2017 (<http://gov.wales/topics/environmentcountryside/epq/airqualitypollution/airquality/guidance/policy-guidance/?lang=en>) joined up these two domestic regimes by requiring Local Authorities in Wales to follow the ways of working set out in the WFG Act when carrying out LAQM. The Welsh Government also made regulations in 2017 requiring Public Services Boards to consider Local Authorities' LAQM progress reports when carrying out assessments of local well-being.

National improvements in air quality have also been driven by European Directives, including those that set limits on:

- concentrations of pollutants in ambient air (for example, the Ambient Air Quality Directive which sets EU limit values for air quality in Member States, similar to the national air quality objectives under LAQM);
- annual pollutant emission totals for each Member State, helping to tackle trans-boundary pollution (for example, the National Emission Ceilings Directive, which implements the UNECE Gothenburg Protocol); and
- concentrations of pollutants from specific sources (for example, the Industrial Emissions Directive which, together with domestic environmental permitting legislation, controls emissions to air from industrial sites regulated by Natural Resources Wales and Local Authorities, and EU legislation covering car and lorry exhaust pipe emissions).

Under European legislation, the Ambient Air Quality Directive (2008/50/EC) requires the Welsh Ministers to secure compliance as soon as possible with EU air quality limit values at locations where the public has access. The work of Local Authorities in relation to LAQM makes an important contribution to actions being implemented by the Welsh Government to achieve compliance with EU legal limits.

The Cabinet Secretary for Environment and Rural Affairs wrote to the Leaders of all Welsh Local Authorities in July 2017, emphasising the importance of their public protection, planning and transport departments taking joint ownership of the LAQM work programme, and, in Cardiff's case, of having regard to the non-compliance with EU air quality limit values highlighted in the UK air quality assessment.

## Appendix 5



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Scrutiny Research Report

### Improving Air Quality Initiatives – Best Practice Examples

Research report for the  
Environment Scrutiny Committee

February 2018



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## **Appendix 5**

### **1. Introduction**

The Environment Scrutiny Committee is undertaking a Task and Finish Inquiry on Improving Air Quality in Cardiff. The findings and recommendations of this inquiry will inform the development of Cardiff Council's strategy on air quality. To contribute to the evidence that will be reviewed by the inquiry, Members commissioned research to identify current initiatives and arrangements that selected cities have adopted to achieve improvements in air quality. This report will specifically focus on initiatives and measures introduced by selected local and transport authorities that reduce levels of nitrogen dioxide (NO<sub>2</sub>) emissions and Particulate Matter (PM<sub>10</sub>). In the UK, this research examined the work in improving air quality in London and its Boroughs as well as specific initiatives implemented in Nottingham and Manchester. The report will also focus on best practice initiatives in implementing Low Emission Zones, the procurement of clean cars and transport, the use of economic incentives and disincentives such as congestion charging, parking management approaches and improvements in modal shift. The research involved reviews of available grey and academic literature on this subject area. The collection of information relied heavily on documents and publications that are available on-line.

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### **2. Summary of Findings**

The Environment Scrutiny Committee commissioned this research to identify current initiatives and arrangements that selected cities have adopted to achieve improvements in air quality. This report will focus on initiatives and measures that reduce levels of Nitrogen dioxide (NO<sub>2</sub>) emissions and Particulate Matter (PM<sub>10</sub>) as introduced by selected local and transport authorities in the UK, and other countries.

#### **European City Ranking**

The European City Ranking report examined various initiatives to improve air quality in European city capitals. In 2015, their evaluation work reviewed initiatives in 23 key cities in Europe. The city which has achieved the highest ranking for improving air quality for that year was Zurich, closely followed by Copenhagen, Vienna and Stockholm. Although the City of London ranked 7<sup>th</sup> in 2015, this latest ranking is a significant improvement from the previous review in 2011. A Table showing the ratings and achievements of the 12 highest ranked cities in 2015 is available in the full report.

In reducing PM<sub>10</sub> and NO<sub>2</sub> emissions, the same report cited that the cities of Helsinki Zurich and Vienna have made significant improvements in this area. In Helsinki, the reduction in these pollutant indicators are partly attributed to the implementation of the LEZ while in Zurich this partly attributed to regulations around emission standards for old and new vehicles.

#### **Low Emission Zones**

Low Emission Zones (LEZ) are often introduced to reduce particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) and nitrogen dioxide (NO<sub>2</sub>) emissions. Minimum emission standards are set within these areas for vehicles that wish to enter the zone. The scheme operates by regulating the entry (ban, restrict, charge) of highly polluting vehicles into the area.

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So far, it is reported that there are 225 active or planned LEZs in Europe. In the UK, there are only 2 LEZ, the biggest covering most of the Greater London area. In Europe, the cities of Stuttgart and Berlin are reported as leading practice in implementing Low Emission Zones.

The LEZs in Berlin and Stuttgart as with others in Germany are also referred as Green Environmental Zones. These environmental zones only allow traffic for vehicles bearing a green environmental badge i.e. vehicles that meet the minimum EURO 4 or better emission standards. This stricter regulation has been in force since January 2017. The restriction to traffic apply all the time irrespective of whether the levels of air pollution are higher or lower at any one time. Vehicles that drive as well as stop and park in an environmental zone without a valid environmental badge, are fined 80€ plus an additional 25 € to cover administrative fees.

It is also planned that “diesel restriction zones” or “blue environmental zones” will be introduced in the cities of Berlin, Hamburg, Munich, Leipzig and Stuttgart by 2018. These zones will regulate traffic of diesel vehicles depending on their emission rate of nitrogen dioxide (NO<sub>2</sub>).

### **LEZ in Berlin**

The environmental zone in Berlin covers 88 km<sup>2</sup> and was introduced in 2008. Significant reductions were seen in the level of PM<sub>10</sub> and NO<sub>x</sub> following the introduction of the measure. Reports have cited that the introduction of the scheme had no measurable impact on traffic flows in Berlin. However, this scheme is credited for speeding up the turnover of vehicle fleet towards more cleaner vehicles and is regarded as a significant factor to the change in composition of vehicles in the area.

### **LEZ and Congestion Charging in Milan**

Milan has adopted a combined LEZ and congestion charging. The measure was trialed in 2008 and was fully implemented in 2012. The scheme in Milan differs to the environmental zones in Germany in charging petrol and diesel cars entering the zone. Entry to the zone is forbidden for pre-EURO gasoline

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vehicles and for pre-EURO, EURO1 and EURO2 diesel vehicles. The entry fee for vehicles that meet emission standards is €5. The restriction applies every working day (Monday-Friday) from 7:30am-7:30pm with shortened hours on Thursdays from 7:30 am to 6:30 pm to encourage weekday shopping activities. The area is free to access (no charge) on weekends and public holidays. The payment allows users to travel for the whole day in the charged area. Electric vehicles, hybrid vehicles, bio-fuel natural gas vehicles and scooters, public utility vehicles are exempted from the charge.

The implementation of the measure in Milan had reduced PM10 by approximately ~19% and NOx by around 14%. The scheme also led to a significant reduction in traffic volume with the average number of vehicles that entered Area C declining by 34%. The number of polluting vehicles entering the area also declined by 49%. The number of cleaner vehicles entering the area increased from 9.6% to 16.6% of total vehicles entering the area.

### **LEZ in London**

In London, the LEZ was introduced 2008. Unlike the LEZ in Milan and Berlin, this measure only applies to all heavy goods vehicles greater than or equal to 3.5 tonnes (e.g. diesel lorries, buses, coaches, motor caravans, motorised horseboxes, larger vans, minibuses and other specialist vehicles) so that cars and motorcycles are not affected by this regulation. From 2012, heavier goods vehicles including buses are required to meet Euro 4 emission standards and Euro 3 for heavier vans and mini buses. All vehicles in these categories that do not meet the required emissions standards have to pay a daily charge. The charges range from £100 - £200 depending on vehicle category and weight. The LEZ covers most of the Greater London area. It operates 24 hours a day, every day of the year, including weekends and public holidays. Charging days run from midnight to midnight. Similar to the impact of LEZ in other cities in Europe, the scheme in London has also led to reduction in PM10, NOx.

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### **ULEZ in London**

The Ultra Low Emission Zone (ULEZ) was to be introduced in 2020 but will instead come into force in Central London in April 2019. The ULEZ will replace the “toxicity charge” T-charge, that was recently introduced. The ULEZ will cover the same area as the Congestion Charging Zone in London. It is also planned that in 2020, ULEZ could be further expanded to cover nearly all of Greater London for heavy polluting buses, coaches and lorries. Starting April 2019, all vehicles will need to meet exhaust emission standards (ULEZ standards) or pay a daily charge, when travelling in central London. With the implementation of this measure, the minimum Euro standard for motorcycles is Euro 3 and for petrol cars and light utility vehicles not exceeding 500 kg, the minimum standard will be Euro 4. For diesel cars and vans, Euro 6 and for lorries and buses the requirement is Euro VI. The daily charge for non-compliant smaller vehicles is £12.50 and £100 for buses and lorries. These charges are in addition to the existing congestion charges in London and the Low Emission Zone requirements.

### **London T-Charge and Zero Emission**

The London Toxicity Charge or T-charge came into force on 23 October 2017. The charge was introduced to further improve air quality within the capital and to prepare Londoners of the Ultra Low Emission Zone (ULEZ) that will be introduced in 2019. The T- charge costs £10 per day and is payable on top of the London Congestion Charge and applies to all vehicles that do not meet the current emission requirements within the zone. For petrol and diesel vehicles, the minimum standard required is Euro4/VI and Euro 3 for motorised tricycles and quadcycles. There are no charges for motorcycles.

The Transport for London (TfL) plans that the entire road transport system in London will be zero emission by not later than 2050. Zero emission zones will be introduced in Central London and in town centres from 2025, with a view of achieving this for inner London by 2040 and across the whole of London zone by 2050.



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### **London's Low Emission Neighbourhoods (LEN)**

Another scheme that was introduced by the Mayor of London's Air Quality Fund is the Low Emission Neighbourhood (LEN). The LEN is an area-based scheme that includes a package of measures and focused on reducing emissions and promoting sustainable living locally. This scheme is currently being implemented in 5 areas across different Boroughs in London. This is focused on areas of high exposure to high pollution which can be reduced through local measures, and locations with high trip generation. Key to the success of LEN is the partnership and involvement of the local community, businesses and the local authority to jointly identify and deliver a common set of goals. The Mayor of London provides some funding to support the measure and initiatives that are implemented by LENs.

### **Marylebone LEN**

The Marylebone LEN was developed in partnership between Westminster City Council and local stakeholders, including businesses, landowners and residents. The LEN has implemented a range of innovative projects to improve air quality throughout the area and has encouraged behavioural changes that directly impact on reducing emissions. This include projects that involve working with major landowners to improve emissions from buildings, better management and reduction of freight movement and service vehicles entering the area e.g. via consolidation of deliveries and use of shared supplier scheme. The scheme also implemented an emissions based street parking charges wherein vehicles are charged according to their emissions level when parking in on-street pay and display and residents' bays. This measure intends to encourage use of electric vehicles and discourage more polluting vehicles. The Council has also commenced the trial for a 50% surcharge for all diesel vehicles in certain locations in area. The LEN is also working with the taxi industry to improve the management of taxi ranks through the use of parking sensors, that provide real time information of the location of available taxi rank spaces. Taxi drivers and drivers for local hospitals are encouraged to reduce unnecessary vehicle idling in the Westminster and Marylebone area. Air Quality champions were recruited to support the scheme and encourage drivers to stop vehicle idling and inform

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them of its harmful effects. They will be empowered to enforce unnecessarily vehicle idling via a penalty charge notice (PCN). The LEN will encourage temporary street closures to encourage children to play and explore outside environment.

### **Manchester Air Quality Strategy**

The Transport for Greater Manchester (TfGM) authority via its new Greater Manchester Low-Emission Strategy and Greater Manchester Air Quality Action Plan has identified its key priority areas and commitments in improving air quality. The authority will work towards increasing the take up of electric vehicles and alternative fuel vehicles. It hopes to achieve this by providing incentives and by setting emission standards and restricting vehicle access to specific areas. It is also committed to increasing the number of publically available charging points and increasing the number of ULEV within the public sector via joint procurement schemes. TfGM will work with licensing authorities to standardise the minimum emission requirements (i.e. age) of the vehicles that will be allowed to operate and the standards that will be enforced in the future. The strategy is also committed to reducing freight emissions by shifting freight to Urban Distribution Centres. This will allow loads to be broken down for final delivery via low emission vehicles. It is also planned that local consolidation centres will be set-up so that courier services and small deliveries can be coordinated to avoid multiple delivery providers from visiting same premises. The strategy supports the take-up of zero emission transport refrigeration and will promote anti-idling policies with freight transport companies. TfGM will also work with bus companies to ensure that bus operators sign-up to targets for improving emission standards and will implement practical measures such as the deployment of buses with the lowest emissions in areas with the highest pollutant concentrations. The TfGM will continue to work with operators to roll out the bus electrification scheme, encourage the use of new technology and support training initiatives for drivers of hybrid buses.

TfGM will explore the feasibility of establishing a LEZ in the Greater Manchester area, as well as also explore implementation of the 20mph zones

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in areas where this will have significant impact on emissions. Finally, TfGM will work with the planning authorities to develop common guidance and toolkit for assessing proposals to support the identification of appropriate mitigating measures e.g. electric vehicle charging points, access to public transport or sustainable transport.

### **Procurement and Retrofitting of Vehicle Fleet**

Many cities are working on improving the emission standards of their fleet through the retrofitting of older vehicles with diesel particulate filters (DPFs) and investment vehicles that use electric and sustainable fuels. Leading in practice is the city of Berlin wherein it adopted a policy for using green air technology. More than 50% of diesel vehicles in the municipal fleet are equipped with particulate filters or meet the Euro V/EVV standard. Similarly, the City of Copenhagen aims to make its public transit carbon neutral. So far, the city has acquired 255 electric vehicles and has attained its goal in having 85% of its own vehicles are electric, hydrogen or hybrid powered. The city of Zurich has introduced regulations that require the strictest Euro standards for new vehicles and have planned for the extensive retrofitting of its older vehicles. It is also working to increase usage of electric vehicles in its sustainability plans. The cities of Zurich and Copenhagen provide financial incentives and infrastructure to support the use of electric vehicles through reduced taxation or exemptions from vehicle tax and increasing availability of charge points.

### **Congestion Charging Zones**

A congestion charging scheme is implemented to restrict the number of vehicles entering a specified area to reduce traffic volume, improve air quality and environmental conditions. This scheme was introduced in Stockholm in 2006 in the form of a congestion tax. The tax applies to cars, lorries and buses while there are exemptions for emergency vehicles, buses, diplomatic vehicles, disabled persons vehicles, military vehicles, hybrid or electric cars, motorcycles and mopeds. The amount charged varies depending on the time of day that the driver enters or exits the congestion tax area. Generally, the cost is higher during periods when traffic is heaviest. Unlike other congestion

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charging schemes, the scheme in Stockholm charges vehicles on both entry and exit of the affected area. A limit is set (£9.35 or 10.54 Euros) for the amount that a vehicle can be charged per day. The charges do not apply Saturdays, Sundays, public holidays or the day before public holidays, in the month of July, nor during the night-time period (18:30 - 06:29). The vehicle owner is expected to pay the charges at the end of the next month.

Congestion charging has served as an effective stimulus for the adoption of alternative fuel cars. Following the introduction of the measure, the number of alternative-fuel cars increased from 3% in 2006 to 15% in 2009. The exemption was abolished in 2009 as the authority believes that the scheme had filled its role as a facilitator for market introduction. Overall, the implementation of the scheme has led to a reduction in traffic level (22%). The reduction in congestion increased the reliability of travel time and travel times have declined substantially inside and close to the inner city. The reduction in traffic led to reduced emissions of between 10-15% across different types of emissions. There was also no adverse impact on retail as was initially feared. The number of passengers in the transit system also increased as a result of the scheme.

A key obstacle to congestion charging is the support and acceptability of the scheme. The experience in Stockholm is a key example where there was a change in the attitude and support of the public on an issue or a measure that needed acceptance and support. In this case, the public's attitude changed from fairly hostile to overwhelmingly positive. The experience in Stockholm supports the hypothesis "familiarity breeds acceptability" i.e. once a system is in place, support will generally increase or build up as the benefits and advantages of the scheme becomes more evident.

### **London Congestion Charging**

The world's first congestion charging scheme was introduced in Central London in 2003. The aim was to reduce congestion and encourage motorists to use other modes of transport. The daily congestion tariff is £11.50. This charge allows motorists to drive around, leave and re-enter the charging zone as many times as required in one day. The charge is in operation Monday to

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Friday from 07:00-18:00 and does not apply at weekends, Bank Holidays, public holidays or the period between Christmas Day and New Year's Day, when traffic levels are lighter. The charges generate a significant source of revenue for the Transport for London (TfL) authority that is invested on improvements to the bus network in London. The net revenues from this scheme make a significant contribution to the London Bus network. However, questions have been raised on the cost effectiveness of the scheme in generating money for investment in transport improvement and infrastructure. Similar to the experience in Stockholm, the ring fencing of income proceeds for improvements in transport facilities and infrastructure has increased its acceptability. Following the introduction of the scheme, there was a decline in the level of automobile traffic, however the long-term impact of congestion charging to traffic levels have yet to be established. Studies have reported that the implementation of the measure changed people's travel patterns in London and have increased the use of buses (14%) and the underground system. The introduction of the scheme also resulted in significant increase in traffic speeds within the zone and peak period congestion also declined. Although the measure has brought many benefits, the system is not considered optimal because the fee charged is not based on how many miles a vehicle is driven within the charging area and is not time-variable as the fee is not higher during the most congested periods and lower during less congested periods.

### **Singapore's Electronic Charging**

Singapore adopted a congestion charging scheme in 1975, referred to as an Area Licensing Scheme which required vehicles to have a special license to operate within specific areas. In 1998, the scheme was replaced by the Electronic Road Pricing (ERP). This new system introduced electronic toll collection, electronic detection, and video surveillance technology. The in-vehicle unit communicates with detectors when passing under gantries and the respective charge is deducted from the driver's cash card. The amount varies by time of day (rush hour is 2-3 times more expensive), type and size of vehicle and the type of road (arterial and expressways).

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### **Parking Management Schemes**

Parking management is used as a travel reduction strategy in many cities in Europe and the US. The reductions in car travel will reduce traffic congestion and will reduce transport emissions. Various parking schemes have been adopted to dis-incentivise motorists from taking private vehicles in their commute into the city. In Rotterdam, the parking scheme adopted by the Erasmus Medical Centre in Rotterdam required employees to pay for parking according to arrival time and gives credit for every kilometre not travelled by car if employee decides to take public transport.

Improving user information as part of parking management allows motorists to identify parking locations and prices so they can choose the best option for each trip. Some cities make use of Advance Parking Management Systems (APMS) which provide motorists with real-time information to help them quickly find a parking space. Since 2011, the San Francisco Municipal Transportation Agency (SFMTA) implemented a comprehensive smart parking system to help manage congestion. The system is demand responsive whereby rates can vary by location, by time of day and day of the week. Parking rates would vary incrementally, depending on time of day and availability of spaces. In areas and at times of the day where it is difficult to find a parking space, rates will increase incrementally. However, in areas where open parking spaces are plentiful, rates will decrease until empty spaces are filled.

Some local authorities in the UK use charging for parking to help with their CO<sub>2</sub> reduction objectives. Richmond upon Thames Borough Council charges residents for parking permits according to the CO<sub>2</sub> emissions of their vehicle. The Council is considering extending this principle to charges at parking meters and in car parks. Edinburgh City Council has proposed to introduce a similar CO<sub>2</sub>-related charge for residents' parking permits.

Nottingham City Council introduced the Work-place Parking Levy (WPL) in 2012. It was intended that the WPL scheme would serve as an incentive for

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employers to manage their workplace parking provision and encourage commuters to use public transport on their journey to work. The scheme works as a levy for employers who provide parking spaces for its employees. The local authority collects a charge for each parking place used by employees, business visitors, and pupils and students. The employer decides whether they would pass the charge on to their employees. Each employer that provides more than 10 parking spaces for its employees is required to obtain an annual license for the maximum number of liable places they provide. The charge for each workplace parking for the financial year 1<sup>st</sup> April 2017 to 31<sup>st</sup> March 2018 is £387. The scheme generates significant revenue for the Council that is ring-fenced to finance improvements in transport infrastructure and air quality in the city The WPL generates around £9 million pounds a year for the City and since its implementation has generated over “over £44 million of revenue” with “100% compliance of liable employers. The scheme is low cost to run, as the operating costs only take up around 5% of the total revenue. It is considered more cost effective scheme than the London Congestion Charge. The London Congestion Charge raises more money in absolute terms than the WPL, however it is regarded as less efficient due to more than 40% of total revenue taken up by operating costs. So far, the revenue from the WPL has successfully leveraged £400+m funding from central government to finance major transport infrastructure developments and improvements.

### **Reduction of speed limits**

Cities can also impact on air quality by reducing speed limits. As vehicle emissions are at its lowest at 30-50 km/hr, a number of cities have adopted 30 km/hr speed limits in residential areas (Zurich and Copenhagen) while the City of Paris envisages reducing the 50km per hour limit to 30km/h across the central district in the future.

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### 3. European City Ranking – Improvements in Air Quality

#### 3.1. Top 12 highest ranked European Cities

In 2015, the *Soot-free for the Climate Campaign* together with the *Clean Air Life+* published the results of an evaluation of various European cities' initiatives in improving air quality. Table 1 below outlines the ranking of key western European city capitals with high pollution levels that demonstrated good practice in meeting European air quality standards. The ranking considered those initiatives that have high potential to reduce air pollutants regulated under EU air quality legislation such as particulate matter (PM10) and nitrogen dioxide (NO<sub>2</sub>). To determine the ranking, these cities were evaluated using nine category measures including emission reduction success, sustainable transport, economic measures and public information and citizen participation.

In total 23, cities were evaluated (full list in <http://sootfreecities.eu/city>), however for this report, the list in Table 1 will only show the 12 highest ranked cities in Europe. The city that has achieved the highest ranking for improving air quality in 2015, was Zurich, closely followed by Copenhagen, Vienna and Stockholm. In 2011, the city of Berlin ranked the highest, but had gone down in ranking to 5<sup>th</sup> in 2015. The city of London ranked 7<sup>th</sup> in 2015 achieving a rating of C-(71%) which was an improvement from its 2011 rating of F (58%). Of the 23 cities, 6 have gained an F (failed) grade. The two lowest ranked places were taken up by the cities of Lisbon and Luxemburg.



