LOCAL TRANSPORT PLAN CONSULTATION
ELECTRIC VEHICLE TECHNICAL REPORT
SUMMER 2018

September 2018
Environment
0300 123 4047
www.hertfordshire.gov.uk

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1. INTRODUCTION

Following Hertfordshire County Council's public consultation on their new Local Transport Plan (LTP) in 2017, questions and queries were raised regarding electric vehicles (EVs), EV infrastructure and provision in the county. This paper aims to address some of these queries and issues raised.

Responses to the consultation raised questions on technical issues regarding EVs and infrastructure and the requirement for more explanation, context and what the practical implications might be. Given the current importance placed on EVs it was recommended that a technical report be produced with consideration for a subsequent EV strategy following this.

2. ELECTRIC VEHICLES IN HERTFORDSHIRE

In the graph below (figure 1) we can clearly see that since 2011 there has been a substantial increase in the number of ultra-low emission vehicles in Hertfordshire since 2011.

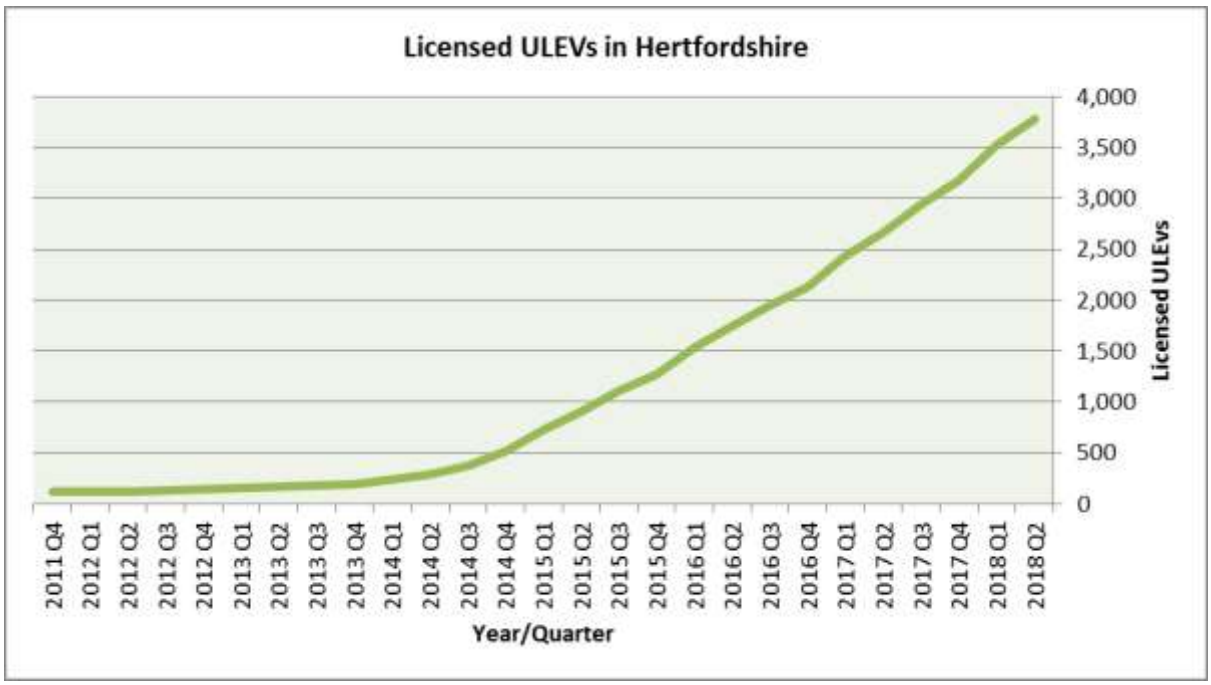


Figure 1: Licensed ULEVs in Hertfordshire 2011 to 2018

Chargemaster, the UK's largest provider of EV charging infrastructure forecasts 60% of new cars being electric by 2030. Given the trend from 2011 and future expected projections uptake of EVs, it was expected to receive many varying questions regarding EV technology, its capabilities, practicalities and potential issues and concerns during the consultation. With EV ownership growing and government policies, legislation and laws encouraging EV uptake, along with car manufacturers supplying more variety and models of EVs with the rapid developments in technology, it is expected that those with a limited knowledge of EVs would raise valid questions of the future of EV technology.

3. THE LOCAL TRANSPORT PLAN

Currently the Hertfordshire LTP states that 'technology is having a significant impact on transport' in the county which includes the effects of EVs. The LTP recognises that there is a rapid change occurring with technology and this is as a driver of change for Hertfordshire. It represents a significant uncertainty and so a future scenario test was undertaken to test how technology will interact to change transport demand and on the capabilities of the transport system including transport infrastructure. This change in technology includes a key uncertainty of new fuel and energy technologies which include the rise and development of EVs.