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Table 1. European City Ranking 2015 Best Practices for urban clean air in urban transport

City	Overall Mark	Emission Reduction Success	Low Emission Zones and bans of High Emitters	Public Procurement	Non-Road Mobile Machinery	Economic Incentives	Mobility Management and Modal Split	Promotion of Public Transport	Promotion of Walking and Cycling	Participation and Transparency
Zurich	A <sup>+</sup> B <sup>+</sup> (89%)	++	0	++	++	+	++	+	+	++
Copenhagen	A <sup>+</sup> B (87%)	+	0	++	+	+	++	++	++	+
Vienna	A <sup>+</sup> B (84%)	++	0	+	+	+	++	++	+	+
Stockholm	B- (80%)	0	0	0	+	++	+	++	++	+
Berlin	C (76%)	0	++	++	+	0	+	0	0	+
Helsinki	A <sup>+</sup> C- (71%)	++	0	0	--	0	++	++	+	0
London	A <sup>+</sup> C- (71%)	-	0	+	+	+	0	++	+	0
Paris	A <sup>+</sup> C- (71%)	--	+	)	-	+	++	+	++	+
Stuttgart	C-(71%)	0	++	+	--	+	+	+	0	+
Amsterdam	D+(69%)	+	-	0	-	+	0	+	++	+
Graz	D+ (69%)	0	0	0	0	0	0	++	+	+
Dusseldorf	A <sup>+</sup> D (7%)	0	++	0	0	-	0	0	+	+

For each of the category measure the following ratings were used: ++ (very good), + (good), 0 (satisfactory), - (fair), or -- (fail).

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### 3.2. Success in reducing PM10 and NO2 emissions in European Cities

Traffic emission is a key contributor to air pollution and reducing this can lead to improvements in air quality. The EU Directive and target for PM10 is set at 50 µg/m<sup>3</sup>, as a 24-hour mean daily limit with a maximum of 35 permitted exceedances per year. The annual mean limit is set at 40 µg/m<sup>3</sup>.

The EU daily limit value for NO<sub>2</sub> is 200 µg/m<sup>3</sup> as a 1 hour mean. This value should not to be exceeded more than 18 times a year. The annual mean value limit is set at 40 µg/m<sup>3</sup>.

Based on the 2015 European Ranking report, the three capital cities that have made significant improvements in successfully reducing local emissions are Helsinki, Zurich and Vienna.

Table 2. Improvements in transport emission outputs in 3 top ranking Cities in Europe

	EU Standards	Helsinki		Zurich		Vienna	
		2006	2012	2009	2012	2012	2013
PM10 Exceedance Days	35 days	37	6	12	9	30	30
PM10 Annual mean values	40 µg/m <sup>3</sup>	30 µg/m <sup>3</sup>	21.3 µg/m <sup>3</sup>	22.6 µg/m <sup>3</sup>	19.8 µg/m <sup>3</sup>		
NO <sub>2</sub> Mean values	40 µg/m <sup>3</sup>	42.2 µg/m <sup>3</sup>	36.5 µg/m <sup>3</sup>		34.0 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>

Source: Sootfree Cities Report, 2015

In Helsinki, the number of PM10 exceedance days declined from 37 in 2006 to 6 in 2012 at the (Mannerheimintie) traffic station. The success of reductions in PM10 and NO<sub>2</sub> in Helsinki was partly attributed to the introduction of the LEZ in 2010.

Significant reductions in the number of PM10 exceedance days were also seen in Zurich. The reported figures in 2009 decreased from 12 to 9 in 2012.

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Additionally, declining figures for the mean values for NO<sub>2</sub> were reported in specified traffic monitoring stations. In 2012-13, the city of Vienna also achieved reductions in values for PM<sub>10</sub> below the EU set limits and have narrowly missed compliance to NO<sub>2</sub> EU set limits.

Compared to other European cities, Zurich has adopted a much lower limit for the PM<sub>10</sub> annual mean value and has set this at 20 µg/m<sup>3</sup> and one exceedance day per year instead of the EU mandated 40 µg/m<sup>3</sup> and 35 exceedance days.

### **4. Low Emission Zones & Bans of High Emitters**

A Low Emission Zone (LEZ) is defined as a geographical area that require emission standards for vehicles and prohibit vehicles that do not meet these standards from entering. It is a restriction scheme specifically designed to limit highly polluting vehicles from entering a specified area. The restriction varies for each LEZ. Some LEZs might only cover certain vehicle classes (HGVs, LGVs) while others cover all vehicles entering the zone. Some cities implementing LEZ could restrict, ban or charge according to the emission standard of vehicles that want to enter the zone.

Low emission zones generally excludes more polluting cars from entering the city. If the emission standards set are sufficiently stricter than the average emission level of the local vehicle fleet, the scheme will accelerate the introduction of cleaner vehicles (including retrofitting of older and more polluting vehicles) and consequently reduce emissions. However, if the standards are not ambitious enough, the vehicle fleet will not experience the desired change.

According to Strompen, F. et. al. (2012) Low Emission Zones are becoming increasingly popular in European cities and are considered effective in achieving pollution reduction targets. The key objective for establishing LEZs is to reduce particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) and nitrogen dioxide (NO<sub>2</sub>),

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emissions and consequently improve the health of residents in the city. Where the measure is combined with a charge in accordance to emission standards, it may also target a reduction of vehicle traffic in the area.

The first LEZ was introduced in Stockholm in 1996. Many European cities have applied this powerful tool in managing air quality. The European ranking initiative report cited that as of 2015 there were 225 active or planned LEZs in Europe. In the UK, there are two LEZ with the largest scheme operating in London and a LEZ that restricts buses in Norwich. In collaboration with the Low Emission Strategies (LES) Partnerships of local authorities, DEFRA have produced guidance documents including practice guidance (available in: <https://laqm.defra.gov.uk/action-planning/aqap-supporting-guidance.html#LESguide>) for local authorities seeking to develop supplementary planning documents for low emission strategies.

### 4.1. Low Emission Zones in Germany

In Germany, Low Emission Zones are referred to as Environmental Zones (“Umweltzonen”). These are mostly in-place in cities that exceed the pollutant emission threshold set by the European Union. These environmental zones are also referred to as “green environmental zones”. So far, as many as 55 environmental zones have been introduced throughout the country (<https://www.umwelt-plakette.de/en.html>). The main goal of these environmental zones is to protect the health of inhabitants in the cities and lower the high levels of particulate emission (PM) and nitrogen dioxide (NO<sub>2</sub>) pollution in the air. The traffic restrictions in these areas apply all the time, i.e. irrespective of whether the levels of air pollution are higher or lower at any one time.

At present, these environmental zones only allow traffic for vehicles bearing a green environmental badge (except in one zone) or those vehicles that meet the EURO 4 or better emission standards.

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Driving into an environmental zone without a valid environmental badge, as well as stopping and parking in an environmental zone lead to a fine of 80€. An additional charge of 25 € will be added to the 80 € fine for administrative fees. It is obligatory for all vehicles i.e. cars, busses, trucks regardless of fuel type and permissible weight to display an environmental badge in order to drive into an environmental zone. The environmental badges are in three colours which correspond to Euro emission norms.



The red badge corresponds for vehicles that meet the Euro norm category 2, yellow for the Euro norm category 3 and green for the Euro norm category 4 or better i.e. Euro 5, Euro 6 or better, including hydrogen, electric, gas powered and hybrid vehicles.

Older petrol vehicles classified under Euro norm 1 and diesel vehicles categorised under Euro norm 1,2 and 3 can obtain a green environmental badge Euro norm category 4 that will allow these vehicles entry into designated environmental zones if they are retrofitted with particulate filters. Light vehicles such as motorbikes, motorcycles and tricycles are not affected by these restrictions and may drive into environmental zones without bearing the environmental badge.

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In the past, each city or municipality in Germany determines the badge colors that are allowed to drive into its environmental zones. In January 2017, the regulation was changed so that only vehicles with an environmental badge of the 4th class (Green) are allowed to drive into environmental zones throughout the country.

### *The Blue Euro 6 Badge or (Nitrogen Oxide) NOx Sticker*

In early 2016, a proposal was made at an EU environmental conference to introduce a new Europe-wide blue *Stickoxid* (nitrogen oxide) sticker. This scheme has yet to be introduced in Germany. The German Environmental Agency wants to come up with alternatives to fight the nitrogen oxide smog-creator – particularly in Berlin, Cologne, Aachen, Düsseldorf, Essen, Gelsenkirchen, Frankfurt am Main, Stuttgart, Munich, and Darmstadt – and plan to adopt this measure.

These “diesel restriction zones” or “blue environmental zones” will regulate traffic of diesel vehicles depending on their emission rate of nitrogen dioxide (NO<sub>2</sub>). The Green Environmental Zones only control fine particulates, but not carbon dioxide and nitrogen oxide. The German Environmental agency sees this a solution to addressing the NO<sub>2</sub> emissions. The introduction of the blue sticker would effectively ban 13 million diesel vehicles from entering most large German cities.

It is also planned that the blue sticker traffic restrictions for diesel vehicles will be introduced by 2018 in selected German cities including Berlin, Hamburg, Munich, Leipzig and Stuttgart (<http://www.blaue-plakette.de/en/info-blue-nox-badge/blue-environment-zones-in-germany.html>).

So far, based on the City ranking summary of 2015 City in Table 1, the German cities of Stuttgart, Berlin and Dusseldorf were leading in practice in implementing Low Emission Zones (LEZ).

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### 4.1.1. Berlin Low Emission Zone

The city of Berlin introduced a Low Emission Zone (LEZ) on 1<sup>st</sup> January 2008. The LEZ covers the central city area of approximately 88km<sup>2</sup>, covering a mostly built up area with around 3.4 million inhabitants.

As with the objectives of all environmental zones in Germany, the environmental zone in Berlin was introduced to help protect public health. Many of the principal traffic routes in the densely populated areas in Berlin have exceeded the emission thresholds of particulate matter (PM<sub>10</sub>) and nitrogen dioxide (NO<sub>2</sub>). Road traffic was the biggest source of these pollutants in Berlin and has contributed around 40% PM<sub>10</sub> and 80% of (NO<sub>2</sub>) prior to the introduction of the environmental zone.

The implementation of the Low Emission Zone in Berlin was in two stages:

Stage 1: From January 2008, all vehicles entering the zone must at least meet the requirements of Euro norm emission class 2 (red badge). Vehicles with red, yellow or green stickers were allowed to enter the zone.

Stage 2: In 2010, stricter standards were introduced so that only vehicles bearing a green environmental badge equivalent to Euro norm 4 emission standard or better and those vehicles retrofitted with particulate filter are allowed to enter in the environmental zone.

Various research reports (Lutz, M. 2009, 2015 City Ranking report and Strompen, F. et.al. 2012) have cited evidence of improvements in air quality in Berlin as a result of the implementation of LEZ. Strompen, F. et.al. (2012) cited that the first stage implementation in 2008 resulted in 25% reduction in particulate matter (PM) and 15% reduction in NO<sub>2</sub> compared to the baseline scenario.

The second stage of implementation resulted in further improvements with PM<sub>10</sub> reduced by 58% and NO<sub>2</sub> by 20% against the baseline figures. The

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report further argues that without the environmental zone, Berlin would have exceeded the European PM10 emission standards for ten more days in a year. The City Ranking report attributes improvements to the air quality in Berlin to close monitoring and strict enforcement in the LEZ.

Although the introduction LEZ had significant impact of traffic emissions, the impact analysis undertaken by Lutz M. and Rauterberg-Wulff, A (2010) revealed that this had no measurable impact on traffic flows in Berlin. However, the introduction of this measure had considerably speeded the turnover of vehicle fleet towards more cleaner vehicles. At the time of reporting, the vast majority of diesel passenger cars have been issued a green badge (meeting Euro4 or retrofit). The same report argues that without the LEZ, the percentage of diesel passenger cars that would have the green badge, based on the long-term renewal trend would be well below 50%. Additionally, more than 50% of commercial vehicles comply with the green category instead of only 20% if LEZ were not introduced. Following the implementation of the LEZ and the stricter standards adopted in Stage 2, as many as 40,000 (24%) diesel passenger cars and 12,000 lorries (17%) have been retrofitted with a particle filter since the end of 2009.

In a separate work by Lutz (2016) on “Berlin’s low emission zone (LEZ) as a successful recipe to curb pollutant emissions from road traffic in cities” he further outlines some lessons learned and recommendations based on the implementation of LEZ in Berlin.

The more recent report cited above also states that in 2012, around 96% of diesel cars and approximately 85% of all trucks had a green sticker. To achieve this, some 60,000 diesel vehicles were retrofitted with particle filters. Without the environmental zone, only around 80% of diesel cars and 50% of trucks would be awarded a green sticker.

The City Ranking 2015 report cited similar outcomes and had concluded that as a result of the introduction of the LEZ there has been significant change in composition of the vehicles in the area. It is reported that about 90% of the



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cars driving in Berlin both inside and outside the LEZ, are meeting the minimum of Euro 4 standard.

### **4.1.2. Stuttgart Low Emission Zone Case study**

In Stuttgart, a (LEZ) covering the whole city area was introduced in January 2007 and entered into force in March 2008. The area covers the whole city with all its 23 districts with the exclusion of motorways and specified link and access roads.

All vehicles that want to enter the city are classified using the 4 Euro norm emission categories 1 - 4 and are required to display the corresponding environmental badge. All vehicles classified under Euro Emission category 1 are banned from the area. Vehicles in Emission category 2 were banned since July 2010, while Vehicles in Emission category 3 were banned from January 2012.

The environmental zone has traffic signs pointing out that only vehicles with a valid badge are allowed to pass in the zone. The green sticker (representing Euro 4 emission standard or better) became obligatory for vehicles since January 2013. The green sticker indicates unlimited permission to drive in the area.

Vehicles that are legally exempt from the driving ban in Stuttgart and not required to display a sticker include the following:

- Mobile machines and equipment,
- Work machines,
- Agricultural and forestry tractors/towing machines,
- Two-wheeled and three-wheeled motor vehicles
- Ambulances, emergency doctors' vehicles with the relevant markings "Arzt" (doctor) or "Notfalleinsatz" (emergency service).
- Motor vehicles which are driven by or used to drive persons with an exceptional walking disability, or who require continual assistance or are blind.

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- Vehicles belonging to non-German troops from non-contractual states of the North Atlantic Pact, which are in Germany for purposes of military co-operation, and on condition that the vehicles are being used for journeys required for urgent military reasons,
- Civilian vehicles that are being used the German Federal Armed Forces, as long as this concerns undelayable journeys required to fulfil official duties for the German Federal Armed Forces,
- Classic cars which have a license plate including those registered in another member state of the European Union, another contractual party to the Agreement on the European Economic Area or Turkey, if they fulfil equivalent requirements

### 4.2. Milan's combined Low Emission Zone and congestion charging

The city of Milan in Italy has adopted a combined Low Emission Zone and congestion charging scheme that was implemented in "Area C" of the city. Area C is an 8.2 square kilometer (3.2 square mile) Congestion Charge Zone in the central Cerchia dei Bastioni area of the city of Milan.

The scheme started as a trial pollution charging scheme called "Ecopass" which was launched in 2008 and lasted until 2011. During the trial period, entry to the zone was controlled by cameras that recorded the license plate number and automatically determined the pollution class of the vehicle as specified in its registration booklet. The scheme in Milan differs to the environmental zones in Germany in charging petrol and diesel cars that enter the zone.

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Table 3. Comparison of charging and Entry by Emission standard in Berlin and Milan

Emission standard	Berlin		Milan (Ecopass 2008)		Milan (Area C, 2012)	
	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol
Euro 0	No entry	No entry	10€ (all vehicles)	5€ daily	No entry	No entry
Euro 1	No entry	Entry allowed (with catalytic converter)	5€ daily charge 10€ freight	2€ daily charge	No entry	5€
Euro 2	No entry	Entry allowed (with catalytic converter)	5€ daily charge 10€ freight	2€ daily charge	No entry	5€
Euro 3	Only with particulate filter	Entry allowed (with catalytic converter)	5€ daily charge (also freight vehicles)	Free	No entry	5€
Euro 4	Allowed to enter	Entry allowed (with catalytic converter)	Free with particulate filter (also freight)	Free	5€	5€
Euro 5	Allowed to enter	Entry allowed (with catalytic converter)	Free with particulate filter (also freight)	Free	5€	5€
LPG, Electric, Hybrid	Green badge		Free		Free	

Source: Strompen, F. et.al., 2012. Reducing Carbon Emissions through Transport Demand Management Strategies

Within Area C, access is denied for Euro 0 petrol vehicles and for Euro 0,1,2, and 3 diesel vehicles. Access for vehicles classified as Euro 4 diesel without a diesel particulate filter is restricted, unless this restriction is personally waived. Any vehicle over the length of 7.5 meters is also restricted. It was intended that these restrictions would help keep traffic flowing properly and reduce diesel emissions.

A referendum in 2011 resulted in with almost 80% voting in favour of the scheme. Following this, the new congestion charge system was implemented in January 2012.

The scheme is in force every working day (Monday-Friday) from 7:30am-7:30pm with shortened hours on Thursdays. On this day, hours of operation run from 7:30 am to 6:30 pm. The timescale of operation is shortened on

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Thursday evenings to encourage weekday shopping activities. The area is free to access (no charge) on weekends and public holidays

The entry fee to the zone is €5 for all vehicles. The payment allows users to travel for the whole day in the charged area. Vehicles that meet emission requirements can enter Area C as many times while the ticket is valid. Tickets can be bought for multiple days for 30 Euros or 60 Euros. Residents in the area given 40 free daily entries per year and on subsequent entries are required to pay a reduced daily tariff charge of €2. Entry is forbidden for gasoline pre-EURO and for pre-EURO, EURO1 and EURO2 diesel vehicles. Entry charges also apply to foreign vehicles. Electric vehicles, hybrid vehicles, bio-fuel natural gas vehicles and scooters, public utility vehicles are exempted from the charge.

Tickets can be purchased from various locations such as parking metres, ATMs, garages, tobacconist, over the telephone or online. Ticket holders are required to activate it for use no later than midnight after the day of purchase. Tickets can be activated via a telephone text messaging, via a call centre, dedicated areas or online.

Cars entering Area C are detected by a system of 43 electronic gates (of which seven are reserved for public transport vehicles), equipped with ANPR (Automatic Number Plate Recognition) technology.

### *Impact of the Area C implementation*

Prior to the introduction of the pilot scheme, Strompen, F. et.al. (2012) cited that the level of particulate emissions in Milan exceeded the European PM10 threshold (PM 10 should not exceed  $50 \mu\text{g}/\text{m}^3$  for more than 35 days a year) in 2005 with a total of 151 days. During the first year on the trial, PM10 decreased by 19%, NOx by 14%, and CO2 by 15%. In 2010, two years (following the implementation trial charging system), the number of PM10 exceedance days declined to 86 days.

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A case study by Eltis (<http://www.eltis.org/discover/case-studies/area-c-milan-pollution-charge-congestion-charge-italy>) cited that the first 6 months of the scheme had impacted on (from January to June 2012) on the level of traffic coming into the area. The average number of vehicles that entered Area C declined by 34%. It was also reported that the scheme appears to have impacted on the traffic levels outside of Area C wherein traffic had on the average reduced by 6.9%. The number of polluting vehicles entering the area also declined by 49% i.e. equivalent to 2400 less vehicles. Conversely, the number of cleaner vehicles entering the area increased by 6.1% (an increase from 9.6% to 16.6% of total vehicles entering the area).

### 4.3. London Low Emission Zone

Previous Mayor Ken Livingstone initiated the concept of the Low Emission Zone (LEZ) in London in 2006. It was intended to help London achieve the national and EU air quality objectives as well as improve the air quality in London and consequently improve the health and quality of life of those who live and work in London.

London introduced a Low Emission Zone (LEZ) in 2008. This measure requires all heavy goods vehicles greater than or equal to 3.5 tonnes (e.g. diesel lorries, buses, coaches, motor caravans, motorised horseboxes, larger vans, minibuses and other specialist vehicles) to meet the Euro 3 emission standards for particulate matter PM when entering most of the Greater London area. It was also intended that the emission standards set for the LEZ in 2008 would encourage the upgrade or replacement of diesel engines in heavy vehicles to meet the Euro 3 standards for PM10.

In 2012, the LEZ regulations were tightened to Euro 4 emission standards for PM10 for heavy goods vehicles and buses, and Euro 3 for heavier vans and mini buses. Cars and motorcycles are not affected by this regulation. All heavy goods vehicles under this category that do not meet the required emissions standards have to pay a daily charge.

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Vehicles that are registered outside the UK, must register with the Transport for London (TfL) authority if intending to enter the in the LEZ. Unregistered foreign vehicles will be required to pay a daily charge even if it meets the emission standards or will otherwise receive a Penalty Charge Notice (PCN).

The LEZ operates 24 hours a day, every day of the year, including weekends and public holidays. The charging day run from midnight to midnight. In cases where a vehicle drives within the LEZ between 23:30 and 01:00 the next day, a charge for two days will apply. Vehicles parked in the zone but not driving are not subject to the LEZ requirements for that day.

The area affected by LEZ covers most of Greater London. All roads within Greater London, those at Heathrow and parts of the M1 and M4 motorways within the Greater London Authority (GLA) boundary are included. The M25 motorway is not included in the LEZ (even where it passes within the GLA boundary).



Source: reproduced from Transport for London

Low Emission Zone areas will have signs at its boundary and side of the roads to show where it applies. There are no barriers or tollbooths. Traffic cameras will read the vehicle number plate as it drives within the LEZ. These enforcement cameras are connected to a data base with information from the DVLA, DVANI, the Driver and Vehicle Standards Agency (DVSA - formerly VOSA), generic vehicle weight data typical of the make and model, and

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drivers and operators who have registered. This enables the enforcement camera to automatically determine whether a vehicle meets the LEZ emissions standards, is exempt, is registered for a discount, or have paid the daily charge.



There are advanced warning signs on major approaches to boundaries of the LEZ to allow drivers the opportunity to choose to divert route and avoid entering the zone. Within the zone, there are visible signs on main roads to remind drivers that they are in the zone and that cameras enforce the scheme.

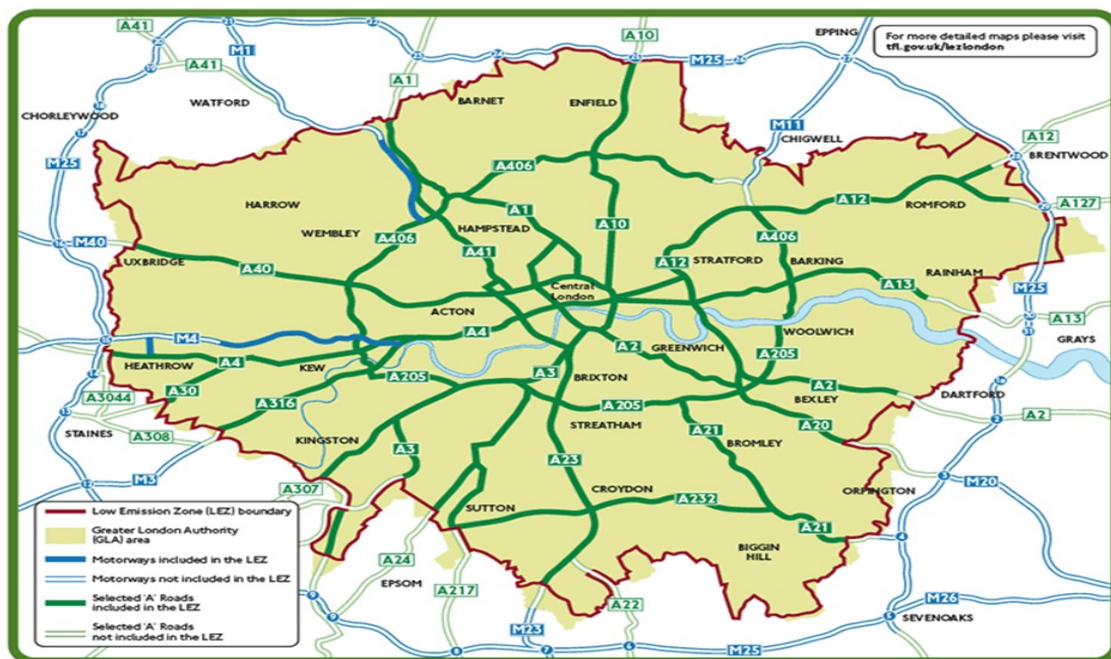


Figure 1: Map of London Low Emission Zone  
Source: reproduced from Transport for London

It is important to note that the London LEZ is not the same as the central London Congestion Charging zone. The Congestion Charge applies 7.00am – 6.00pm, Monday – Friday, excluding bank holidays. Vehicles that drive within the Congestion Charging zone during these times will have to pay the Congestion Charge, even it meets the LEZ emissions standards or have already paid the LEZ daily charge.

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### *Charges in the Low Emission Zone*

Operators of vehicle that do not meet the required emissions standards, are required to pay a charge for each day its vehicle is driven within the LEZ.

Vehicles that meet the emission standards will be able to operate in the LEZ without paying a charge.

The Table below outlines the existing charges for those vehicles that do not meet the emission standard required.

Table 4. Daily LEZ Charges in London by Vehicle Type

Vehicle	Weight	Daily charge
Larger vans; 4x4 light utility vehicles; Motorised horseboxes; Pickups	Between 1.205 tonnes unladen and 3.5 tonnes gross vehicle weight	£100
Ambulances; Motorcaravans	2.5 – 3.5 tonnes gross vehicle weight	
Minibuses (more than 8 passenger seats)	5 tonnes or less gross vehicle weight	
Lorries; Breakdown and recovery vehicles; Concrete mixers; Fire engines; Gritters; Motorcaravans; Motorised horseboxes; Refuse collection vehicles; Removals lorries; Road sweepers; Snow ploughs; Tippers	More than 3.5 tonnes gross vehicle weight	£200
Buses; Coaches (more than 8 passenger seats)	More than 5 tonnes gross vehicle weight	

Source: Transport for London (<https://tfl.gov.uk/modes/driving/low-emission-zone/make-a-payment>)



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Payment can be made in advance of the day of travel, on the day of travel, or up to midnight the day after driving within the LEZ. The daily charge can be paid in various ways via an online transaction, by telephone, by sending a cheque by post.

There are some exemptions to the charge. The exemptions apply to: specialist non-road going vehicles such as agricultural and forestry tractors, mowing machines, agricultural and farm machinery and equipment, mobile cranes and road and building construction machinery. Vehicles built before 1<sup>st</sup> January 1973 and those operated by the Ministry of Defence that are registered in the UK are exempt from charges.

### *Penalty Charges*

A Penalty Charge Notice (PNC) may be issued to vehicles that do not meet the emission standards and enter the LEZ or for those vehicles that have not paid the daily charge by midnight of the next working day. Penalty would also apply to vehicles entering the zone that has not been registered with the Transport for London authority. Penalty charges are made for each charging day of entry in the LEZ.

Table below outlines the amount that will be charged for vehicles that have failed to pay LEZ charges.

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Table 5. London LEZ Penalty Charges

Vehicle	Weight	Penalty charge	If paid within 14 days
Larger vans; 4x4 light utility vehicles; Motorised horseboxes; Pickups	Between 1.205 tonnes unladen and 3.5 tonnes gross vehicle weight	£500	£250
Ambulances; Motorcaravans	2.5 – 3.5 tonnes gross vehicle weight		
Minibuses (more than 8 passenger seats)	5 tonnes or less gross vehicle weight		
Lorries; Breakdown and recovery vehicles; Concrete mixers; Fire engines; Gritters; Motorcaravans; Motorised horseboxes; Refuse collection vehicles; Removals lorries; Road sweepers; Snow ploughs; Tippers	More than 3.5 tonnes gross vehicle weight	£1,000	£500
Buses; Coaches (more than 8 passenger seats)	More than 5 tonnes gross vehicle weight		

Source: Transport for London (<https://tfl.gov.uk/modes/driving/low-emission-zone/penalty-charges?intcmp=2275>)

### *Impact of the LEZ in London*

The Urban access regulations website (<http://urbanaccessregulations.eu/low-emission-zones-main/impact-of-low-emission-zones>) outlines some of the main impacts of the introduction of LEZ in London. These include:

- Black Carbon has been reduced by 40-50%
- NO<sub>2</sub>: Average concentrations were reduced by 0.12 µg/m<sup>3</sup>, peak concentration reductions up to 0.16 µg/m<sup>3</sup> on polluted streets.

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- PM<sub>10</sub>: Average concentrations reduced 0.03 µg/m<sup>3</sup>, peak concentration reductions up to 0.5 µg/m<sup>3</sup> on polluted streets.
- Emissions of PM<sub>10</sub> were reduced by 1.9% (28 tonnes)
- Emissions of NO<sub>x</sub> were reduced by 2.4% (26 tonnes)
- The feasibility study predicted gain of 5200 years of life, and 310,000 fewer cases of lower respiratory symptoms, 30,000 fewer cases of respiratory medication & 231,000 fewer restricted activity days.
- The Cost Benefit Analysis gave a £250-670 million benefit, £90-250 of which are outside Greater London.

A UK Sect Committee report published in December 2014 on Low Emissions Zone

<https://publications.parliament.uk/pa/cm201415/cmselect/cmenvaud/212/21206.htm>

stated that the introduction of “Low Emission Zones is one of the most powerful tools that local authorities have for controlling vehicle emissions”. To date however, few authorities have introduced them. Some of the key barriers that were identified include the perceived cost involved and a lack of guidance and support from Government.

To support local authorities with the introduction of LEZ, the same report recommended that a national framework should be in place. This could provide a template for creating LEZs with common core features including a national common certification scheme for vehicles meeting particular emissions standards. This would help reduce the cost of LEZs and make it easier for local authorities to administer and facilitate wider adoption of the measure. Such an approach would also make it easier for vehicle fleet operators to meet the requirements of individual zones, and reduce the risk of heavily polluting vehicles simply being re-deployed from one part of the country to another.

The report further adds that the introduction of a national framework, and alongside individual local authorities' willingness to introduce LEZs, could provide the Government with a more credible basis on which any EU infraction fines might be passed on to the local authorities.

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### 4.4. London Ultra Low Emission Zone (ULEZ)

The concept of introducing an Ultra Low Emission Zone (ULEZ) in London was considered from as early as 2013. The ULEZ is an area within which all cars, motorcycles, vans, minibuses, buses, coaches and lorries will need to meet the required exhaust emission standards (ULEZ standards) or pay a daily charge to travel.

It was initially planned that the ULEZ in London will come into force in 2020. However in April 2017, the current Mayor of London, Sadiq Khan announced that the world's first Ultra Low Emission Zone will be introduced much earlier than planned will come into force in Central London in April 2019. The ULEZ will cover the same area as the Congestion Charging Zone in London.

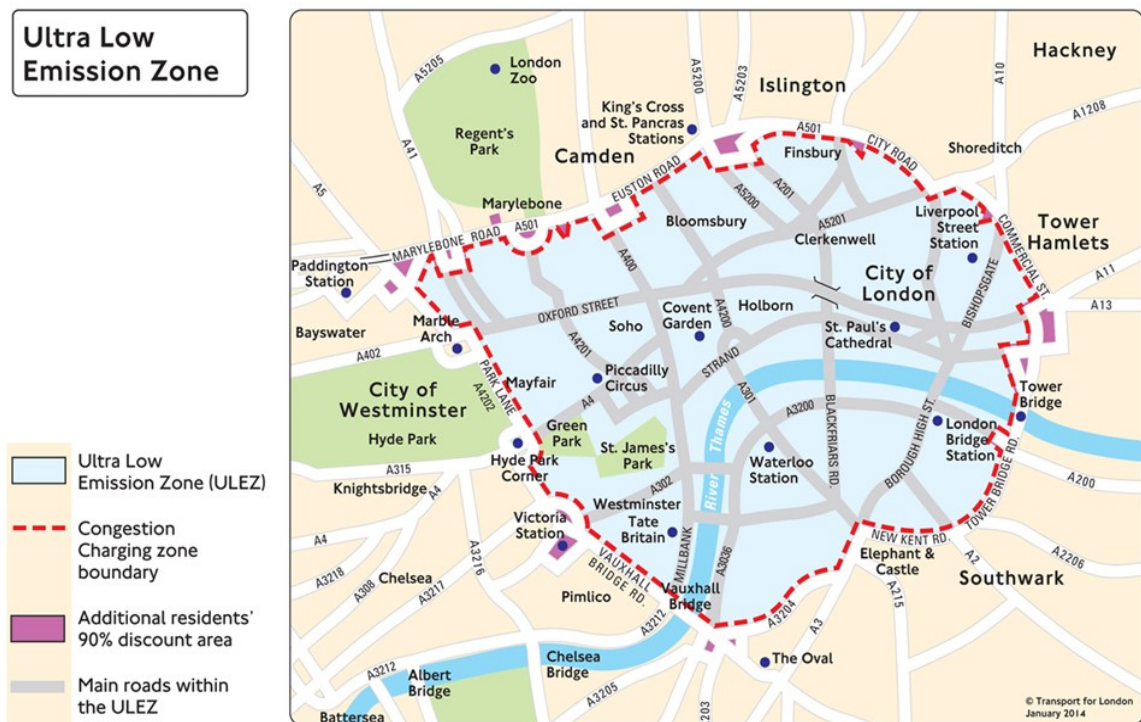


Figure 1. London Ultra Low Emission Zone

Source: Transport for London website

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The ULEZ will replace the “toxicity charge” or T-charge, that was recently introduced for the Central London area. The specific details about this charge are described in next section of this report. It is also planned that in 2020, ULEZ could be further expanded to cover nearly all of Greater London for heavy polluting buses, coaches and lorries.

### *Reasons for introduction of ULEZ*

The introduction of the ULEZ measure is seen as is another way to further reduce the most harmful emissions generated by road transport in central London and across the Capital region. It is planned that this measure will be complimented by other measures such more walking, cycling, use of public transport and use of more sustainable freight deliveries, in order to improve air quality.

It is intended that the introduction of the ULEZ will significantly reduce exhaust NOx and PM emissions. Various reports claim that this measure will reduce transport NOx emissions by 50% and would help to clean-up air quality in London. It is anticipated that the resulting improvements in air quality will be especially beneficial to the young, older people and those who have respiratory problems, as well as residents of high pollution areas. As majority of traffic entering the ULEZ will be from outside the zone, it is also expected that the benefits of cleaner, greener vehicles with reduced emissions will be distributed right across Greater London, including the areas that are not in the zone.

### *Emission standards and charging*

From April 2019, all vehicles will need to meet the following exhaust emission standards (ULEZ standards) or pay a daily charge, when travelling in central London.

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Table 6. London Ultra Low Emission Zone (ULEZ) Charges

Vehicle Type	Euro Standard	Daily Charges for Non compliance to ULEZ standards	Penalty charge if Vehicle does not meet ULEZ standard and non payment of daily charge
Motorcycles, mopeds, motorized tricycles	Euro 3	12.50	£130 (reduced to £65 is paid within 14days)
Petrol Cars, vans, light utility vehicles, pick-ups, ambulances, motor caravans and mini busses All not exceeding 500kg GVW)	Euro 4	12.50	£130 (reduced to £65 is paid within 14days)
Diesel cars, vans, light utility vehicles, pick-ups, ambulances, motor caravans and mini busses All not exceeding 500kg GVW)and mini buses	Euro 6	12.50	£130 (reduced to £65 is paid within 14days)
Lorries Buses and coaches and HGVs, motorised horseboxes, breakdown and recovery vehicles, snow ploughs, gritters, refuse collection vehicles, road sweepers, concrete mixers. Fire engines, tippers, removals lorries and busses and coaches (all exceeding 3500 kg GVW	Euro VI	100.00	£1000 (reduced to £500 if paid within 14 days)

Source: Transport for London (<https://tfl.gov.uk/modes/driving/ultra-low-emission-zone/complying-with-ulez>)

The ULEZ standards and charges are in addition to the Congestion Charge and the Low Emission Zone requirements. For example, a non-compliant car entering Central London would be charged a total of £24 (£11.50 for congestion charging and £12.50 for ULEZ charge)

The ULEZ will operate within the same area as the current Congestion Charging Zone (CCZ). The area will be clearly signposted with road signs

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showing where it applies. There will be no barriers or tollbooths. Cameras will read vehicle number plates as they are driven within the zone and will check the information against the database. The ULEZ will operate 24 hours a day, every day of the year, including weekends and public holidays.

In cases where the vehicle does not meet the ULEZ emissions standards and the daily charge is not paid, a Penalty Charge Notice (PCN) will be issued to the registered keeper. This penalty is in addition to any CC or LEZ penalties received.

### *Discounts and Exemptions*

Certain vehicles will be entitled to discounts or could be exempted from the ULEZ charge. People residing in the area within the ULEZ will be granted a time limited discount to allow them time to change their vehicles to meet the emission standards required in the ULEZ area. The discount will apply until April 2022 and on the condition that the registered individual continues to live within in the zone. During this period these residents will be continue to pay the T-charge at a discounted rate of 90%.

Vehicles for disabled people will be granted a sunset period and will be exempted from daily charges until September 2023. Taxis are exempted as the TfL have introduced a new licensing scheme for taxis to phase out diesel vehicles and increase number of zero emission capable vehicles. Other vehicles that are exempted from the ULEZ charges include historical vehicles i.e. those vehicles that have a “historic vehicle class category, agricultural vehicles, military vehicles, non-road going vehicles, mobile cranes, and showman’s vehicles.

### **4.5. London T-Charge**

The Mayor of London’s ‘Toxicity charge’ or T-charge came into force on 23 October 2017. The charge was introduced to further improve air quality within

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the capital and to prepare Londoners of the Ultra Low Emission Zone (ULEZ) that will be introduced in 2019.

The T-charge cost £10 per day. This charge operate within the central London from 7:00 am – 18:00 pm, Monday - Friday and will cover in the same area as the existing congestion charging zone. This will be payable on top of the existing congestion charge. The charge apply to those vehicles that do not meet the emission requirements required within the T-charge zone.

To avoid the charges vehicles that enter the T-charge zone must meet the following minimum emission standards:

- Euro 4/IV for both petrol and diesel vehicles, and
- Euro 3 for motorised tricycle and quadcycles,

Motorcycles are not subject to the T-charge. .

### **4.6. London Zero Emission Zone Target**

The Mayor of London, Sadiq Khan, had also announced as part of his transport strategy that Transport for London (TfL) will work to make London's entire road transport system zero emission by 2050 at the latest.

Zero Emission Zones (ZEZ) will be introduced in Central London and town centre zero emission zones from 2025. It is intended that the zero emission zone for inner London will be in place by 2040 and a London-wide zone by 2050.

It is planned that the adoption of the zero emission zone will be delivered through a phased approach. This will build on the experience from the introduction of the Ultra Low Emission Zone (ULEZ) and the T-charge and will involve wide-spread public consultation.



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### 4.7. London's Low Emission Neighbourhoods (LEN)

The Mayor of London's Air Quality fund is currently supporting 5 Low Emission Neighbourhoods (LENs) across various boroughs in London. A LEN is defined by the TfL as an area-based scheme that includes a package of measures delivered within a specific area and is focused on reducing emissions and promoting sustainable living locally. This is a recent initiative sponsored by the Mayor of London to combat air pollution in the most polluted boroughs and will come to full effect by April 2019.

The scheme is delivered by selected London Boroughs with support from Transport for London (TfL), the Greater London Authority (GLA), businesses and voluntary groups in the local community.

The Mayor of London is supporting 5 LENs in the following London boroughs with £1m each. Examples of some of the measures and initiatives are outlined below:

**Westminster** – the Marylebone Low Emission Neighbourhood is a partnership between the council and local stakeholders including residents' associations and Business Improvement Districts. Proposals includes better management of taxi ranks, improving building emissions and an electric vehicle delivery scheme in conjunction with UPS consolidating freight delivery to cut down on vehicles on the road.

**Hackney, Islington and Tower Hamlets** – the City Fringe Low Emissions Neighbourhood proposal includes tree planting, an emphasis on walking and cycling with improved pavements and cycle routes, and parking spaces for the sole use of the cleanest vehicles.

**City of London** – the Barbican Low Emission Neighbourhood proposal includes no-idling zones where stationary vehicles must turn off their engines, restricted access to certain streets for all but the cleanest vehicles and green taxi ranks.

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### **Greenwich** – the Town Centre and Trafalgar Road Low Emissions

Neighbourhood proposal includes a series of car-free days in the town centre, an incentive scheme to encourage walking and cycling and an extensive series of mini parks throughout the area.

### **Redbridge and Newham** – the Ilford Garden Junction Low Emission

Neighbourhood proposal includes a green barrier between the road and pavement to reduce pedestrians' exposure to fumes, plus other road restrictions.

The Mayor of London Air Quality Fund (MAQF) provides specific guidance on how communities can deliver and develop LEN. The guidance specifies what needs to be achieved and the criteria that needs to be met and how available funding should be used for the specific initiatives that contribute to improvements in air quality.

This detailed guidance note summarising the steps that might be taken to develop a LEN can be found on the mayor of London's Air Quality Fund webpage (<https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/mayors-air-quality-fund>)

The key outcome cited for a LEN is reduction in concentrations and exposure to air pollutants. It is expected that the projects should have a transformative impact on the urban environment and the way the area operates.

The guidance provided on LEN requires that this should focus on areas of high exposure to high pollution that can be reduced through local measures, and locations with high trip generation and the potential to reduce emissions in the wider road network. The package of measures associated with LEN are less suited to areas where the high pollution levels are restricted to a single road, especially if through-traffic is a large source of emissions, as the package of measures would do little to address this source.

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The use of the term “neighbourhoods” is key in this approach. The concept is not solely restricted to residential areas, it covers busy streets and urban spaces where air pollutant concentrations and public exposure are highest. The term ‘neighbourhoods’ is also used to highlight the need for local community involvement (residents, businesses and regular visitors) and support in developing a LEN to ensure it is successful. It is also intended that a LEN would involve partnership between the local community, businesses and the local authority to jointly identify and deliver a common set of goals.

Crucial to the success of the LEN is the community buy-in. For a LEN to work, collaborative effort is required from all stakeholders. The LENs’ transformative nature is intended to foster a sense of pride in those involved.

A successful LEN will be dependent on the involvement of local people and businesses. It is therefore more appropriate to select an area defined by the community within it, such as an urban town centre, or a business park and its surrounding environment. Local circumstances should determine the size and boundary of a LEN.

### **4.7.1. The Marylebone Low Emission Neighbourhood (LEN)**

The Marylebone Low Emission Neighbourhood (LEN) was established in July 2016. The LEN is a partnership between Westminster City Council and local stakeholders, including businesses, landowners and residents with many of the core projects led and delivered by stakeholders. It is a three-year initiative commencing in July 2016 until July 2019. Through this scheme, the Marylebone LEN aims to improve air quality throughout the area via a range of innovative projects delivered in partnership with businesses and members of the community. It is intended that the overall outcome of the LEN programme will be achieved through behavioural change measures that have a direct impact on reducing emissions.

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The delivery of the Marylebone LEN is managed through the LEN steering group coordinated by Westminster Council who are responsible for its priorities and for the management of its operations. Sub-steering groups have been created to manage and deliver specific workstreams.

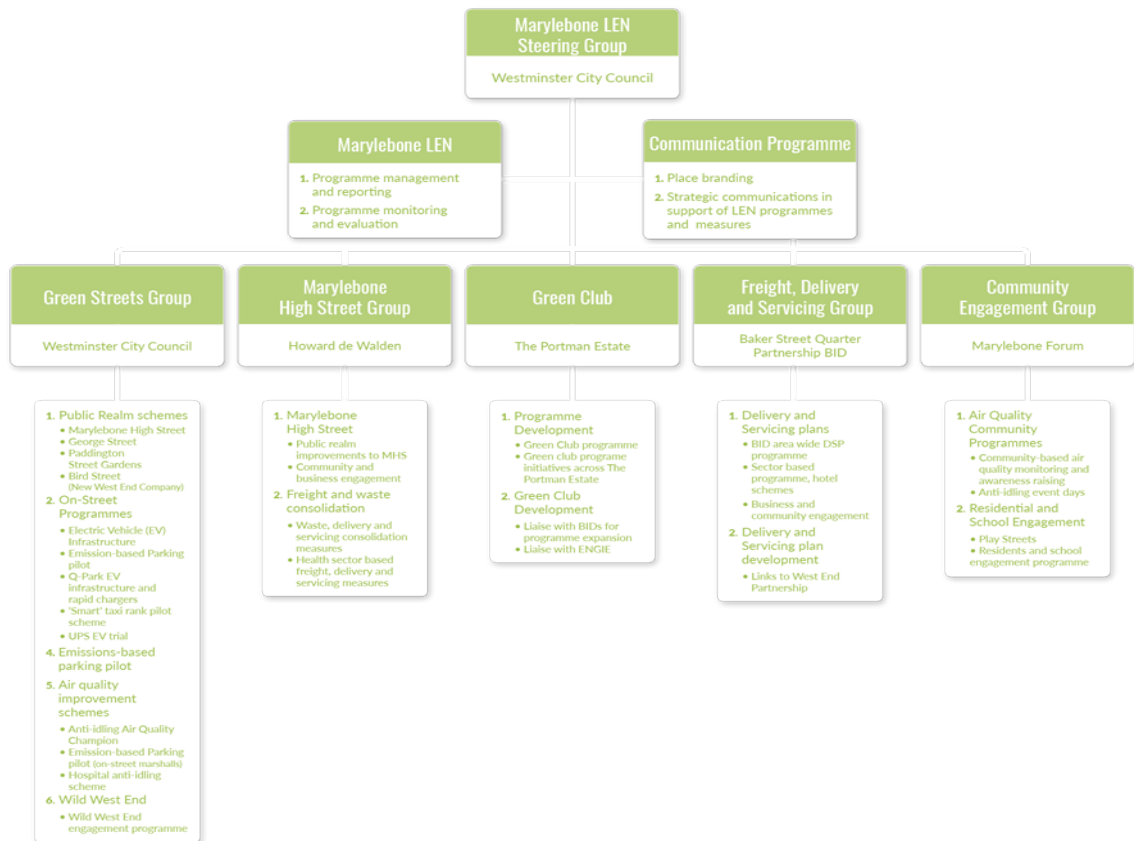


Figure . Structure of Marylebone LEN

Source: Mayor of London Air Quality Fund Marylebone LEN website

The key partners who are involved in the delivery of the projects include the Business Improvements Districts (Bakers Street Quarter Partnership BID, Marble Arch London BID, and the New West End Company BID), land owners, residents' associations, private sector partners (Kings College, UPS, QPark) and public sector partner groups ( Mayor of London and Transport for London).

The following some of the key projects and measures that are being implemented as part of the scheme.