The rise of EVs could represent a shift from traditional fuel powered vehicles with internal combustion engines to electric and potentially help to improve air quality at the point of use whilst lowering the cost of car travel for residents. Because of this the LTP's future scenario testing generated a series of interventions for the next 10 years which included;

- Staying abreast of market developments and trends in relation to alternative fuelled vehicles and services.
- Facilitate the installation of charging infrastructure and other facilities to support low emissions schemes.
- Support access to an electric vehicle car club where appropriate and,
- Procure electric vehicles within the county council fleet to show leadership.

The LTP also recognises that transport can harm the quality of place. This includes environmental damage caused by emissions/air quality, pollutants and noise. Carbon emissions are an environmental impact with global consequences, and as such need to be a priority against which transport can make a significant contribution in reducing future climate change. As EVs contribute fewer emissions, pollutants and are less noisy than traditional vehicles, the LTP sees the low uptake of EVs as a key issue and a barrier in particular to reducing carbon emissions.

The LTP's Emissions Reduction and Air Quality policies specifically supports the take-up of ULEV throughout the county by seeking to address any barriers to the uptake of EVs as well as aiming to work closely with the districts and borough councils to facilitate the installation of charging infrastructure. The LTP states that local planning authorities should also support the take up of EVs, for example by requiring developers to include charging infrastructure in new developments.

EVs are slowly growing in number across the county with statistics from the DfT showing that Watford has by far the highest number of registered plug in vehicles as of the last quarter of 2017. As part of monitoring the performance of the LTP there is a specific performance indicator in regards to emissions reduction which will measure the number of ultra-low emission vehicles, comprising of EVs which are registered in the county.

4. CONSULTATION RESULTS

Whilst the LTP acknowledges the potential benefits of EVs, it also recognises that there are disadvantages such as that a lower cost of travel for residents could encourage more travel. This would be beneficial in increasing access for residents to services however, it does not resolve the congestion issues currently suffered in the county and might add to the problem.

This division in perception of EVs was reflected upon in the consultation questions, to try and obtain residents views on the matter and how the LTP can better inform the County's objectives and policies regarding EVs. The following question was included in the online survey during the consultation;

Drivers of Change and Hertfordshire Futures:

"Chapter 4 on Drivers of Change and Hertfordshire Futures explains how we will make transport plans for the county adaptable and resilient to future change. As part of this it is recommended that the county council do more to encourage shared mobility (car clubs, liftshare, bicycle share/hire etc.) and facilitate the installation and adoption of Ultra Low Emission Vehicles (such as electric cars)."

How much do you agree that the county council should do more to encourage the installation and adoption of Ultra Low Emission Vehicles (such as electric cars)?

The results from this question in the survey, as displayed in figure 2, show that 71% of respondents strongly agreed or agreed that the council should do more to encourage the installation and adoption of ULEVs such as electric cars.

7. How much do you agree that the county council should do more to encourage the installation and adoption of Ultra Low Emission Vehicles (such as electric cars)?

			Response Percent	Response Total
1	Strongly agree		33.66%	204
2	Agree		37.13%	225
3	Neutral		17.49%	106
4	Disagree		7.43%	45
5	Strongly disagree		4.29%	26

Figure 2: Consultation Question and Results: Electric Vehicles

The consultation question also raised approximately 400 written comments and a number of questions. The responses covered a variety of comments regarding barriers to EV uptake. These were analysed and categorised to depict the greatest barriers to EVs. As shown in Figure 3, the main concerns regarding EVs were lack of charging points, followed by the cost of purchase of an EV, the congestion EVs will still cause, and scepticism over how environmentally friendly EVs actually are.

In regards to cost and range, this is quite subjective and are ongoing topics being studied worldwide and so is not covered in this paper however, the perception of a lack of charging points and environmental concerns are answered as part of the technical questions raised in the consultation.