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**Marylebone Green Club** - is working with major landowners to improve emissions from buildings by making improvements to operations and retrofitting energy efficiency measures. LEN will encourage the uptake of improvements and provide seed funding to adopt sustainable schemes. For residential properties, the programme would include developing an advice note for residents on how to access remaining government incentive schemes for the installation of cleaner boilers, better insulation and solar panels

**Freight and Delivery Servicing Group** - This is intended to widen the Business Improvement Districts' (BIDs') existing delivery and servicing schemes to cover the entire Marylebone neighbourhood. Better management of freight deliveries will reduce freight movements or service vehicles accessing the Marylebone area.

The LEN funding will enable the Council and BIDs to work with businesses and residents to develop measures to evaluate the potential benefits and impacts of re-timing of deliveries as well as consolidate deliveries and services in Marylebone where feasible.

So far, the BIDs in the area have been active and successful in reducing the number of freight trips on our roads and through our communities. The LEN is building on the '[West End Buyers Club](#)', a shared supplier scheme pioneered by New West End Company, and will have this rolled out across the LEN-areas to work with the Baker Street Quarter Partnership, Marble Arch BID. The 'West End Buyers Club' will reduce the number of delivery vehicles in the area and support suppliers who use ultra-low emission vehicles for making deliveries. It will make use of its purchasing power for commonly procured goods and services in the LEN area. West End businesses are entitled to exclusive deals and preferential rates from chosen suppliers. The services will include: waste and recycling services, office supplies, staff personal deliveries, couriers and carriers, fruit and milk, printing, catering, building maintenance, green infrastructure, taxis and travel, cleaning, document storage and shredding.

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Businesses are encouraged to procure with the West End Buyers Club to support improvements in air quality. The West End Buyers Club chooses suppliers who are committed in improving air quality. By procuring together, this will reduce costs and West End businesses can save money together. The West End Buyers Club ensure that leading suppliers are procured to deliver business needs. The consolidation of deliveries will remove freight from roads, cutting congestion and creating a more pleasant environment. This scheme will also help businesses in achieving its corporate responsibility with customers and shareholders.

The LEN will also support a programme on personal deliveries. It is cited that up to 40% of deliveries to places of work are personal deliveries. People working in the Marylebone LEN can avoid the hassle of missed deliveries and help reduce emissions by using alternative 'click & collect' delivery services such as Amazon Lockers, CollectPlus, Duddle, HubBox and Parcelly, as well as help reduce congestion and improve air quality in central London.

**Encouraging Uptake of Cleaner Vehicles** - Information on the LEN website cites that a number of specific projects have also been implemented to encourage the use of cleaner vehicles thus improving air quality; however no examples have been provided.

**Emissions-based On-street Parking Charges** – this measure is based on the principle of 'the polluter pays' and would charge vehicles according to their emissions for parking in on-street pay and display and residents' bays. It is intended that this emissions-based parking charging will encourage use of electric vehicles and discourage use of more polluting vehicles. Through this scheme, electric vehicles, including electric motorbikes, would be subject to reduced parking fee and vehicles with the highest polluting emissions 'disincentivised' by paying more.

In May 2017, a Cabinet report by the Westminster Council outlined its proposals on LEN parking related charges. The Cabinet has decided to introduce a **trial for a 50% surcharge for all diesel vehicles** paying to park

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within F Zone (Hyde Park, Marylebone and Fitzrovia). With this decision, the hourly parking tariff will rise from £4.90 to £7.35. It is intended that this surcharge will serve as a deterrent for highly polluting vehicles from parking in these areas. As part of the proposal, all vehicles manufactured during 2015 and thereafter be exempt from the surcharge. Diesel vehicles manufactured in 2015 will be also be exempt from these charges.

**Residents' Electric Vehicle Charging Pilot** - A pilot scheme to provide on-street electric vehicle charging points within residential areas will be progressed. It is intended that this will encourage residents to use of low emissions vehicles. The project will work closely with residents to determine the appropriate location of the parking bays. The LEN will support the expansion of the EV infrastructure. So far, it is reported that EV charging points have been installed in lamp columns as part of a pilot scheme. Additionally, charging points are provided in selected car parks operated by a partner as supplier of the LEN scheme.

**Smart Management of Taxi Ranks and Fast Charging** - The LEN is also working with the taxi industry to improve the management of taxi ranks. Through the use of parking sensors, taxi drivers are provided real time information of the location of available taxi rank spaces via the ParkRight smart phone app. technology.

The sensors help Westminster to manage over-ranking at busy ranks, by helping taxi drivers to find available space and reduce unnecessary circling times, and provide information on when ranks are nearing or filled. It is expected that the smart management of taxi ranks will help to reduce vehicle emission pollutants by reducing the time needed to find a parking space and associated idling and consequently reduce vehicle congestion.

**Electric Delivery Vehicle Scheme with UPS** -The Marylebone LEN is working with the UPS courier company to support switching its existing delivery vehicles to electric.

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**No-idling Enforcement, Awareness Raising and Campaign Days** – The LEN is also working with taxi drivers and local hospitals to reduce unnecessary idling in the Westminster and Marylebone area. The Council has initiated activities to raise awareness in partnership with BIDs and selected businesses to reduce idling in the west end and in the Paddington area i.e. citywide campaigns using social media and flyers on the impacts of vehicle idling.

A no idling campaign also targeted ambulance and other hospital vehicle drivers at the Princess Grace Hospital to encourage them to switch off their engines when stationary. The campaign will encourage patients, staff and visitors to use EV taxis. It is planned that the project would be replicated with Harley Street clinics and other private health clinics

**Air Quality Champions** - A Cabinet report of the Westminster Council in May 2017 stated that the Council would deploy a team of dedicated on street Air Quality Champions. These Air Quality champions will encourage drivers to stop vehicle idling and inform them of the harmful effects of this practice. They will be trained and are empowered to enforce unnecessarily vehicle idling via a penalty charge notice (PCN). Their sole focus will be to take action against idling and spread positive air quality messages including engagement with local stakeholders.

This team will initially be deployed within the LEN and could be rolled out across the City depending on the success of this trial.

**Schools Emissions Engagement Scheme** – the LEN scheme will also work with schools, colleges and universities to raise awareness about air pollution and the measures that can be taken to reduce emissions (e.g. as part of the journey to school) and reduce exposure.

The existing school engagement programme offers pupils a variety of interactive projects that bring awareness to local air quality. This will include conducting engaging and fun classroom activities including competitions



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between classes and schools and various energy saving activities.

**Play streets** – Through this measure it proposed that certain local residential streets will be designated as part-time 'play streets'. Play streets create a safe and fun outdoor playing environment for children in their local area. By temporarily closing the street or a portion of the street, children would be encouraged to play and explore outside environment. By removing traffic from the street, play streets further provide an opportunity for children to learn to cycle or scooter in a traffic free environment.

### **4.8. The Greater Manchester Low Emission Strategy, December 2016**

The work of the Greater Manchester Combined Authority (GMCA) and the Transport for Greater Manchester (TfGM) in improving air quality in Greater Manchester area has been identified during the first UK National Clean Air Day 2016 celebration as one of the best practice in Britain.

Improving air quality in the Greater Manchester area is seen as a key challenge. It is currently one of the major UK conurbations where NO<sub>2</sub> limits are exceeded. Road transport contributes 65% of NO<sub>x</sub> emissions, 79% of particulates and 31% of CO<sub>2</sub> emissions.

On behalf of the GMCA, the Transport for Greater Manchester (TfGM) has developed the Greater Manchester Low-Emission Strategy and Greater Manchester Air Quality Action Plan, which focuses on ways to tackle harmful emissions from road transport to improve air quality and help in reducing carbon dioxide emissions.

The strategy highlights the need for effective the partnership and commitment between various organisations including the TfGM, the Greater Manchester District Councils, the health sector, Highways England, public transport and fleet operators, the government, motor manufacturers and other private sector groups to deliver its aims.

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The key priority areas in the strategy will be described in the following section of this report.

### *Stimulating the uptake of Ultra-Low-Emission Vehicles*

To make a significant impact on emissions the strategy highlights the need to accelerate the replacement of older vehicles, by offering incentives such as scrappage schemes or restricting access to sensitive areas unless vehicles comply with particular standards (proposed Clean Air Zones below).

The strategy addresses concerns and barriers to the take-up of electric vehicles and other types of alternative fuel vehicles e.g. LPG and hydrogen particularly on charging or fueling infrastructure.

It is planned that the number of electric vehicle charging points will be increased significantly. Currently there are 200 publicly available points in the conurbation. However, research cited in the strategy suggests that in terms of size and population density of the area, a network of some 700 publicly available points would be effective. The number of charging points in homes and businesses will also be increased through planning conditions.

The strategy also plans to increase the number of ultra-low-emission vehicles (ULEVs) in fleets within the public sector. This will involve introducing and making use of joint-procurement to reduce the cost of introducing these within the public sector fleets. The use of ULEVs will be a key specification when car clubs are established (or existing contracts are renewed). TfGM will also work with local authorities to set stricter higher emission standards for hackney carriages and taxis.

### *Taxi and Private Hire Quality Controls to Prioritise Low-Emission Vehicles*

Although taxis and private hire vehicles represent a relatively small proportion of the transport fleet, the strategy recognises that they have a significant impact due to the high number of journeys undertaken and vehicle km driven

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within relatively small areas by a fixed number of vehicles. The strategy will work towards ensuring that these vehicles achieve a low-emission profile so that this can contribute in improving local air quality.

TfGM will work with licensing authorities and seek to standardise the minimum emission requirements (i.e. age) of the vehicles that are allowed to operate. It is also planned that the minimum emission standards will be progressively increased in future years to ensure a very low emission limits will be achieved within a defined timescale.

### *Reducing Emissions from Heavy Goods Vehicles*

The strategy highlights the benefits of shifting freight from road to rail or water to reduce emissions at the national or Greater Manchester-wide level. Where possible, ULEV will be used for the final leg of the journey on the local road network from the distribution centre. The TfGM indicates that it will support new rail or canal-served distribution centres subject to planning conditions.

TfGM will also explore the introduction of a fleet recognition scheme as an incentive to operators to improve both safety and environmental standards (through vehicle quality or through 'eco driving' training). It is anticipated that operators can benefit from this scheme both through enhanced reputation and potentially through reduced fuel consumption.

### *Urban Distribution Centres (UDCs)*

As part of its action, plan TfGM is investigating opportunities to create new Urban Distribution Centres (UDCs). These are large-scale warehouses located at the edge of the urban area and in other key areas with high volumes of HGVs. This could be integrated with key national and regional HGV routes (e.g. motorways), as well as alternative transport options, such as water and rail. For example, one centre would be used by several suppliers and customers. These will serve to intercept HGVs on the edge of an urban area and allow loads to be broken down for final delivery by low-emission vehicles.

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It is intended that these new distribution centres will utilise low-emission, or ultra-low-emission vehicles, such as EV LGVs, to complete the last stage of delivery into the city centre or other ultimate destination. Travel planning should also be used to ensure that the greatest local air quality benefits can be achieved during the operation of a new centre.

### *Urban consolidation Centre*

Additionally, TfGM is also exploring the opportunity to introduce a smaller-scale alternative via the Urban Consolidation Centre (UCC) in the city centre and other key areas with high volumes of goods vehicles. These UCCs would be used as shared local distribution centres for delivery of goods and collection of waste, and would reduce the number of HGV/LGV journeys to individual customers.

The Oxford Road corridor in Manchester was identified as one of the areas that has potential for consolidation, as it houses a concentration of higher education and medical facilities in close proximity to one another. This area has one of the highest concentrations of NO<sub>2</sub> and exposure of population, so the potential benefits of reducing emissions here are significant.

Local distribution to and from the consolidation centres will be undertaken with cycle or ULEV by coordinating the scheme with other Courier services and small parcel deliveries to avoid multiple delivery providers visiting the same premises. Other consolidation models will also be encouraged to reduce the number of journeys and increase the use of more sustainable modes such as bicycle courier or EV.

TfGM will work with the industry and customers to raise awareness and actively promote sustainable distribution

### *Diesel transport refrigeration units (TRUs)*

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According to TfGM, another area where impact could be made is in the transport of food products by refrigerated vehicles. The vast majority of refrigerated trucks use diesel-powered refrigeration. In many refrigerated vehicles, the cooling is powered by a secondary diesel engine, thus adding to the emissions already produced by the running vehicle. Diesel transport refrigeration units (TRUs) are effectively unregulated in Europe and, according to forthcoming European Commission regulations, are allowed to emit 29 times as much PM and six times as much NOx than as a modern Euro VI truck.

TfGM will support the development and uptake of the alternatives to Diesel Transport Refrigeration Units (TRUs) to help achieve zero-emission transport refrigeration. The use of Zero emission transport refrigeration would eliminate this source of NOx and PM emissions; and would deliver substantial and progressively larger reductions in greenhouse gas emissions.

### *Engine Idling*

Engine idling is when a driver leaves the engine running and the vehicle stationary for a period of time. It is cited that many cars and trucks idle needlessly, sometimes for hours, and an idling car can release as much pollution as a moving one. Idling does not only have a negative environmental impact but is a waste of fuel and money. When implementing truck anti-idling measures fleet operators can expect average fuel savings from 1% to 5%. TfGM will promote anti idling policies with freight transport companies.

### *Reducing emissions from buses on key urban corridors*

The strategy also recognises that replacing older buses (particularly those with Euro III or older engines) with newer vehicles will make significant impact on emissions. However, the costs of introducing the lowest-emission buses

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are expensive, and the benefits this offers to operators in terms of fuel savings may not be sufficient to justify the cost.

The TfGM action plan have introduced a voluntary bus operators' code of conduct, which all the major operators have signed and which includes targets for improving engine emission standards. TfGM states that it will continue to specify minimum standards for bus vehicles used on its contracts and will seek to explore how air quality considerations can be prioritised. It is planned that measures will be introduced so that (the permitting environment allows it) appropriate vehicles are used on specific routes, and buses with the lowest emissions profile will be routed through the areas suffering the highest pollutant concentrations.

### *Bus Improvements*

It is also reported that significant improvements have been made to the profile of the fleet in Greater Manchester in recent years by working jointly with operators and utilising government funding.

Since 2009, and via successful bids a total of 298 low-emission vehicles for Greater Manchester have been part-funded by DfT, as follows:

Table 7.

Funded	Single Deck	Double deck
Transport for GM	101 diesel-electric hybrid 3 fully electric	
Commercial Operators	28 diesel electric hybrid	166 diesel electric hybrid

Source: Greater Manchester Transport Action Plan 2016

### Yellow School Bus and Clean Bus Technology Fund

TfGM has utilised DfT's Clean Bus Technology Fund to fund the installation of pollution control equipment on the older diesel buses within its 'Yellow School Bus' (YSB) fleet.

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Emission tests were carried out on buses before the pollution control systems were fitted and again after they had been on the road for at least a year.

According to the Clean Air website on local authority good practice, the installation of this measure has resulted in a 99% reduction in nitrogen oxide levels – far higher than the 50% minimum target set by the DfT – with a 93% reduction in particulates (soot and dust particles), 99% in hydrocarbons and more than 97% in carbon monoxide from these retrofitted busses.

The 'Clean Air for Schools' programme targeted the tailpipe emissions from 41 of TfGM's fleet of 93 Yellow School Buses, delivering significant environmental benefits and reducing children's exposure to harmful air pollutants. Of these 33 Euro III YSB vehicles have been upgraded since 2013. It is reported that funding has now been secured to retrofit the remaining seven (7) Euro IV YSBs, which will complete the upgrade of the whole diesel YSB fleet. These are the only vehicles for which a retrofit programme is deemed preferable to renewal, given the limited mileage of their operation.

### *Hybrid Bus Improvements and Driver Training*

A significant number of vehicles that is part of the bus fleet operating in the Greater Manchester region are of hybrid diesel-electric vehicles. These were acquired through the Green Bus Fund and operator self-financing. These use a combination of electric and diesel engines to drive the wheels. However, these vehicles cannot be driven in the same way as diesel engine vehicles, as the diesel engine will supplement the electric drive during acceleration or at high speed).

Driver training is essential to ensure that the buses are operated in such a way that achieves the lowest emissions, with the minimum reliance on the diesel engines. This may be supplemented by geofencing control systems that will automatically use the electric drive preferentially within defined areas, such as the key air quality priority areas.

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TfGM plans to work and influence operators to use new technology such as, such as geofencing control systems (systems that will automatically use the electric drive preferentially within defined areas) and exhaust abatement technology, in key air quality priority areas.

TfGM will work with operators to establish the level to which operators currently deliver eco-driving training and promote its further roll-out where appropriate. This is to provide specific training for drivers of hybrid **vehicles**, **to ensure that the** buses are operated in such a way that achieves the lowest emissions.

### *Trial of Low-Emission Vehicles*

The use of the fully electric metro shuttle in the Greater Manchester has proven to be a success. This shuttle service serves as a free Manchester city centre bus service linking all the city's main railway stations, car park, various bus and Metrolink tram stops and key shopping and employment districts the Salford Central rail stations. The successful uptake of this technology, it will increase the opportunities to introduce additional routes across a wider geographical area.

The range-extender buses are still a very new technology, and are not widely used outside London. TfGM will follow the development of this technology trial in London and identify any opportunities for its application in Greater Manchester

### *Investigation of Clean Air Zones*

The strategy also recognises the benefits of the introduction of a Clean Air Zones (CAZ) as a key measure to improve air quality. A CAZ is defined as a geographically designated area or areas within which a package of measures



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is implemented with the objective of reducing the use of polluting vehicles encouraging the uptake of alternatives. One element of a CAZ could be a Low-Emission Zone (LEZ) which would be an access control scheme targeting the most polluting vehicles. This could also include a charging zone, where vehicles that do not meet specified minimum emissions standards are charged for entering the area.

Although the TfGM is considering CAZ option for reducing emission, it is recommending that a technical feasibility study will need to be carried out to assess whether this reduction will be great enough to justify the cost of implementing and operating the CAZ, given that natural fleet replacement will reduce emissions to some extent without any further action.

The technical feasibility should identify the economic, social and environmental impacts (positive and negative) of establishing a LEZ. The analysis would need to consider geographic and vehicular scope, the level of charge to both drive change and to cover operational costs of the scheme and what exemptions would be allowed. It is also essential that the appraisal should identify the resultant human health and economic impacts.

TfGM also recognises that the introduction of a CAZ would be unlikely to generate excess revenue, as its income will reduce over time as more and more vehicles comply with standards. A further issue is that introducing a CAZ in one area may mean that older vehicles will be displaced to other parts of Greater Manchester.

### *20mph Zones*

The strategy cites that emissions from vehicles are linked to speed profiles. The highest emission generally occur during very low and very high speeds or hard acceleration, as the engine is operating outside the most efficient range. The speed/emission profiles cited in the strategy show that the lowest emissions occur at ~50-70km/hr (~30-50mph).

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The strategy highlights how the implementation of 20mph zones in urban areas can potentially benefit local air quality through smoother vehicle flow through junctions and reduced acceleration and braking. It is also anticipated that this will also encourage modal shift from driving to walking or cycling. Although data cited from average-speed emissions models suggest that vehicle emissions at 20mph are greater than at 30mph, it is thought that the influence on driving styles of 20 mph zones is smoother with less aggressive accelerations and decelerations and more time spent driving in the cruise phase, will result in lower exhaust emissions overall. However, research carried out to date has shown mixed results for different pollutants and different vehicle types.

The strategy also cites recent studies carried out in the City of London indicated that NO<sub>x</sub> and CO<sub>2</sub> emissions of light-duty petrol vehicles were higher for 20mph roads than 30mph road sections. However, for light-duty diesels lower NO<sub>x</sub> and CO<sub>2</sub> emissions were observed for 20mph roads. Emissions of PM for both petrol and diesel light-duty vehicles were estimated to be lower in 20mph zones than 30mph zones, which may be attributable to lower non-exhaust PM emissions at lower speeds (e.g. brake and tyre wear, resuspension of road dust). Overall, it was concluded that it would be “incorrect to assume a 20mph speed restriction would be detrimental to ambient local air quality, as the effects on vehicle emissions are mixed”.

So far, Chapel Street in Salford, has been transformed into a pedestrian-friendly city centre environment, that still remains as a principal public transport corridor. Peak time traffic volumes have been reduced from 1,800 to 1,200 vehicles per hour, with speeds reduced from 30mph to 20mph. It is anticipated that this will have a beneficial effect due to reduced traffic flows, whilst it should also improve traffic flow and reduce ‘stop-start’ movements.

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### *Planning for new developments*

The strategy recognises that the location and design of new developments can help to address the problem of transport emissions. This can be achieved in two ways: by maximising the use of sustainable travel modes to/from the development and by minimising people's exposure to those emissions

Although planning permission is granted for sustainable development, the strategy highlights that the interpretation of what constitutes 'sustainable' is left to individual planning authorities. Consequently, this leads to an inconsistent approach to the mitigation required for similar types of development in different areas.

TfGM highlights the need for common guidance across the 10 planning authorities of Greater Manchester and/or develop a toolkit to help them assess development proposals and identify the mitigation needed. It is recommended that this could include: the appropriate number of charging points for electric vehicles; sufficient cycle parking; access to public transport; detailed delivery and servicing plans which encourage activities outside of peak times; travel plan incentives to encourage the use of low-emission vehicles and sustainable transport; and guidance on setting back or screening residential development from major highways where air quality is an issue.

TfGM plans to develop a Greater Manchester-wide guidance on reducing emissions from new development. And will also develop a toolkit to assist planning officers in identifying requirements for mitigating the impact of emissions in new development.

### *Changing Travel Behaviour*

The strategy will encourage people to change travel behaviour so that they move away from car use (particularly 'driver only' trips and travel to work) and reduce the number and length of journeys made by car.

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So far, TfGM has launched a 'get me there' smartphone app and smart card for Metrolink and multi-operator bus. It is planned that the "get me there" smart ticketing solutions will continue to be developed to provide cashless payment across all three modes. Through smart phone technology, information will be made available, not only when planning a journey but during the journey itself using real-time information available via smartphone apps. Knowing when a service is likely to arrive and when it is approaching the required destination will help to build people's confidence in using public transport.

TfGM is also committed to make significant investment in high quality cycle infrastructure, such as routes and parking, as part of the 'Cycle City' programme – as well as a package of practical support, such as cycle training, for those wishing to cycle more or start cycling. This will need to continue into the future in order to make cycling a natural choice for local journeys or as the first part of a longer public transport journey.

The strategy also supports homeworking as this contributes to reducing the number of commuter journeys, as this way of working has been made more feasible with improvements in broadband connections.

### **5. Public procurement clean cars and transport**

The public sector's vehicle fleets, heavy vehicles and public transport can be a significant source of air pollution in the city. It is recognised that the public sector therefore has a key role in leading the adoption of clean air technologies. Retrofitting of older vehicles with diesel particulate filters (DPFs) and the replacement and investment in vehicle fleets that use electric and sustainable fuel and the reduction of vehicles in the public sector fleet are some of the measures that the public sector can adopt to reduce vehicle emission and contribute to improving air quality in their localities. Additionally,

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it is important for the public sector to have a timeline for cleaning up the municipal fleet.

### **5.1. Retrofitting of old vehicles with clean air technologies Berlin**

According to the Sootfree Cities report (2015), the City of Berlin has adopted the policy for using clean air technology and has codified this in an administrative regulation in 2012. So far, the bus fleet in Berlin is completely equipped with diesel particulate filters for 10 years already. It was also intended that 100 buses with Euro III standard be retrofitted with NO<sub>2</sub>-reducing Selective Catalytic Reduction (SCR) filter systems in 2013. It was also planned that busses will be completely modernised to Enhanced Environmentally Friendly Vehicle (EEV) standard, and procurement of new busses will be tendered with Euro VI requirements where possible.

Other municipal vehicles have also adopted cleaner technology with as many as 25% of the city's cleaning vehicles are fueled by gas and 400 new utility vehicles (garbage, power sweepers etc.) using SCR systems or hybrid engines to comply with the best environmental standards.

Overall, the proportion of diesel vehicles that are equipped with particulate filters or have a Euro V/EEV standard has increased from 25% in 2008 to as many 50-100% at the time of reporting.

### **5.2. Copenhagen's vehicle fleet**

The City of Copenhagen has required that all vehicles within the municipal fleet will comply with the city's LEZ.

Through its extensive climate plan, the city intends to become the world's first carbon neutral capital. In order to achieve this goal it plans to make public transit carbon neutral and 20%-30% of all light-duty vehicles and 30%-40% of heavy-duty vehicles using alternative fuels. The city's transition toward sustainable mobility is supported by the provision of free and designated

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parking, developments in charging infrastructure, and the purchase of only electric or hydrogen powered vehicles for municipality use, and electrification of public transit.

It is reported in recent article in the State of Green.com website, that the City authority has acquired 255 electric vehicles (EV) in spring 2017 (<https://stateofgreen.com/en/profiles/city-of-copenhagen/solutions/more-electric-vehicles-in-copenhagen>). With this development, it has attained its goal that 85% of the municipality's own vehicles are electric, hydrogen or hybrid powered. It is a key target in the city's climate plan, that all vehicles in the fleet will achieve a complete transformation to electricity, hydrogen or biofuels.

The Table below that follows presents summary of actions and incentives to encourage and support the use of electric vehicles in the Copenhagen Metropolitan area.

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Table 8. Support for use of electric vehicle support in the Copenhagen metropolitan area

Type of Program	Description
Financial Incentives	Federal Incentives include: Exemption from vehicle registration taxes (up to 180%) until 2016; partial exemption until 2020 Exemption from annual car tax Tax refunds on electricity used to charge electric vehicles
Non-financial incentives	Designated free parking
Charging infrastructure	Total of 850 charge points and 60 fast charge points By 2025: 500-1,000 public charging stations and 5,000 restricted public access charging stations
Research and campaigns	“Meet the electric vehicle” – 12-day trial for businesses to test electric vehicles “Rent an electric vehicle” – employees of companies in Copenhagen can rent electric vehicles for two weeks to assess their practicality Financial subsidies for builders and tradesman purchasing electric vans in return for their experiences “Vehicle X” – using electric vehicles to charge and operate tools and equipment Two electric buses at the Copenhagen Airport to gain practical experience with electric buses
Transit and Fleets	More than 20,000 electric bikes sold in 2014 DriveNow – car sharing service with a fleet of 400 BMW i3's Entire bus fleet to be replaced by electric buses starting in 2019 Municipality only purchasing zero emission vehicles starting in 2011 85% of government vehicles must be zero emission by 2015
Charge point data from E.ON (2016) and Clever (2016) as of October 31, 2016; may not include some smaller charging networks	

### 5.3. Zurich standards for new vehicles

To help lower PM10 and NOx emissions from transport, the City introduced regulations that require the strictest Euro standards for new vehicles. From 2009, all new vehicles were required to meet Euro 5 requirements, making particle filters mandatory (motorcycles Euro 3). At the end of 2010, all existing vehicles were required to be retrofitted with particulate filters. With the implementation of Euro 6 regulations in 2015, particle limits for buses and lorries are reduced to make particle filters mandatory for these vehicles.

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It was also planned to convert the diesel bus fleet to electric trolley busses where possible and the procurement of new diesel busses will need to ensure these comply Euro V "Enhanced Environmentally Friendly Vehicle" standard.

More recent reports state that the City is working to incorporate increasing usage of electric vehicles in its sustainability plans. Like Copenhagen, Zurich accounts for the highest electric vehicle sales in the country.

The energy supply company EKZ has played a major role in promoting electric mobility in the region and has worked to maximize the environmental benefits of electric vehicles by linking charging with renewable energy.

The Table below provides as summary of various actions and incentives to encourage and support the use of electric vehicle in Zurich.



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Table 9. Summary actions and incentives to support use of electric vehicles in the Zürich metropolitan area

Type of Program	Description
Financial Incentives	Exemption (for BEVs) and 80% reduction (for PHEVs) from vehicle taxes in Canton of Zürich
Nonfinancial incentives	
Charging infrastructure	Total of 190, 12 fast charge points National charging station registry LEMnet Utility EKZ operates fast charging stations in city powered by renewable energy
Research and campaigns	Utility EKZ partnering with IBM to research charging and consumer outreach practices Research on electric vehicle powertrains, purchasing behaviour at ETH Zürich EKZ Ökostrom-Vignette program guarantees green power for all electric vehicle driving
Transit and Fleets	Ongoing electrification of taxi fleet through private-sector initiatives eMotion Zürich electric car-sharing trial. Replacing diesel buses with electric trolleybuses
Charge point data from E.ON (2016) and Clever (2016) as of October 31, 2016; may not include some smaller charging networks	

Technology platforms: All electric or battery-electric vehicle (**BEVs**) and plug-in hybrid electric vehicles (**PHEVs**).

### 5.4. Stockholm Electrification of fleet

It is reported in the Sootfree City report (2015) that the city of Stockholm vehicle fleet consists of 100% alternative fuel vehicles where this is possible. Additionally, the City also has an intensive programme for greening its vehicle fleet. Its public procurement targets in 2016 specify that, 75% of its bus fleet will be powered by renewable fuels and will increase to 90% by 2021. The city authority plans that by 2025, the vehicle fleet will be free of fossil fuel.

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The City also actively promotes the use of electric vehicles in its municipal fleet and provides a range of incentive and support to encourage the public to use electric vehicles. The City has ambitions of becoming the world's leading clean vehicle city and intends to have fossil-free vehicle by 2030, with electric vehicles playing an important role in the transformation. Hall (2017) reports that Stockholm has seen higher electric vehicle sales compared to average sales figures for Europe and Sweden. This is attributed mainly to financial incentives offered to replace old, high-polluting vehicles, as well as free parking.

To encourage use of electric vehicles, the City has collaborated with various organizations including the utility Vattenfall to transform public and company fleets and to provide public charging stations using clean energy. The City also awards electric vehicles free parking permits in the city center, which normally cost 5000 kroner (more than \$560) per year.

### **6. Use of economic incentives or disincentives**

Some cities have adopted measures to restrict the number of vehicles entering a specified area to reduce traffic volume and improve environmental conditions including air quality. This measure is often put in place to reduce congestion and considers the environmental improvement outcomes as a co-benefit. Asian cities such as Singapore and Seoul have led in restricting the use of private vehicles to mitigate or reduce congestion and the environmental impacts of urban transport. Some cities in Europe, use a combination of congestion charging and environmental restrictions wherein the usage of cars is restricted in accordance the level of atmospheric pollution.

#### **6.1. Stockholm Congestion Charging**

The Stockholm congestion charge is a traffic congestion and environmental tax that has been imposed on the majority of vehicles in Stockholm. It is the

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second of its kind to be introduced in Europe following the London Congestion Charge.

The Stockholm congestion charge was first introduced as a trial between January and July 2006. A referendum was held on the future of the congestion charge in September 2006 with majority of the residents of Stockholm municipality voting yes. In 2007, the Swedish government approved the permanent introduction of a congestion charge in Stockholm. It was reported that the income from the reintroduced congestion charges in Stockholm were to be to partly finance a new bypass road, 'Förbifart Stockholm'

### *Who pays the charge*

All vehicles registered in Sweden or abroad are required to pay the congestion tax in Stockholm. The tax applies to cars, lorries and buses. There are exemptions to the charge for emergency vehicles, buses, diplomatic vehicles, disabled persons vehicles, military vehicles, hybrid or electric cars, motorcycles and mopeds. A number of locations such as motorway sections that pass through the affected area when travelling past central Stockholm are also exempted from charging.

### *Congestion Charge*

The charge are referred to as congestion tax. This charge apply to vehicles that pass a control point. The amount charged varies depending on the time of day that the driver enters or exits the congestion tax area. Generally, the cost is higher during periods when traffic is at its heaviest. The maximum amount that a vehicle can be charged per day in the Stockholm area is SEK105 (£9.35 or 10.54 Euros).

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Table 10. Congestion Tax for Stockholm and Gothenburg

Time	Tax for Central Stockholm	Tax for Essingleden
06:30-06:59	SEK 15	SEK 15
07:00-07:29	SEK 25	SEK 22
07:30-08:29	SEK 35	SEK 30
08:30-08:59	SEK 25	SEK 22
09:00-09:29	SEK 15	SEK 15
09:30-14:59	SEK 11	SEK 11
15:00-15:29	SEK 15	SEK 15
15:30-15:59	SEK 25	SEK 22
16:00-17:29	SEK 35	SEK 30
17:30-17:59	SEK 25	SEK 22
18:00-18:29	SEK 15	SEK 15

The charges do not apply Saturdays, Sundays, public holidays or the day before public holidays, in the month of July, nor during the night time period (18:30 - 06:29).

There are 18 unmanned electronic control points at all entrances to the congestion charging this area. Unlike other congestion charging schemes, in Stockholm, the congestion tax is charged to vehicles on both entry and exit of the affected area.

The payment gates are equipped with number plate recognition cameras to record the identity of vehicles passing through. Vehicles do not need to stop and pay at control stations. The vehicles passing the control points are identified through Automatic Number Plate Recognition (ANPR). There are no payment booths at each control point. The Swedish Transport Agency sends a payment slip to the owner of the vehicle if the vehicle is registered in Sweden. In cases where a vehicle is registered abroad, EPASS 24 is authorised by the Swedish transport Agency, to identify owner of vehicle, send invoices and obtain payments.

The bill must be paid at the end of the next month. The vehicle owner is responsible for payment of tax even if the bill does not arrive. The charges

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maybe paid directly via a website, over the telephone by credit card or alternatively at selected convenience stores in the City. The failure to pay the tax within the allotted time could incur an additional SEK500 fee.

### *Impact on use of green vehicles*

It was intended that the exemptions for alternative fuel cars from the charging would be an effective stimulus towards the adoption of these types of vehicle. The research report published by Stockholm Centre for Transport Studies in 2014, have confirmed the success in this area. Following the introduction of the measure, the share of alternative-fuel cars increased from 3% in 2006 to 15% in 2009. The same report also referred to several studies that had made the same conclusions. The exemption for alternative fuel cars was later abolished for vehicles sold from 2009 with the argument that it had filled its role as a facilitator for market introduction.

### *Impact on traffic*

The report cited above also stated that the introduction of the congestion tax during the trial period in January 2006, had a substantial effect on car traffic from day one. A few weeks following the introduction of the charge, the traffic reduction stabilised to around 22% during the charged period. Although there were some doubts as to whether the traffic reduction would actually take place, especially since the trial was only seven months long, but effects turned out to be immediate and persistent.

At the end of the trial period in July 31 2006 when the charges were abolished, traffic volumes immediately rebounded to almost the same level as before the charges. However the trial period had some residual effect between the end of the trial and the reintroduction of the charges wherein traffic volumes remained 5-10% lower than in 2005.

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The reports suggests a hypothesis that some car users developed new travel habits during the trial that persisted even after the charges were abolished. With the reintroduction in August 2007, traffic levels declined to the same level as during the trial period in 2006. Since then, traffic levels have remained roughly constant, despite inflation, economic growth, growing population and an increasing car fleet.

Table 11. Traffic reduction across cordon compared to 2005 traffic levels (charged weekdays Monday – Friday, 06:00- 19:00)

A	2006a	2007b	2008	2009	2010	2011	2012	2013
Traffic Reduction	- 21.0%	- 18.7%	- 18.1%	- 18.2%	- 18.7%	- 20.5%	- 21.4%	- 22.1%

### *Impact on travel times*

The report also stated that the charging had a dramatic impact in reducing congestion. The reduction in congestion has meant an increase in the reliability of travel time. Tangible improvements were felt by the public and these were not only limited to the inner city areas but have also significantly impacted in areas where there spillback queues.

It was observed that the travel times for vehicle traffic declined substantially inside and close to the inner city. There was also significant reduction in delay times on arterial roads. This fell by one-third during the morning peak period and by half during the afternoon/evening peak period. The overall impact was considerably improved reliability of travel times with travelers being more certain about the duration of a car trip.

### *Environmental effects*

As a result of reduction in traffic, emissions were reduced. The largest reduction was in the inner city, between 10%-15% across different types of emissions. Since the area covered by congestion charging is the most densely populated area, this has an important effect from a health point of view.

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Overall, the results reveal that air quality improved in many streets in the inner city. Carbon dioxide emissions from traffic in the whole metropolitan area (the county of Stockholm) decreased by 2-3 per cent. One of the goals for the trial was to “improve the perceived urban environment”. The report also cited several studies that confirmed citizens’ (including, car drivers, children and cyclists) perceived improvements in traffic movement and density as well as air quality within the inner city area.

### *Retail effects*

Although concerns and fears were raised regarding the impact of congestion charging to the retail market, these were proven to be unfounded. The Centre for Transport Studies Stockholm 2014 report cited various research (Daunfeldt, Rudholm, & Rämme, 2009) which found that “studies of the retail markets were not able to show any effects of the congestion charges” and “during the Stockholm Trial period showed that these developed at the same rate as the rest of the country”.

Fear of adverse impact of the charging scheme on retail is common in many cities. The report also cited that large efforts were made in Stockholm to track possible adverse impact of congestion charging, only to conclude that they were very small or non-existent. Furthermore, the report also cites that similar conclusions have been reached in other cities with congestion charges.

### *Impact on public transport*

The Stockholm trial did not only involve the introduction of the congestion charges but was simultaneously complemented by an extension of public transit services. The report by Kottenhoff & Brundell Freij (2009) cited that the transit services were extended partly to meet increased demand for public transport, and partly by a political will to show “carrots” and not just “sticks”.

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Drivers switching from car to public transport meant that the number of passengers in the transit system increased by around 4-5%. The number of standing passengers, increased in the Metro (crowding as a measure in the public transport system) but decreased in the commuter trains, most likely due to expanded public transport capacity.

Reduced road congestion in and around the inner city led to increased speeds and punctuality for bus services. Bus traffic across the charge cordon – experienced considerably shorter travel times.

### *Change in attitude*

It is generally recognised that the main obstacle for congestion charging is often the lack of public acceptability. According to the Centre for Transport Studies in Stockholm, the city's experience demonstrates “the most remarkable and interesting development” with regards to the “change in attitudes, from fiercely hostile to overwhelmingly positive” and shows how support for the congestion charging has evolved over time.

The specific details of research undertaken measuring the level of support for introduction of congestion charging is described in detail in the Centre for Transport Studies report (2014), CTS Working Paper 2014:7. The report cited that during the introduction of the idea in spring of 2004, 43% of Stockholm residents stated that they would probably or most likely vote yes to permanent congestion charges. In the period approaching the trial in 2005, support has fallen to 34% from those who were “most likely to say yes”. However, once the trial has started in 2006, the support increased to 53%.

The report also stated that the views or representations by media also changed once charges were in place, from initially intensely critical to, in many cases, very positive. The percentage of trial-related newspaper articles with a positive angle increased from 3% in the autumn of 2005 to 42 % in the spring



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of 2006, while the share of negative newspaper articles was almost halved from 39% to 22% (Winslott-Hiselius et al., 2009).

Although there was some initial opposition to the permanent introduction of congestion charging, the political decision to use the revenue as part of transport investment package has to the change in the public's views on the initiative. Since the permanent introduction of the package in 2007, support has increased from 53% during the trial period in 2006, to 67% in December 2007. Succeeding polls in the following years have shown similar or higher support. The results of a poll conducted in 2013, showed support of 72%.

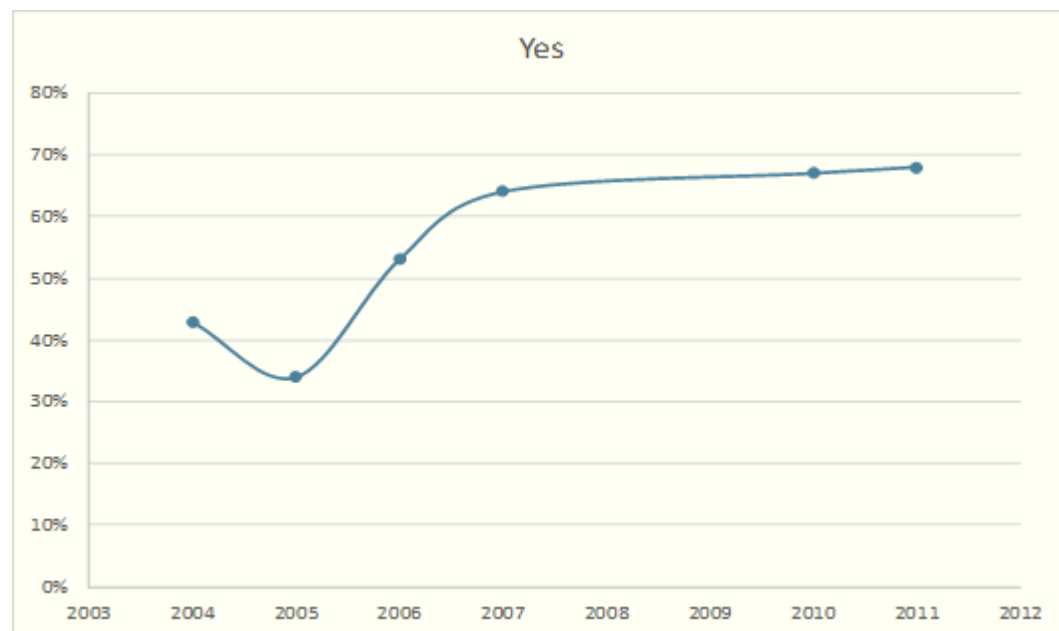


Figure 1. Respondents who would vote "Yes" in referendum on congestion charging

Source: Adapted from Centre for Transport Studies CTS Working Paper 2014:7

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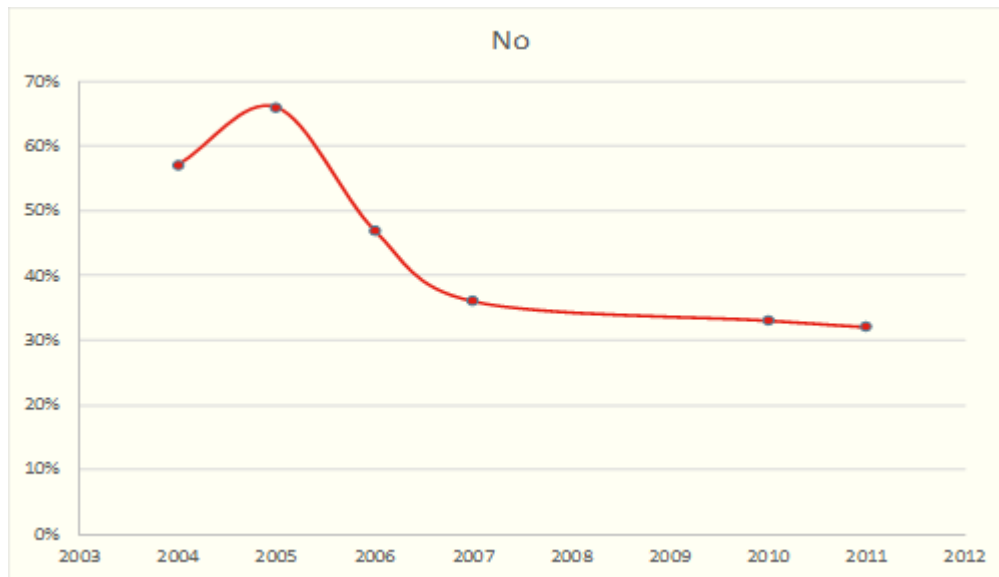


Figure 2. Respondents who would have voted No and not supported the congestion scheme

Source: Centre for Transport Studies, Stockholm, CTS Working Paper 2014:7

The results of the research examining views of various citizen groups i.e. those who have no cars, car owners who never or seldom pays, car owners who sometimes, pays, who may or may not directly affected by the congestion charge show a similar pattern as with the views of other stakeholders.

These findings suggests that the change in attitude or support to congestion charging not only driven by the amount of tolls but is “is at least partly driven by other factors than self-interest variables such as tolls paid and time gains.”

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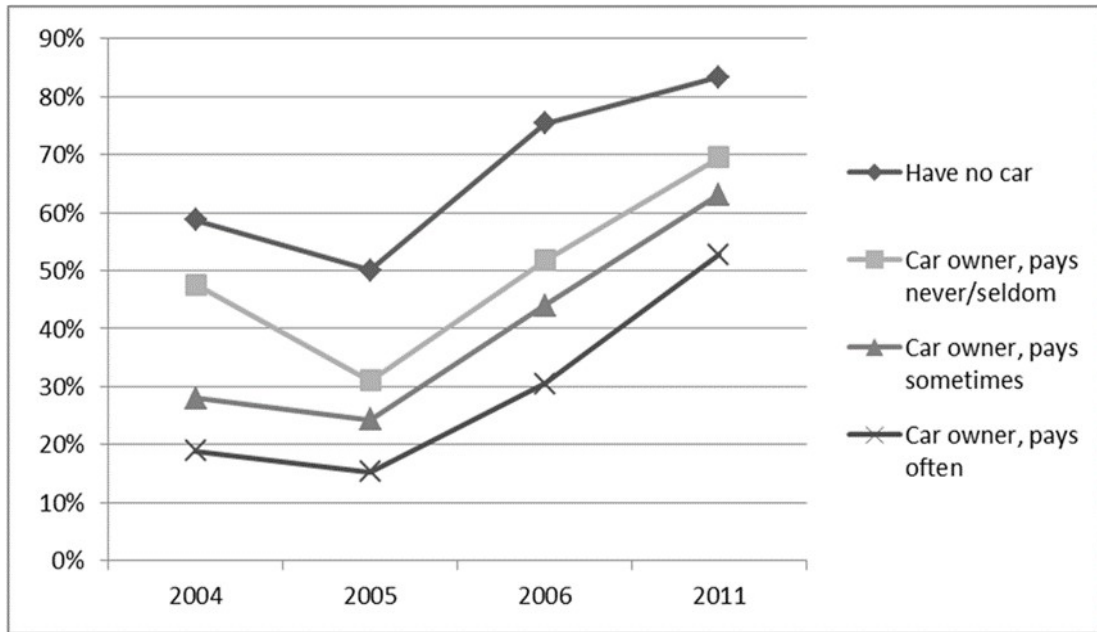


Figure 2. Support for congestion charges depending on car ownership and paid charges.

Source: Centre for Transport Studies, Stockholm, CTS Working Paper 2014:7

The Chart above show that the changes in attitude over time for each group look very similar, regardless of how much they are affected by the changes in terms of travel costs and travel times. By 2011, the views of all of the groups surveyed showed that this has changed to favour of the charges.