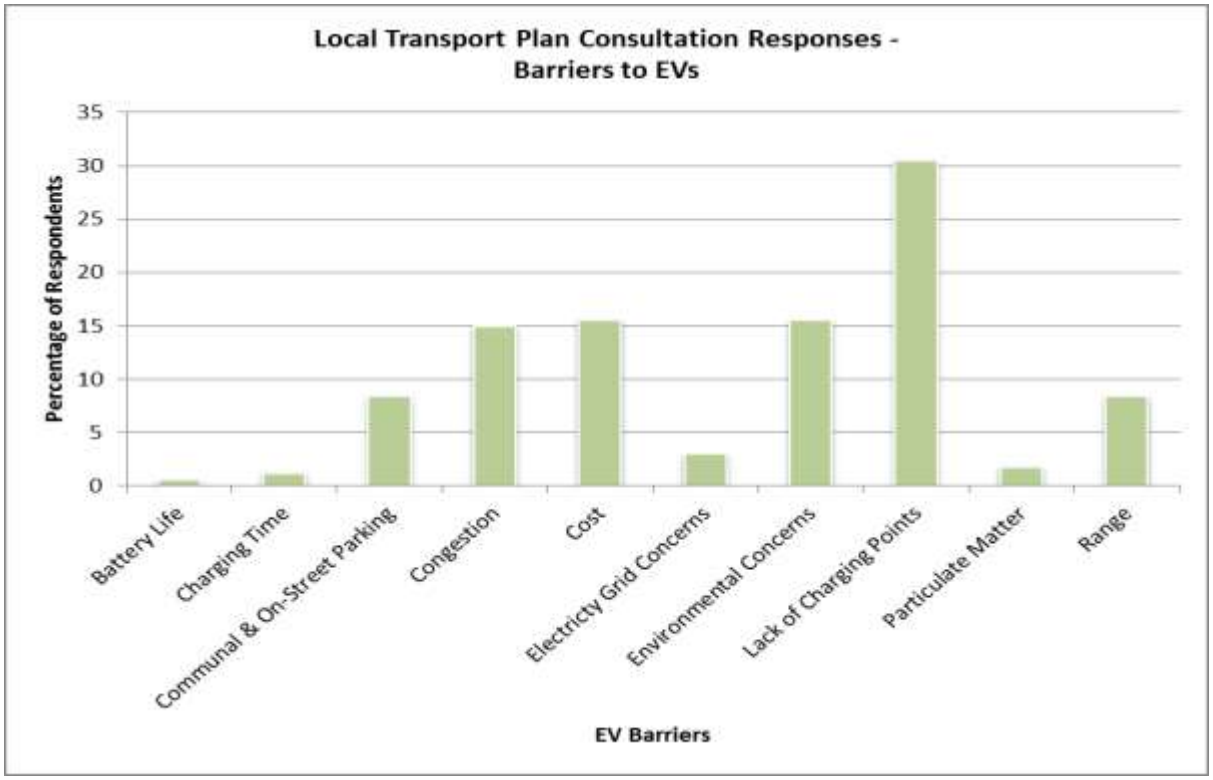


Figure 3: Local Transport Plan Consultation Responses – Barriers to EV

While the graph above provides a categorical break down of barriers to EVs in Hertfordshire, this paper does not discuss general particular factors such as range concerns, or cost as there is clear variation in people's perception of EVs cost and capabilities, in particular trust in the technology. There are studies available on these topics and also, it is advisable that further research is carried out as EV technology develops. This paper seeks to answer the more technical related questions raised from the consultation regarding EVs as outlined below.

5. EXTERNAL BILLS AND STRATEGIES

While the LTP's approach to reducing vehicle emissions is covered in the policies it also supports government and private sector led efforts to increase adoption of EV technology. These include;

- **The Automated and Electric Vehicles Act** will address common standards and interoperability for ULEVs in the UK and will help the transition towards installing ULEV infrastructure across Hertfordshire and the rest of the country.
- **The Government's draft Air Quality Action Plan (May 2017) which** proposed a number of additional activities to tackle transport emission levels, including further support to accelerate the take-up of Ultra Low Emission Vehicles (ULEVs), and review the information provided to consumers and on environmental performance of vehicles.
- **Road to Zero Strategy (2018)** which aims to support the development of one of the best electric vehicle infrastructure networks in the world by launching a Charging Infrastructure Investment to help accelerate charg8ing infrastructure nationally.

6. TECHNICAL QUESTIONS AND ANSWERS

Various technical questions arose from the LTP consultation which have been analysed and answered in this section. Many questions raised relate to one another so these have been categorised and answered under the headings below. The full list of technical questions regarding EVs from the consultation can be found in the appendix.

6.1 Energy Production

Several questions regarding energy production for EVs were received and in particular, how is sustainable energy produced for EVs. EV registrations are increasing making this a valid point to raise as we must take into consideration not only the direct emissions of greenhouse gases from the EV tailpipes, but indirect emissions from the production and distribution of energy which power EVs. There is concern that while EVs release less carbon dioxide (CO_2), the greenhouse gas contributing to climate change, the actual production of energy required to power these vehicles still requires the use of non-renewable fossil fuels such as coal which generates CO_2 and can be viewed as counterproductive in reducing greenhouse emissions.