The development and changes in of attitudes to congestion charging is remarkably close to the general pattern described in Goodwin (2006) that was cited in the same report.

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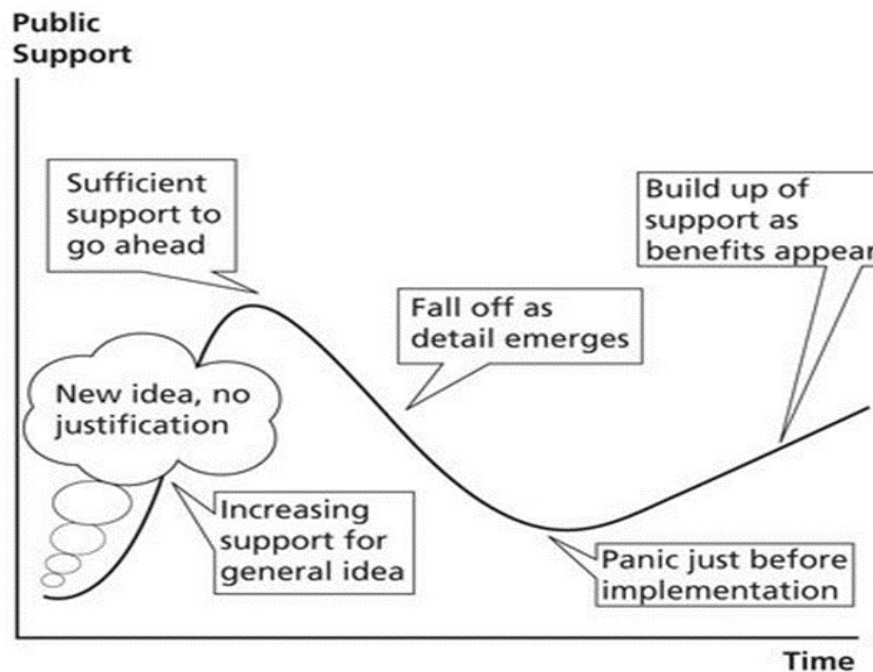


Figure 3. "The gestation process for road pricing schemes" – reproduced from (Goodwin, 2006).

The work Goodwin (2006) explains that once the idea has been introduced and explained, a large fraction of the population is generally willing to support the idea of congestion pricing. How large this fraction is depends on how the question is formulated and framed – for example, revenue use, the purpose of the charges and what policy alternatives it is contrasted against all matter. But once a detailed proposal is worked out, support generally decreases. There may be several reasons for this – for example, that the disadvantages suddenly become more evident than the potential advantages, or fears that the technical system will not work or become very expensive. This is sometimes summarised in the formula "acceptability decreases with detail". But once the system is in place, support will generally increase, which is often summarised as "familiarity breeds acceptability". There are probably several reasons for acceptability to increase once a system is in place and key to this in Stockholm is the use of revenue generated from the scheme.

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### **6.2. London Congestion Charge**

In 2003, London became the first city in the world to introduce congestion charging over a significant part of its central area. The congestion charge is a daily charge for driving a vehicle within the charging zone. This aims to reduce congestion within a specified area of central London. It is intended to encourage motorists to use other modes of transport and has helped London become the only major city in the world to see a shift from private car use to public transport, walking and cycling.

The daily congestion charge tariff is £11.50. This daily charge allows motorists to drive around, leave and re-enter the charging zone as many times as required in one day. The charge is in operation Monday to Friday 07:00-18:00 and does not apply at weekends, Bank Holidays, public holidays or the period between Christmas Day and New Year's Day, when traffic levels are lighter.

The daily charge can be paid before or on the day of travel, by telephone, text message, online, and by post. Drivers have up to midnight on the day of travel to pay the £11.50 charge. If paying on the next charging day after travelling in the zone, the charge is £14.00. The charge can also be paid via an automated payment system for a discounted daily rate of £10.50. Drivers or vehicle operators who have not paid the charge by midnight on the next charging day after they travel in the zone, will be issued with a Penalty Charge Notice (PCN). The penalty charge is £130 but is reduced to £65 if paid within 14 days.

The congestion charging zone includes the areas of Victoria, St. James's, Waterloo, Borough, City of London, Clerkenwell, Finsbury, Holborn, Bloomsbury, Soho, Mayfair and parts of Marylebone. There is no charge for driving on the boundary roads around the zone.

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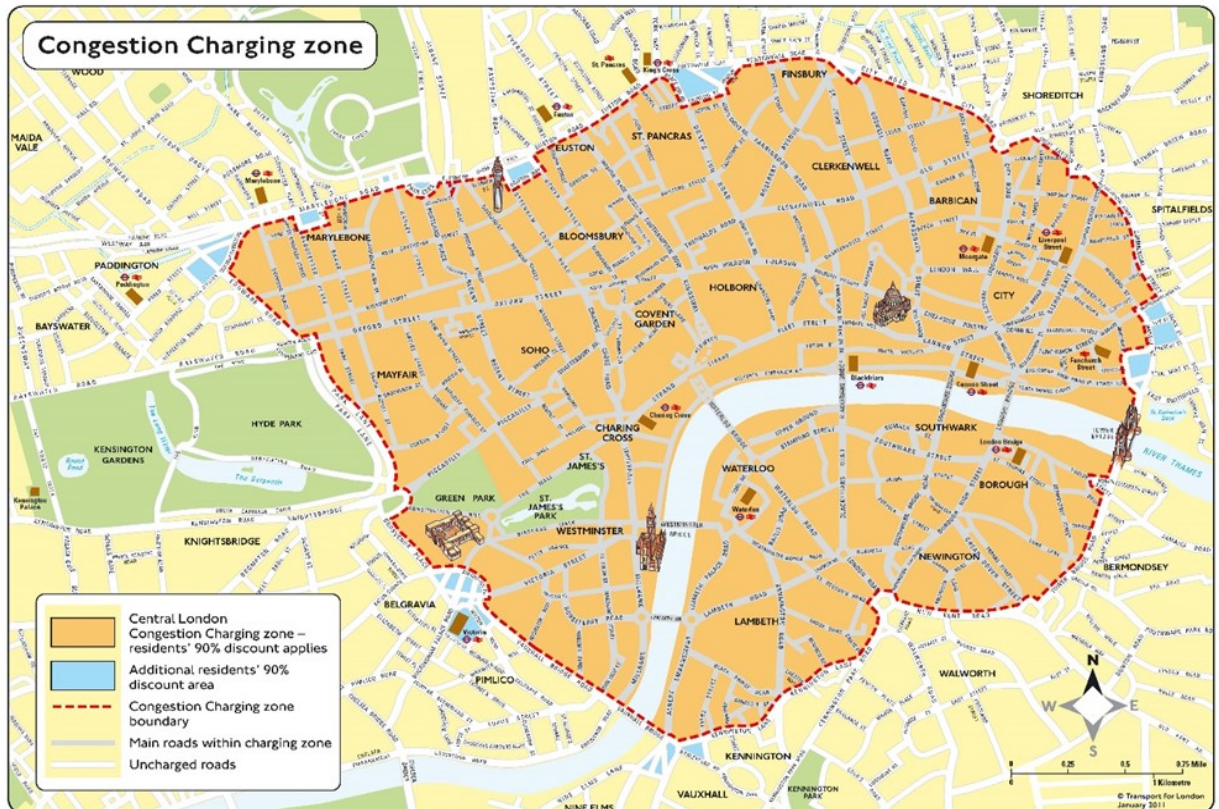


Figure 4. Central London Congestion Charging Zone  
Source: Transport for London webpage

There are no barriers or tollbooths in the congestion charging area. Instead, there are 197 camera sites which monitor every single lane of traffic at both exit and entry points to the charging zone. All cameras have an integrated Automatic Number Plate Recognition (ANPR) computer system. Drivers or operators must register their Vehicle Registration Number (VRN) on a database and pay the daily charge. The cameras read the number plate as the vehicle enters, leave or drive within the charging zone. This information is checked against the database for those who have paid the charge, those who have registered for Fleet or Congestion Charging Auto Pay or those who do not have to pay the charge because they are either exempt or registered for a 100% discount. Once the VRN has been matched, the photographic images of your vehicle are automatically wiped off the database. For VRNs that have been registered for Fleet or Congestion Charging Auto Pay, the photographic images are retained until the account has been settled.

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There are exemptions and discounts available to certain categories of vehicles and individuals. London licensed taxis and private hire vehicles, motorcycles, bicycles and vehicles with nine or more seats that are licensed with the DVLA as buses are automatically exempt from congestion charges. People who reside in the congestion charging zone are eligible to register for a 90% discount, which means they would pay a minimum of £5.75 for five consecutive charging days. Blue Badge holders are eligible to register for a 100% discount and so pay no daily charge. Businesses and other organisations operating a fleet of at least 6 vehicles, including cars, can register for the Congestion Charging Fleet Scheme and pay £10.50 per day per vehicle.

### *Usage of revenue*

It is required by law that the net revenue from the London Congestion Charge must be spent on further improvements to transport across London.

### Revenues from Congestion Charging scheme

Table 12. Cost and Revenues of the London Congestion Charge

Financial year	2004/5	2005/6	2006/7	2007/8
Charges	117	145	158	195
Enforcement	72	65	55	73
Income				
Total Revenues	190	210	213	268
Total Operating costs	(92)	(88)	(90)	(131)
Net Revenues	97	122	123	137
Net revenues invested in Bus network	80%	82%	82%	82%

Table 12 above shows the revenues generated from the implementation of the London Congestion Charging over a period of 4 years from the second year of its operation. The figures show an increase in revenue over time while yearly

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costs remain fairly similar (except for 2007/8). The increase in cost was due to the extension of the charging zone. The results also show increasing net revenues that are available for investment in improving the bus network and transport system.

It is important to note that the revenue generated from the congestion charging scheme is an important factor as one of the main objectives of the scheme is to raise money for investment in the transport system (hypothecation). According to Gavoni (2010), the net revenues from the congestion charging scheme contributes about 5% to the total budget spending on transport services for London. The TfL budget dedicated to bus services is £667m in 2004 which make the contributions of the congestion charging (\$97m) quite a significant proportion (approximately 15%).

It is worth noting from the data shown in Table 12 above that the operating cost for the congestion charging accounts for more than 40% of the total revenues (in the range of 42% - 49%).

The same report has raised that “it is not clear that congestion charging is the best way to raise this amount of money for investment in the transport system especially given the high initial investment that was required”. The scale of investment is an important factor when considering the operating costs and revenues that are generated by the scheme. Gavoni (2010) stated that TfL gave no official information on the initial cost required to introduce the scheme, although some estimates are given in the literature. Santos (2008) quotes an estimate provided by TfL of £200 million (at 2002 prices), and notes that most of it was provided by the central government, while Metz (2008) suggests implementation costs of £162m for the original scheme.



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### *Public and political response*

As with the experience in Stockholm, the plan to introduce the congestion charging scheme was widely criticised by various groups including politicians, motorist groups, labour organisations and the media.

Litman (2011) reported that since its introduction, the scheme has been generally accepted by the public and by various interest groups including many who have criticised it. Gavoni (2010) cited in his report that “earmarking the congestion charging proceeds to public transport might have increased its public acceptability (as it provides for better alternatives to the one that is penalized)”.

Gavoni’s (2010) report also cited that a survey of the London First business group following the introduction of the scheme have shown that its members consider the scheme to have positive overall impacts on business activity . The majority (69%) felt charging had no impact on their business, 22% reported positive impacts on their business, and only 9% reported an overall negative impact. Many industries support the charge because its direct costs are offset by savings and benefits, such as faster delivery times.

Other businesses however have criticised the scheme e.g. small retailers and bulk goods retailers who rely on customers who drive cars. The same report also cited various studies and surveys which found that congestion charging had minimal overall impact on economic productivity and activity, although some sectors and businesses are affected more than others, either positively or negatively.

### *Effect on levels of traffic and congestion*

The report by Litman (2011) summarised some of the impacts of the introduction of congestion charging in London. Prior to the introduction of the scheme, 12% of the peak period trips were made by private automobile. During the programs first few months, automobile traffic declined about 20%

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(a reduction of about 20,000 vehicles per day), resulting in a 10% automobile mode share.

The report by Gavoni (2010) however challenges the conclusions around the impact of the scheme to road congestion. His report supports other findings on the immediate impact that CC had on the levels of traffic and congestion. However, his report cited that two years later traffic levels were starting to increase (after declining for several years) and congestion increased later. Similar immediate effect was apparent in the Stockholm CC trial (in Eliasson, Hultkrantz, Nerhagen and Smidfelt Rosqvist, 2009). He concludes that the long term effect of congestion charging on traffic levels and congestion is still not clear.

More research need to be undertaken to establish reasons for the decrease in traffic in big urban centres . Gavoni (2010) also cited evidence in Birmingham, the second largest city in the UK where congestion charging was not implemented, where the data shows that the number of people entering Birmingham city centre by car in the morning peak has fallen by 32% in 2007 compared to 1995. In the same period, the use of public transport increased and the share of public transport rose from 42% in 1995 to 56.4% in 2007.

### *Effect on public transport use*

Litman (2011) also reported that people changed their travel pattern due to the charge and have made more use of the bus as public transport. The number people using the busses had increased by 14% and those using the underground by 1%. Some motorist have shifted route while others shifted their mode of transport by using taxis, motorcycles, pedal bikes or have shifted to walking.

Gavoni's (2010) report acknowledges that a sharp increase in the use of bus transport but however questions this 'success' as a result of the introduction of the congestion charging scheme. His report states that there is no evidence to

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suggest that congestion charging was an important contributor to this increase, not even indirectly by improving the speed and reliability of bus services.

The change that needs to be noted according to Gavoni (2010), was the increase in the level of service, the reduction in fares and other improvements to bus services that was made possible by the funds from congestion charging. The revenue has contributed a significant part to the budget for bus transport in London. The increase in bus use in central London is important to note as it demonstrates that improving services will increase ridership. Congestion charging has made this possible by providing the funds for improving services.

Litman (2011) highlights the impact of the scheme on traffic speeds. His reports stated that as a result of the introduction of the scheme there was significant increase in traffic speeds within the zones. During the charging days traffic speeds increased by 37%, from 8 miles per hour prior to the scheme, to 11 miles per hour after the introduction of the scheme.

The delays because of peak period congestion declined by 30% and bus congestion delays has declined by 50%.

The cost of travelling by taxi also declined significantly by 20-40% due to reduced delays. Vehicles cover more miles per hour, so that taxis and bus service productivity (riders per day) and efficiency (cost per passenger miles) increased substantially. The usage of motorcycles, mopeds and bicycles have also increased.

### *Traffic and spill over impacts*

The evaluation report also cited that there were concerns that congestion may increase on nearby roads due to diverted traffic. Although some diversion occurred, the effect appears to be too small to measure. There is 10% more traffic on the peripheral roads, journey times on them have not increased, in

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part because traffic signal systems on these roads were adjusted in anticipation of these traffic shifts.

### *Effectiveness of the scheme*

According to Litman (2011), congestion charging system in London effective. As of the time of reporting, many as 110,000 motorists in London a day pay the congestion charge (98,000 individual drivers and 12,000 fleet vehicles).

However, he believes that the charging system is not optimal because:

The fee is not based on how many miles a vehicle is driven within the charging area. Once paid the fee once can drive limitless in the charging area.

The fee is not time-variable, i.e. the fee is not higher during the most congested periods and lower during less congested periods.

The fee does not vary by location. It would be more efficient to have higher rates on more congested roads.

The scheme is also widely criticised due to the high overhead costs of the system. More than 40% of London's congestion pricing revenues are used to cover pricing administration costs – but unit costs decline as systems expand so costs are distributed over more vehicle travel. Hence, the implementation for large metropolitan cities is more cost efficient than for smaller cities.

It is reported that the City of London significantly underestimated the costs of the congestion charging scheme. The costs were nearly double as high as expected. This was mainly due to higher costs of enforcement than expected. At the same time, revenue was considerably less than projected. The success in reducing the number of vehicles was higher than expected and was a set back from a revenue point of view. The share of low emission vehicles have

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increased resulting to a higher number of exempted cars and thus a cut in revenue.

### **6.3. Milan Congestion charging case study**

Milan created a combined Low Emission Zone (LEZ) and congestion charging zone called Area C. This area is controlled through surveillance cameras at its 43 access points. From 2017, hybrid vehicles, methane-powered, LPG and bi-fuel vehicles will also be subjected to the charge. Daily charges range from €2.00 for residents to €5.00 for external or service vehicles. Some car parks offer combined tickets for accessing and parking in Area C. Violation fines differ in winter and summer time and range between €75.00 and €450.00. About 800,000 violations were detected in 2013. In 2012 and 2013, the total revenue of 29 million euros were reinvested in sustainable mobility (e.g. frequency improvements for public transport, the bike-sharing scheme) and in IT maintenance.

### **6.4. Congestion charging in Singapore**

In Singapore, the implementation of road pricing and Area License Schemes has resulted in less pollution and less congestion. This scheme has been in place since 1975 and requires vehicles to have a special license to operate within specific areas.

In the past, to enter the restricted area, drivers had to purchase a paper license (US \$2.20 daily or US \$43 monthly). A major disadvantage of the paper-based area licensing scheme was that once the license was bought, the vehicle could enter the area as often as desired and was not charged a higher fee when the roads were congested

To address this problem, scheme was replaced by Electronic Road Pricing (ERP) in September 1998. It was designed to minimise traffic congestion and maintain optimal traffic speeds of 45 to 65 km/h for expressways and 20 to 30

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km/h for arterial roads. The system introduced electronic toll collection, electronic detection, and video surveillance technology. The charging area is divided into central business districts (cordon pricing), and expressways and ring roads (congestion pricing). The in-vehicle unit communicates with detectors when passing under gantries and the respective charge is deducted from the driver's cash card. The amount varies by time of day (rush hour is 2-3 times more expensive), type and size of vehicle (taxis and passenger cars according to engine capacity, goods vehicles and buses and others) and the type of road (arterial and expressways). The cash card can also be used to enter parking facilities without having to stop.

The success of the scheme in Singapore was due to high public acceptance and strong enforcement in Singapore. The ERP is considered fair as it charges on the basis of the user-pays principle while vehicle tax rates have been lowered. It was considered convenient because of its high technological standards.

### **6.5. Vehicle quota in Singapore**

Singapore has also successfully used auctions to limit the total number of vehicles registered in the city. The Land Transport Authority (LTA) determines the quota for each vehicle category every year. To register a new car everyone must go through a bidding process and, if successful, a Certificate of Entitlement is obtained. The fees charged often exceed the value of most cars, essentially doubling vehicle purchase costs. This scheme is successful because Singapore has very high quality public transit and taxi services, so that few residents would need a personal automobile. Some other Asian cities (including Delhi, India and Hanoi, Vietnam) are considering increasing vehicle purchase and registration fees, primarily as a way to generate funding for public transit improvements.

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### **6.6. Vehicle Number Plate Restrictions**

Vehicles are restricted to drive in an area based on the registration plate. The aim is to reduce private vehicles in use. This measure generally aims to reduce congestion within a specified geographical area. The restrictions can be limited to certain vehicle types, to days or areas. A key advantage of this measure is that implementation is not very costly and usually easy to enforce. The short-term effect on traffic reduction can be significant. The number plate restrictions are often undermined by an increase in car ownership wherein households register a second car in order to avoid restrictions. Some of the counter measures to prevent ownership of a second car include limiting vehicle restriction to peak hours and banning vehicles with several different, rotating numbers on the number plate from driving.

### **7. Parking management and pricing**

Parking in many cities has become a problem. Inefficient management of parking would often lead to further issues such as parking congestion and causing motorists to cruise for available parking spaces, which increases urban traffic congestion and air pollution.

Studies have also shown that abundant, subsidized parking encourages increased automobile ownership and use, which exacerbates other transportation problems, including traffic congestion, accidents, energy consumption and pollution emissions.

Parking management can be an effective travel reduction strategy, it can also be an effective emission reduction strategy. Emission reductions are generally proportionate to vehicle travel reductions. Efficient parking management that reduces the amount of land needed for parking facilities can provide additional emission reductions by reducing sprawl and heat island effects (additional solar heat gain from pavement).

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The following section will provide a summary of innovative parking management approaches that has been implemented in various cities in the UK and in Europe and America

### *UK Parking management experience*

A Parliamentary Select Committee report on *Parking Policy and Enforcement 2014*, stated that parking management is an important transport policy tool that local authorities can use to effectively manage traffic levels in specific areas. Parking charges is seen as an important tool in the absence of other measures, such as congestion charging.

#### **7.1. Parking charges and reducing CO<sub>2</sub> emissions**

Some local authorities have use parking charges to pursue their objectives, in terms of CO<sub>2</sub> reduction. Richmond upon Thames Borough Council charges residents for parking permits according to the CO<sub>2</sub> emissions of the vehicle. The Council is considering extending this principle to charges at parking meters and in car parks. Edinburgh City Council has proposed to introduce a similar CO<sub>2</sub>-related charge for residents parking permits.

This approach to charging has been criticised as unjustified, ineffective in terms of CO<sub>2</sub> emissions and regarded as undermining green taxes in general. Norwich City Council, on the other hand, charges based on the length of the car. The AA criticizes these charges for unfairly "surcharging" owners of larger engine cars—regardless of use. AA believes that such schemes are detrimental to the relationships between the motorist and the local charging authority.

#### **7.2. Nottingham' Work-place Parking Levy': using parking charges for green infrastructure investment**

Nottingham City Council adopted a radical and innovative scheme to ease congestion in the city and generate significant revenue to finance



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improvements in transport infrastructure and air quality. The Work-place Parking Levy (WPL) scheme was introduced in 2012 by the Council as a charge on those employers who provide workplace parking to its employees. The scheme is a congestion charge aimed easing traffic congestion thus improving air quality and promote sustainable transport choices. The Council believes that this scheme will serve as an incentive for employers to manage their workplace parking provision and will encourage commuters to use public transport on their journey to work. Additionally, it is also intended that the revenue will provide ring fenced funding for major transport infrastructure initiatives in the City.

### *Work Place Parking (WPL): Legislative Basis*

The provisions under the Transport Act of 2000 (Sections 178-200) serves as the legislation that enables local authorities to impose a charge for every parking space provided by the employer at the place of work. Under this Act local authorities in England and Wales that are outside of London may introduce a work place parking scheme and it is for the local authorities to decide whether or not they will introduce the scheme.

According to the Act, the levy is to be collected via a licensing scheme. Liable employers will need to apply to their local authority for a license to park a specified number of units ("licensed units) within their premises and will be required to pay a total sum based on a per unit charge. The local authority can adopt variations on how charging for the scheme can be implemented. The possible variations are summarized in the "House of Commons Standard Note SN628 as follows:

"A licensing scheme could allow for variations in the charges according to different days or times of day, different parts of the licensing area, different classes of motor vehicles or different numbers of licensed units, depending on local circumstances. For example, an authority would be able to choose to apply the levy to parking during normal office hours on weekdays, to charge

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different rates for two-wheeled vehicles, or to set a sliding scale so that the charge per vehicle increases or decreases above certain thresholds”.

The Act also has provision on how the money raised is spent. It is required that the revenue raised during the initial period of the scheme (i.e. 10 years from commencement) should be spent to support the local authority's Local Transport Plan.

Nottingham has been the first local authority in the UK and in Europe to introduce the scheme. Recent news also cited that Cambridge City Council will implement the levy scheme as part of the Greater Cambridge and Oxford Councils and are exploring how the WPL could be implemented in their area. So far, Nottingham's experience has been recognised by various publications including the national media and academic journals in its achievements for reducing congestion.

### *The Nottingham WPL in practice*

The Work Place Parking Levy scheme in Nottingham City has been operational since in April 2012. Prior to the introduction of the scheme, Nottingham City Council launched a 12-week consultation on WPL and a 5 day public examination to assess the plan prior to the approval of the Department for Transport.

According to the Nottingham Council's Transport Plan, the WPL works as a levy for employers where charge made for each parking place used by employees, certain types of business visitors, and pupils and students. The strategy clearly states that the decision remains with the employer whether or not they decide to pass the charge on to their employees. Employers will be required to obtain an annual license for the maximum number of liable places they provide.

The existing licensing scheme applies to employers who provide more than 10 liable parking spaces within the Nottingham City administrative area. The

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scheme allows premises to be exempted from this charge or receive a 100% discount based on following conditions:

- Premises are locations in which frontline health services are provided by or on behalf of the NHS
- Premises occupied by the emergency services.
- Places occupied by customers, disabled blue badge holders and delivery vehicles.
- Parking spaces for employers with 10 or fewer WPP

### *Charging Price*

During its introduction in 2012, the charge was initially set at £288 per space per year. Each year this figure is re-calculated in line with the RPI Retail Price Index figure released by the government. Currently the Nottingham Council website shows that the WPL charge for each workplace-parking place per year for the licensing period 1 April 2017 to 31 March 2018 is set at £387. There is no VAT payable on the WPL charge.

The existing scheme allows employers to pass the charge onto employees who use the space. In 2016, the LGA report on this topic cited that “about 53% of the spaces covered currently do so”.

### *Revenue generated and cost effectiveness*

It is reported that the WPL generates around £9 million pounds a year for the City (WWF Scotland, 2016). So far, according to the article published by the Campaign for Better Transport published in June 2017, the scheme has generated “over £44 million of revenue” with “100% compliance of liable employers.”

At least two articles cited (WWF Scotland, 2016 and Dale et. al 2013) that the scheme is low cost to run. Dale et. al.(2013) reported that in 2012-13, the total revenue from WPL was £7,773, 406. Of this figure, the total operating cost for the scheme is around 5% of the total revenue. These operational costs

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include less than 10 FTE employees and the necessary resources including office accommodation.

Space Range	Liabe Employers	Chargeable WPP	Revenue
<11	116	439	250409
11-100	373	11,480	3324463
101-5000	42	14,545	4198534
Total	531	26,464	7773406

Note: The 2012/13 revenue figures take account of license variations that came into effect prior to the end of the financial year thus the revenue figure is not always 288 multiplied by the number of chargeable places. Revenue raised within the banding 1-10 is due to these employers

An example of the breakdown of the use allocation of the WPL revenue for the period 2012-2013 as cited in Dale et. al report (2013) is shown below:

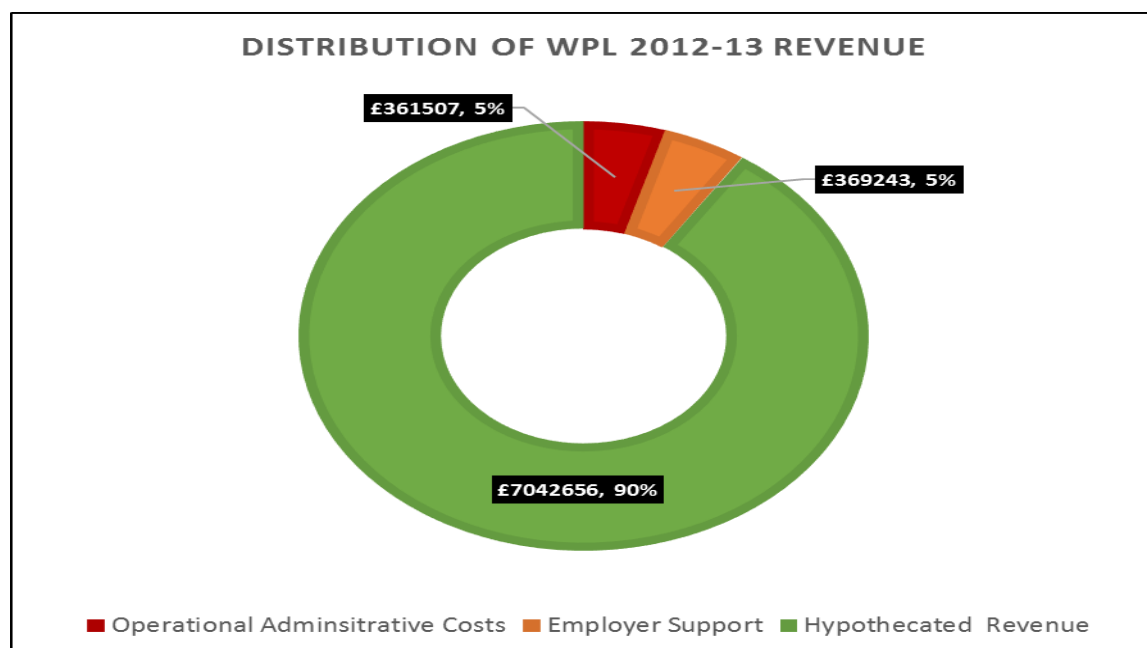


Figure 5.

The figure above also illustrate that an additional 5% of the revenue was spent by Nottingham Council to manage the impact of WPL on employers and to encourage the use of sustainable transport (Dale, S. et. al. 2013)

Source: Nottingham City Council 20/05/2013 as cited in DALE, S. ... et al, 2013. Workplace parking levies: the answer to funding large-scale local

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transport improvements in the UK? Thredbo 13, 13th International Conference on Competition and Ownership in Land Passenger Transport, St Anne's College, Oxford, 15th - 19th September 2013, 16pp.

The total revenue of £7,773,406 in 2012-13 was collected from 531 employers. The same report also highlights that less than only 42 or less than 10% of the total number of liable employers (531) provide the biggest proportion of WPL revenue, which accounts for 55% of total revenue generated. It is important to note this as according to the report "this is an important consideration as it makes compliance and enforcement easier to target in terms of securing revenue"

A Loughborough University evaluation report declares that WPL scheme is a cost effective way of generating revenue that can support the financing of huge transport infrastructure projects. It further argues that this scheme is comparatively more cost effective than the London Congestion charge in saying:

"Although the London Congestion Charge raises more money in absolute terms than the WPL as one would expect, it is less efficient with 49% of revenue taken up by costs" p12

The article written by Joseph, S., in City Metric 26 August 2016, highlights further the benefits of adopting the parking levy scheme as opposed to congestion charging with regards to its impact on the volume traffic into the city and enforcement costs. He stated that:

"Although every city is different, there might be some wider lessons here. One, for the transport economist geeks, might be to stop obsessing with congestion charging. Efficient in economic theory though this might be, Nottingham looked at it and decided that it would be very costly – all those cameras and enforcement – and would not target peak hour traffic jams and single-occupancy car commuting as effectively as the levy would."

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He further argues that the proposals around introducing the levy scheme is more likely to get the support of the businesses and commuters because of the tangible benefits in terms of traffic congestion, air quality and related public health that these would bring.

“The wider lesson from this is that the politics of a levy are different, too. With congestion charging you have to get support from the whole city and potentially its hinterland; and referenda in Manchester and Edinburgh show how difficult that is. With a workplace parking levy, there is a narrower and potentially more politically winnable discussion with businesses and commuters about what a levy could pay for – things that might make journeys to work easier and cut peak hour jams and pollution.”

Finally, he adds that this levy scheme provides a local authority with a significant revenue stream to “grow their economy without increased traffic and congestion, and while reducing carbon emissions”.

### *Barriers to implementation*

Following the Council’s approval to introduce the WPL, the local authority had to manage and deal with opposition from the public, the business community and some of elected Council Members.

According to Dale et. al. (2013) various concerns were raised during public consultation on the WPL and in press coverage around the introduction of the scheme. These concerns include: potential negative impact of WPL to local businesses and the city’s economy; as an additional tax burden to the motorist and questions around its effectiveness in combatting congestion.

The PWC research is cited in the same report stated that business were highly critical of having to bear the cost of WPL. Their study showed that some of the businesses have considered relocating in another area, while others claimed that this could affect their planned investment. Other criticism stated that the scheme could deter companies from relocating in the city.

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There was also a belief that the benefits from improvements in infrastructure and transport will not be felt by small businesses.

### *Use of revenue*

As required by the Transport Act 2000, the revenue generated from the WPL is ring-fenced to be spent on transport initiatives identified in the Council's Local Transport Plan.

According to the Campaign for Better Transport article, the "WPL has enabled a step change in transport infrastructure has made significant impact and contributions towards achieving the transport objectives of Nottingham. The WPL revenue has also leveraged funding from central government to finance a £570m extension of the tram network, the £60m redevelopment of the City's Railway Station and the £15m award-winning fully electric Link Bus network.

The Campaign for Better Transport stated that revenue generated from the WPL has made a significant contribution to enabling the local authority to provide local match funding to enable the City Council to bid for external funds from the Department of Transport and elsewhere. The Table below illustrates how the WPL has contributed to transport improvements in Nottingham.

Funded schemes	WPL local contribution (£M)	External funds (£M)
Tram extension	199	371
Train stations	12	48
Electric buses	5.8	9.2
Bus stations	1.7	1.3
Smartcard system	1.1	1.0
Real time info system	1.2	1.0
TOTAL	220.8	431.5

Source:

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Various publications have highlighted a number of significant impacts that the WPL has brought to the City's economy and the attainment of its sustainable transport goals. The report of the LGA stated that the tram improvements as a result of WPL investment "led to an immediate £100 million boost into the local economy as well as further long term benefits."

The concerns over the loss of jobs and WPL's potential negative impact on the local economy has been disproven. On the contrary, the LGA stated that s that "Nottingham has experienced a growth in the commercial property market as well as significant jobs growth throughout the period that the charge has been in effect."

Additionally, the recent trend shows increasing use of public transport accounting for more than 40% of journeys taken in Nottingham. Since the completion of major works to improve the tram network, there has been a reduction journey time per vehicle mile in locally managed A roads in the morning rush hour.

The City Metric report also states that the introduction of the levy scheme alongside other measures, has also helped Nottingham reach its carbon reduction target a few years early.

### 7.3. Employee Parking Management – Cash-Out Rotterdam

The Erasmus Medical Centre in Rotterdam employs around 10,000 people. Their research on travel patterns show that 80% of patients travel by car to the hospital and 45% of employees commuted with private vehicles, and a significant share live within 5-6km from the hospital. Due to significant shortage of parking the hospital introduced supply and demand measures. To increase supply, they constructed a new car park and also introduced a cash out scheme. The scheme required employees to pay for parking according to arrival time. The charges are outlined as follows:



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- €1.50 for arrival during peak hour,
- €4 for arrival during peak hour and living within 5 to 6 km from hospital,
- €0.50 a day when arriving during off-peak hours.
- €0.10 credit for every km not travelled by car, if the employee decides to take public transport.

The new approach was communicated in advance via newsletters, intranet and a service point. As a result, the number of commuters travelling by car has dropped from 45% to 20-25%.

Source: SUTP, Transport Demand Management Training Document, 2009.

### **7.4. Limit Parking Supply**

Some cities limit the maximum number of parking spaces developers may build in certain areas, such as downtowns in order to limit total downtown traffic and encourage more efficient parking management.

For example, Portland, Oregon set a limit of 40,000 total parking spaces in their downtown, which has increased public transport mode share from 20-25% in the 1970s to 48% in mid 1990s. Similarly, for more than thirty years both Zurich, Switzerland and Hamburg, Germany have prohibited any net increase in city center parking supply. When a new off-street space is built (for example, in a new building), an on street space is removed and converted to other uses such as wider sidewalks or bikeways. The city Zurich only allows developers to build new parking spaces if the surrounding roads can absorb additional traffic without congestion and the air can handle additional pollution without violating ambient air quality norms. This policy has helped make Zurich one of the most liveable cities in Europe.

### **7.5. Improving User Information**

Improved user information can allow motorists to identify parking locations and prices so they can choose the best option for each trip. Motorists want to know which parking facilities are closest to their destination, their prices,

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whether a space is actually available, and how to walk from their parking facility to their destination. This can include maps, signs, websites, mobile telephones and vehicle navigation systems indicating the location and price of parking options.

It is recommended that cities support the development of advanced parking management systems (APMS) which provide real-time information through the internet and in-vehicle navigation systems to help motorists quickly find a parking space. These systems increase user convenience, reduce delays, driving and illegal parking, increase parking facility utilization, and encourage shifts to alternative modes.

Cities can help develop such systems by establishing parking supply, price and occupancy information standards. For example, a municipal transportation agency can require all commercial parking operators to report the number of parking spaces they rent and prices at each parking lot, and in the future, when electronic systems are developed that report parking lot occupancy, this information can be uploaded automatically to a website, and made available by mobile telephones and vehicle navigation systems.

### *San Francisco "SF-Park" pricing Policy*

This type of parking management started in 2011 and involves a combination of time of day, demand responsive pricing, off-peak discounts at garages. It was intended this approach will reduce circling and double-parking, and influence when and how people choose to travel.

This scheme is supported by enhanced parking regulation enforcement, and new parking information systems. This approach uses new technologies including networked in-street parking sensors that collect real time information on occupancy levels and parking meters that support various forms of payment, including coins, smart cards, as well as credit and debit cards.

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With the demand-responsive pricing system, parking spaces can be opened on each block and reduce circling and double-parking. Rates may vary by block, time of day and day of week. Rates are adjusted by no more than 50 cents per hour down or 25 cents per hour up, and no more often than once per month.

In areas and at times where it is difficult to find a parking space, rates will increase incrementally until at least one space is available on each block most of the time. In areas where open parking spaces are plentiful, rates will decrease until some of the empty spaces are filled. The performance target is 85% maximum occupancy, so at least 15% of parking spaces are available even during peak periods. This is to insure that motorists can nearly always find a parking space on each block. Most of the parking spots have a maximum time limit of four hours. Rates are adjusted per block according to its occupancy.

In pilot areas, the meter pricing can range from between 50 cents an hour to a maximum of \$7 an hour, depending on demand. For example, parking meters on blocks within walking distance of the ballpark are \$7 an hour for events. Parking rate adjustments also happen in City-owned garages and lots in pilot areas. Hourly rates decrease in City-owned garages where there are often many empty spaces.

The effectiveness of parking management in helping to reduce traffic and emissions in San Francisco was confirmed by the results of a survey of San Francisco Bay Area Commuters which had shown that those who pay directly for parking drive less than half as often as commuters who receive free parking, as indicated in Table 13 that follows:

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Table 13.

	With Free parking	Without free parking
Drive alone in car	75%	37%
Use transit	5%	43%

Source: Commute Profile 2005, A Survey of San Francisco Bay Area Commute Patterns, RIDES for Bay Area Commuters, Inc. August 2005. Region-wide telephone survey of 3,600 commuters sponsored by the Metropolitan Transportation Commission (MTC)

Some of the benefits from the implementation of the scheme are summarized Strompen's report are outlined as follows:

### *Easier parking*

SFpark makes finding and paying for parking faster and easier. Parking availability improved and system has made it easier to find a parking space. The access to demand-responsive pricing information online, via text, and through smartphone apps helps drivers find a space. Longer time limits and new meters that accept credit/debit cards, SFMTA parking cards and coins make parking more convenient and result in fewer parking tickets.

### *Faster public transit*

The reduction in the number of drivers circling and double-parking has decreased overall greenhouse gas emissions and the total number of vehicle miles travelled. Roads are kept clear so municipal vehicles and emergency vehicles can get through streets faster and more reliably.

## **Appendix 5**

### *Safer bicyclists and pedestrians*

Drivers looking for parking are frequently distracted and fail to see bicyclists and pedestrians. Less double-parking and circling means fewer accidents and safer roads.

### *Better businesses neighborhoods*

With parking faster to find and pay for, it is easier to enjoy the City's commercial areas. Less congested, safer and more pleasant neighborhoods mean better business and with less smog and greenhouse gas means healthier environment.

## **8. Traffic and mobility management**

The Sootfree cities (2015) report also highlighted that reducing speed limits adopted by various cities to influence air quality.

### **8.1.1. Reduction speed limits**

#### *Paris*

In Paris, the general speed limit for cars is 50 km/h, but the anti-air-pollution plan envisages a speed limit of 30 km/h across most central districts and soft modes of transport are to feature more strongly. It is reported that a third of roads in the city, (560 km) have a speed limit reduced to 30 km/h. Additionally, there are *zones de rencontres* (encounter zones) with a maximum of 20 km/h, in which cyclists, pedestrians and car users share the same space. On the periphery of the city, the speed limit was reduced from 80 to 70 km/h in 2014.

## **Appendix 5**

### *Zurich*

The city currently limits traffic to 30 km/h in most residential areas. Main roads are generally limited to 50 km/h. As part of its street noise reduction programme, the speed limit of an additional 100 municipal streets (or street sections) has been reduced to 30 km/h.

### *Vienna*

The city's street network comprises about 2,800 km (not including motorways), of which 59% are limited to a speed of 30 km/h. These 30 km/h zones had a total length of about 1600 km in 2013. Main roads are limited to 50 km/h and urban motorways to 80 km/h.

### *Helsinki*

Speed limits in Helsinki are 120 km/h on motorways in (summer) on the main roads 80 or 100 km/h and between 30 and 60 km/h on residential roads.

### *Copenhagen*

Copenhagen it also has an extensive speed limit approach. The planned target is to set 40 km/h as the general speed limit in Copenhagen, and 30 km/h in residential areas.

## Appendix 5

### 8.1.2. Success with Modal Shift

#### *Paris*

In Paris, there has also been improvements in modal split between figures in 2010 and 2013.

Mode	2010	2013
Walking	46.6%	48%
Use public transport	33.5%	36%
Use car or motorcycle	16.2%	13%
Cycling	2.7%	2%

The figures on the weekday modal split for figures for 2010 and 2016 show that show an increase in the modal share for walking and use of public transport alongside decrease in use of car and motorcycles. However, bike use also decreased to 2%, the share of motorcycles decreased to 2% and other modes of transport have a share of 1%.

The car-sharing scheme “Autolib” is continuously increasing its number of stations and cars. Between 2012 and 2013 alone, the number of cars increased from about 1,750 to 2,000 and the number of stations increased by 100 to 830. The use of electric cars is going to be promoted through a network of charging points to be placed every 500 m.

Since 2007, the City of Paris and its municipalities has a comprehensive bicycle sharing scheme Vélib'. This is one of the is one of the largest scale bike sharing systems in the world with 20,000 bicycles and 1450 bicycle stations across the area. Information on bike availability and parking could be accessed on a website, on an iPhone app and at every rental station. A subscription is required to rent a bike. The first 30 minutes of trips are always free of charge. The usage charge increases from 1€ per hour up to 4€ per additional half-hour. A bonus system gives a 15 minute credit for every time a bike is parked on an elevated return station. If a user arrives at a rental station

## Appendix 5

that does not have an open spot the system automatically grants another free fifteen minutes of rental time to ensure that the bike can be returned.

The system is operated by a private company that currently employs 285 full-time employees. As many as 100,000 cyclists use the service daily.

### *Zurich Modal Split*

The city is continuously moving away from motorised individual transport.

Starting at a modal share of 35% in 2005, this had declined to 28% by 2012.

Further improvements in modal split are planned to be achieved by 2020. The targets are outlined in table below:

Mode	Planned Modal share 2020
Walking	26%
Use public transport	42%
Use car or motorcycle	20%
Cycling	8%

### *Vienna*

The modal split statistics for 2010 and 2012 in Vienna reveal a 4% reduction in use of motorised individual transport to 27%, combined with a 1% increase in cycling and a 3% increase in public transport. Targets for 2020 aim at a share of motorised individual transport of 20% (5% less than predicted in 2003), an increased public transport usage of 40% as well as an increased cycling share of 12% (4% more than predicted in 2003). In its long-term urban development plan, re-purposing the urban space is part of the strategic targets, together with a higher integration of public transport, biking and walking as well as an attractive and comprehensive system of cycling lanes and walking paths.



## Appendix 5

### *Helsinki*

The Helsinki Region Transport Authority envisages making public transport the number one choice for travelling within the city by 2025. Helsinki is undertaking a number of measures to strengthen public transport, walking and cycling, and reduce individual motorised transport through mobility management measures. Generally, current investments of about €1,300m per year in public transport, mobility management and infrastructure will be increased to adapt to, for example, public transport expansion plans.

Mode	2000	2012	2014
Walking	17%	30% (2010)	34%
Use public transport	20%	38%	32%
Use car or motorcycle	19%	31%(2008)	22%
Cycling	4%	9% (2010)	11%

Comparing the figures above from 2000 and 2014, show that there has been there has generally been improvements in the modal share for walking the use of public transport and cycling. Although the modal share for use of car has increased to 31% in 2008, this has reduced again in 2014.

### *Copenhagen*

Copenhagen has a comprehensive strategy to increase sustainable mobility and offers a wide range of mobility management services. The Table below show how a greater proportion (in total 64%) using cycling (36%) and the use of public transport (28%) as the major way of getting around the city.

#### Modal Split

Mode	2013
Walking	7%
Use public transport	28%
Use car or motorcycle	29%
Cycling	36%

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Scrutiny Research Report

## Public Sector Vehicle Fleet in Cardiff - Comparative Figures

Research report for the  
Environment Scrutiny Committee

1 February 2018



The City and County of Cardiff



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## **1. Introduction**

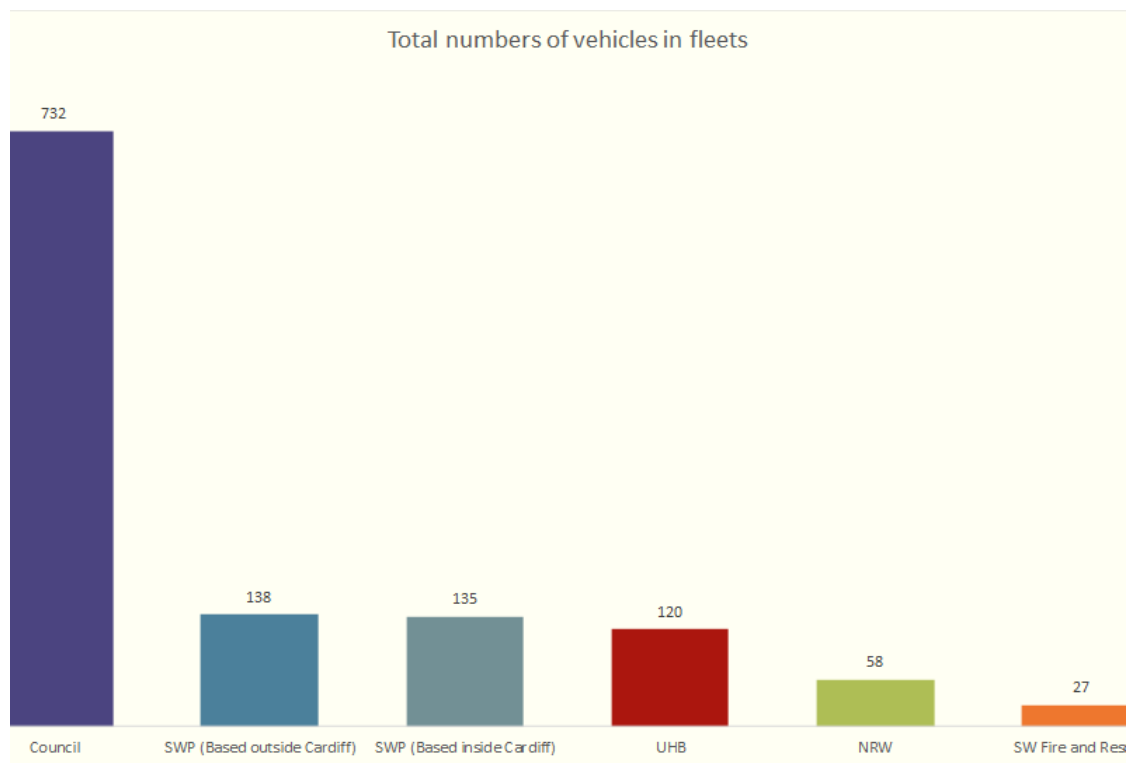
The Environment Scrutiny Committee conducted a Task and Finish Inquiry to support the development of Cardiff Council's policy on improving air quality in the city. To support of this inquiry, research was commissioned to look into the fuel and emission characteristics of vehicle fleets that are being operated in the Cardiff area by various locally based public sector bodies.

The public sector bodies included for this research are: Cardiff Council, Cardiff and Vale University Health Board, South Wales Fire and Rescue, South Wales Police Authority and the Natural Resources for Wales. The findings of this research will provide comparative information on the number, fuel type and age public sector vehicles that are currently in use. Cardiff University was initially contacted and they had advised that the information required on their vehicles will have to be obtained from different departments who operate these vehicles. Due to limited resources, it was not possible to make contact and secure this information from various university departments. In collecting data from various public sector bodies, vehicle fleet managers were contacted by telephone and by email to secure the release of information required. The type of information and the level of detail that was made available from each of the public bodies varied. Where comparable information was available, this will be reflected as part of the findings of this report.

## 2. Number of Vehicles in Public Sector Fleet.

The data in Chart 1 below shows that Cardiff Council has the most number of vehicles in its fleet compared to other public sector bodies in Cardiff. In total, Cardiff Council has 732 vehicles in use. The South Wales Police authority has a total of 273 in its fleet, with 135 of these operating in the Cardiff area. Of the public sector bodies that have provided information, the South Wales Fire and Rescue Service has the least number of vehicles (27) that operate in Cardiff.

Chart 1. Total number of vehicles operating in the Cardiff area by organisation



## Appendix 6

### 3. Public Sector Vehicles by Fuel Type

Chart 2. Total number of vehicles by fuel type by public sector organisation

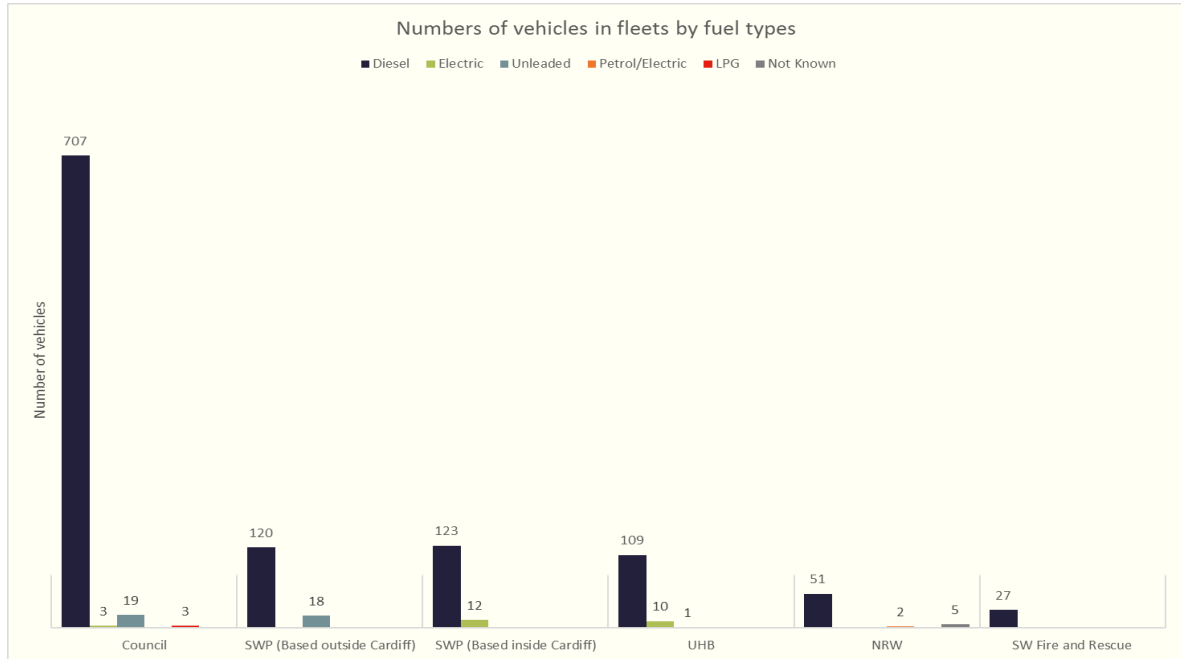
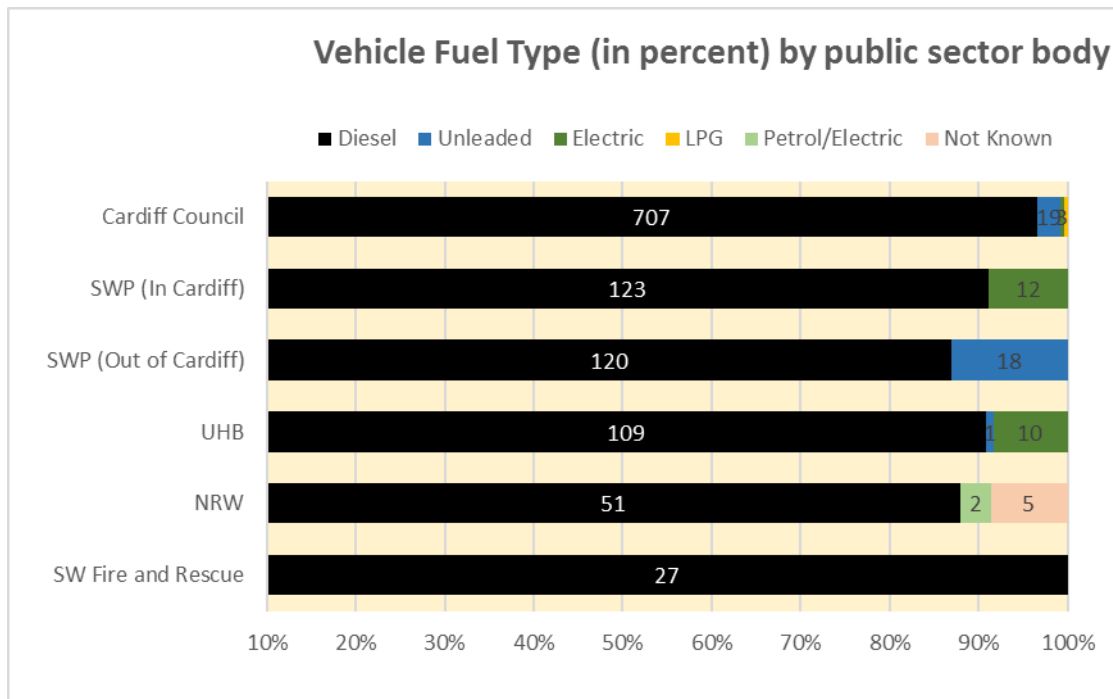


Chart 3. Fuel type of vehicles by public sector body (in percent)

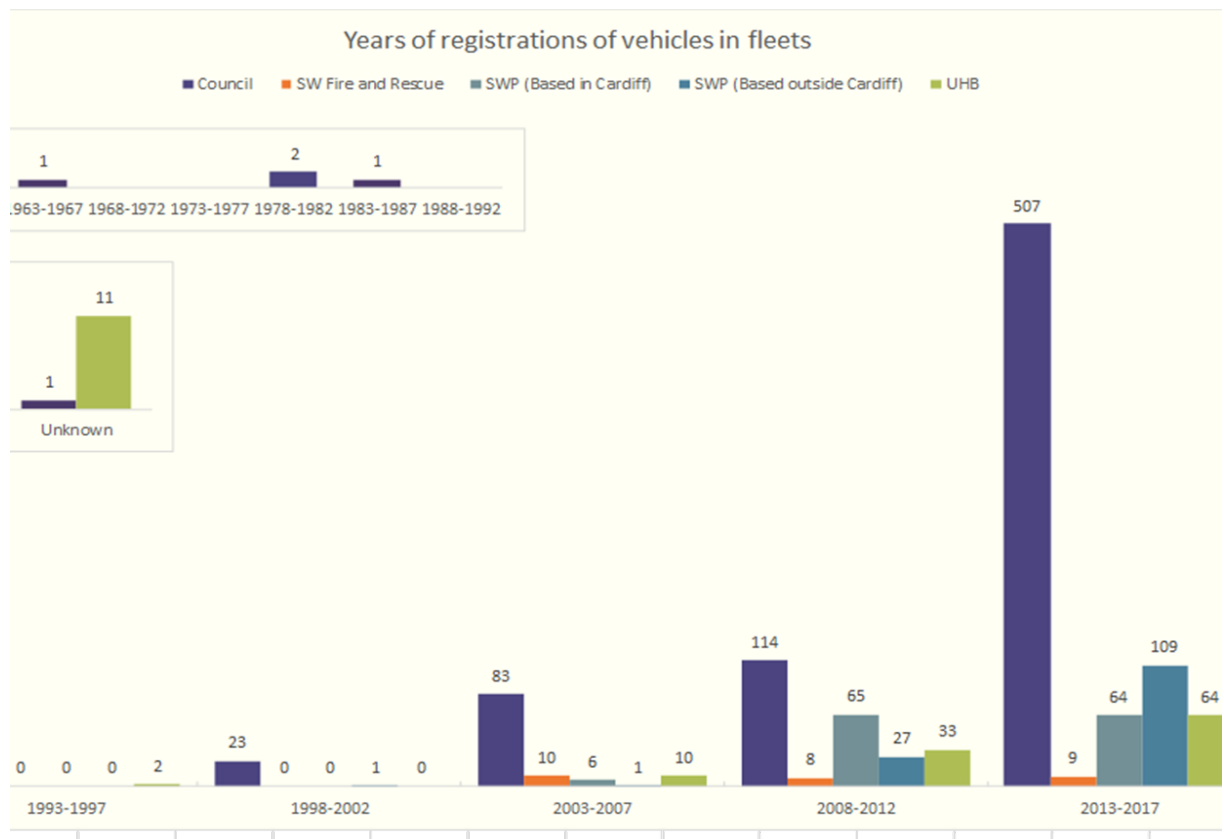


## Appendix 6

The charts above show that the vast majority of the vehicles (>85%) that are operated by most public sector bodies in Cardiff area are using diesel fuel. The South Wales Police authority and the Cardiff University Health Board operate small number of electric vehicles.

### 4. Year of Vehicle Registration

Chart 4. Period of vehicle registration by public sector organisation



The chart above shows that the majority of public sector vehicles were registered during the period 2013-2017. In Cardiff Council, more than two thirds (69%) of vehicles are less than 5 years old (registered between 2013-2017).

## **5. Euro Emission Ratings of Public Sector Vehicles in Cardiff**

Only two of the public sector bodies contacted for this research i.e. Cardiff Council and the South Wales Fire and Rescue, were able to provide information on the Euro emission ratings of vehicles within their existing fleet. Other public sector bodies have information on vehicle fuel type and year of registration but will still need to supply information on individual vehicles' Euro emission rating category.

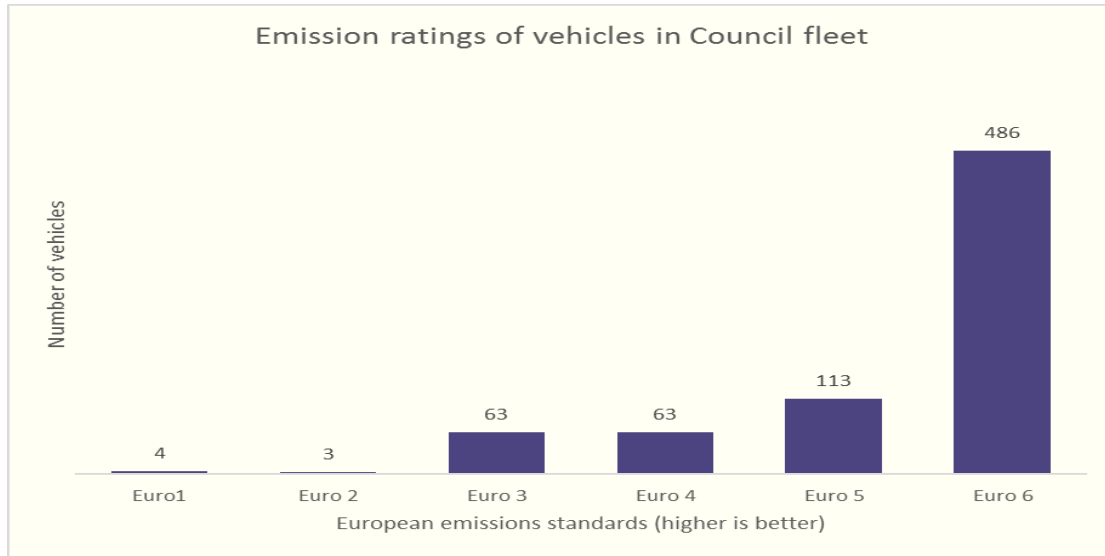
The Euro 5 emission standards apply for new model of cars as of September 2009 and for all new cars in January 2011. The introduction of this standard further restricted the carbon monoxide (CO), hydrocarbons (HC) Nitrogen Oxide (NOx) and particulate matter (PM) emissions from both petrol and diesel cars.

The Euro 5 standard has significantly tightened the limits for particulate emission from diesel engines and required diesel cars to have particulate filters in order to meet the standard. Compared to Euro 4, the limits set for Euro 5 will reduce emissions of particulates from diesel cars by 80%. The standards for NOx was also tightened with a reduction of 28% compared to the Euro 4 limits (i.e. a reduction of the NOx limit from 250mg/km to 180mg/km)

The Euro 6 emission standards applies to all new cars registered from 1<sup>st</sup> September 2015. The emission standards set for this category requires a significant reduction in NOx emissions from diesel engines (67% reduction in NOx emission) compared to Euro 5 standards and have introduced a particle number limit for petrol vehicles.

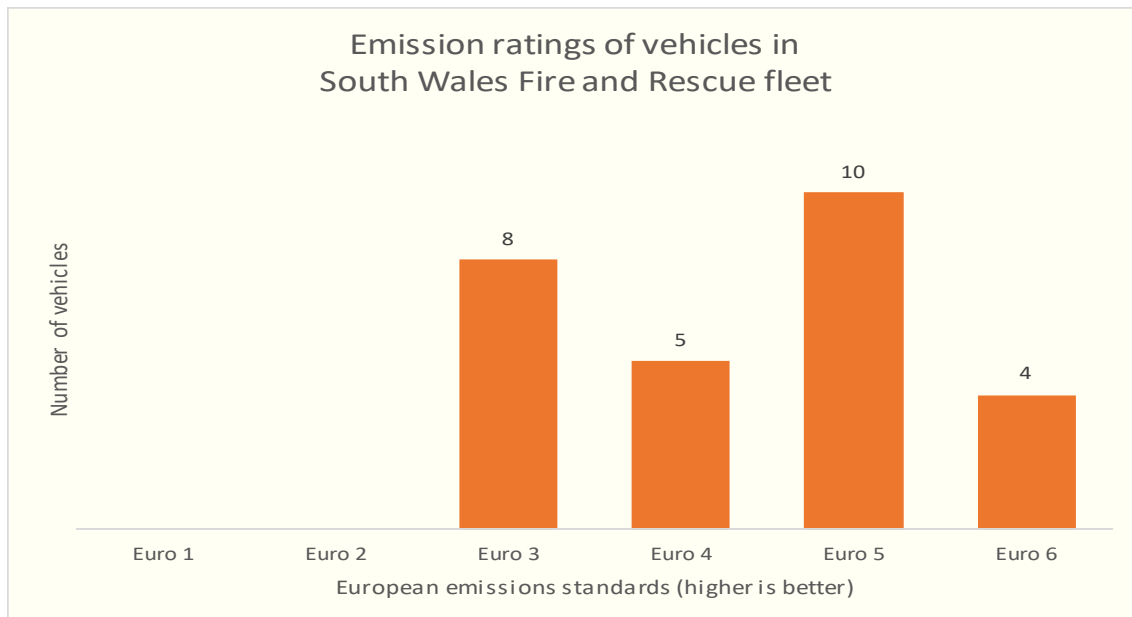
## Appendix 6

Chart 5. Euro emission ratings of vehicles in Cardiff Council fleet



The chart above shows that the vast majority (82%) of the vehicles in Cardiff Council's fleet are compliant to the stricter emission standards required under Euro 5 and Euro 6.

Chart 6. Euro emission ratings of vehicles in South Wales Fire and Rescue Service



## Appendix 6

The chart above show that just over half (52%) of the vehicles in the South Wales Fire and Rescue fleet meet the Euro 5 and Euro 6 standards. It is yet to be established whether the South Wales Fire and Rescue vehicles that fall under the Euro 3 and Euro 4 categories have been retrofitted with diesel particulate filters.

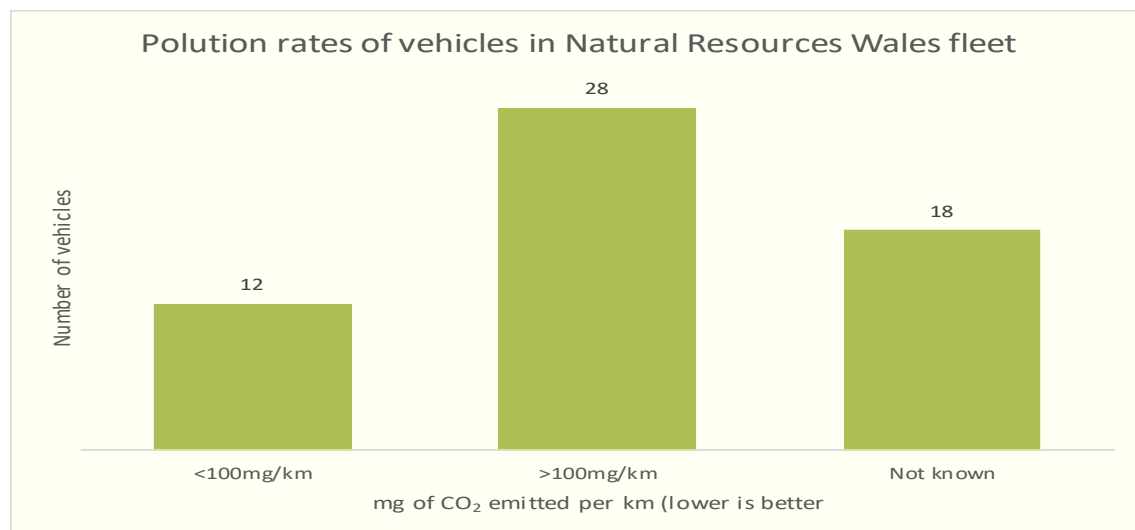
### 6. CO2 Vehicle Emissions

The Euro 5 CO2 emission limits for petrol cars is 1.00g/km and for diesel cars it is set at 0.50g/km. This standard applies to all cars registered from 1<sup>st</sup> January 2011. With the introduction of Euro 6 standards CO2 limits for petrol and diesel cars have remained the same as Euro 5 requirements.

The CO2 limits for light vehicles as well as large goods vehicles (petrol and diesel) are much higher compared to the limits set for cars.

So far, only the Natural Resources Wales and South Wales Police have provided information on the CO2 emissions of vehicles in their current fleet.

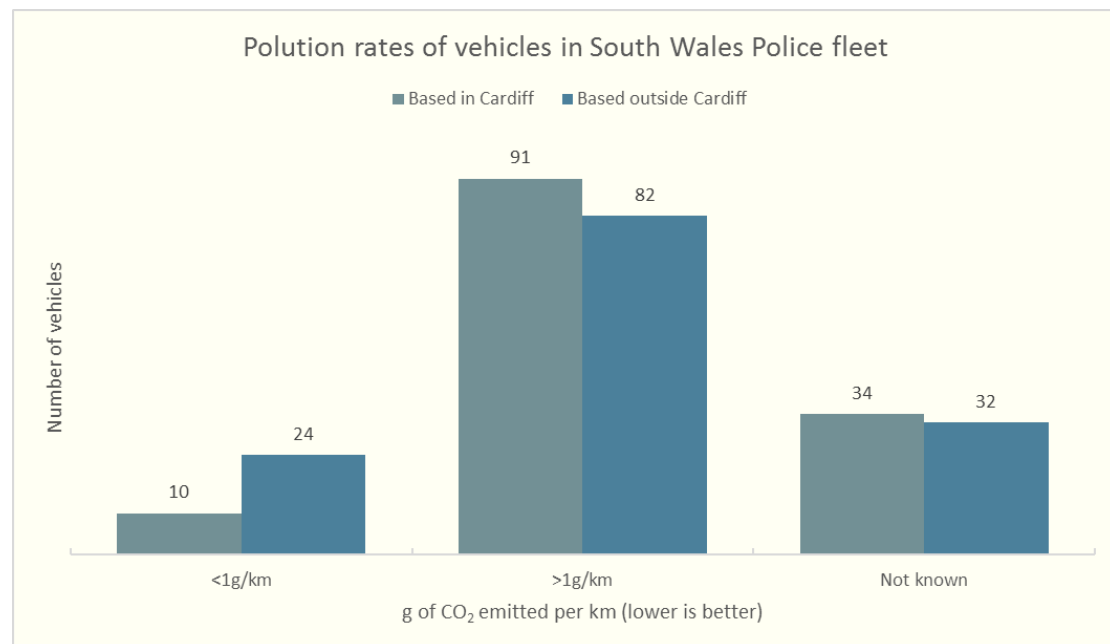
Chart 7. CO2 emissions of vehicles in the Natural Resources for Wales fleet.





## Appendix 6

Chart 8. CO2 Emissions of Vehicles in the South Wales Police Authority



The charts above show that only a small proportion of vehicles in the transport fleet of the Natural Resources for Wales and the South Wales Police Force have low level CO<sub>2</sub> Emissions. Information on the CO<sub>2</sub> emissions of a significant proportion of vehicles in NRW and the South Wales Police fleet is not known.

For more information please contact:

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Scrutiny Services, Cardiff Council

## Appendix 6

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