In the UK, electricity is generated in a number of different ways mainly consisting of;

- The burning of fossil fuels (coal, oil and gas)
- Nuclear energy
- Renewable energy (wind, solar, hydro)
- Imported energy

While the sources of electricity generation varies year to year, according to Energy UK in 2016 approximately 54% of the UK's electricity was produced by burning fossil fuels,

followed by 24.5% renewable energy, 21% in nuclear energy, and the remainder by imported energy where can depending on when it is most economical to import electricity.

Whilst these figures for production of energy is concerning due to large volume of fossil fuels still used, it is important to note that In 2017, total UK greenhouse gas emissions are provisionally 43% lower than in 1990 and 2.6% lower than 2016.

Since 1990, UK total carbon dioxide emissions have decreased by 38%. This decrease has resulted mainly from changes in the mix of fuels being used for electricity generation as shown in figure 4, including the growth of renewables, together with greater efficiency resulting from improvements in technology and a decline in the relative importance of energy intensive industries.

The energy supply sector was the largest contributor to the decrease in carbon dioxide emissions between 2016 and 2017 reducing emissions by 7.6%. This was mainly due to an overall decline in the use of coal at power stations particularly during the 1990s, accompanied by an overall increase in the use of gas, which has lower carbon content. Coal use in energy generation is estimated to have reduced by 89% between 1990 and 2017. Since 2016, emissions produced from power stations using fossil fuels have decreased by 11% with coal use for electricity generation falling 28% between 2016 and 2017. There has been a switch to more low carbon electricity generation such as renewable sources and nuclear energy accounting for around 50% of electricity generation in 2017.

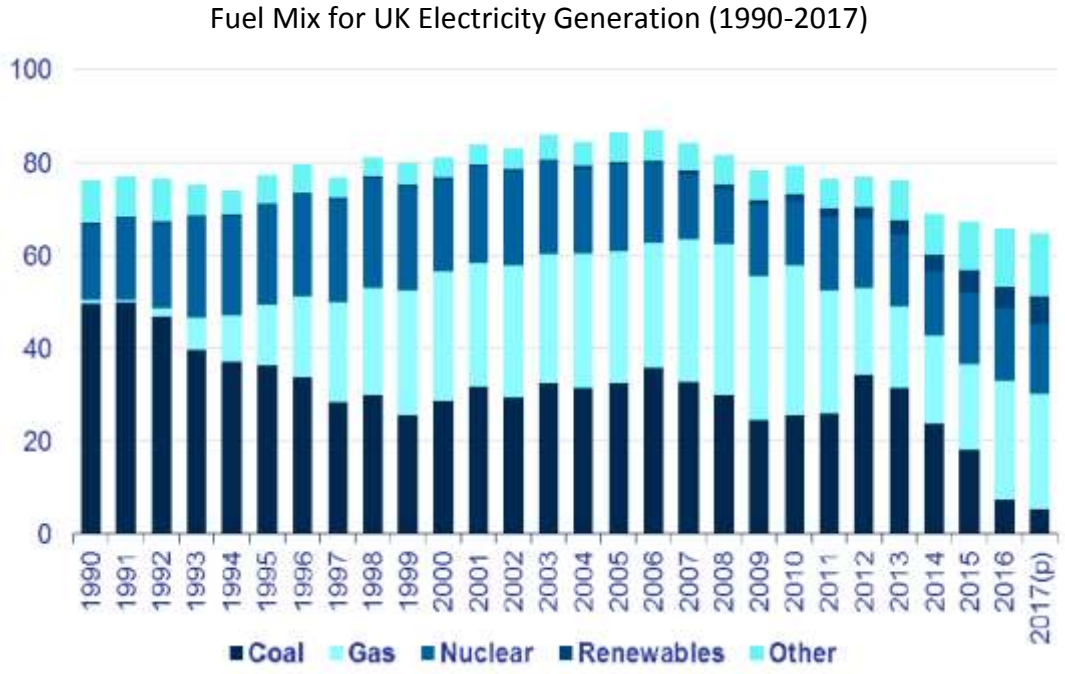


Figure 4: Fuel Mix for UK Electricity Generation (source: Department for Business, Energy & Industrial Strategy, 2017 UK Greenhouse Gas Emissions)

As displayed in figure 5, the trend of switching to more renewable forms of energy production for producing electricity has resulted in a steady decrease in CO_2 emissions released.

Carbon Dioxide Emissions from Electricity Generation (1990-2017)

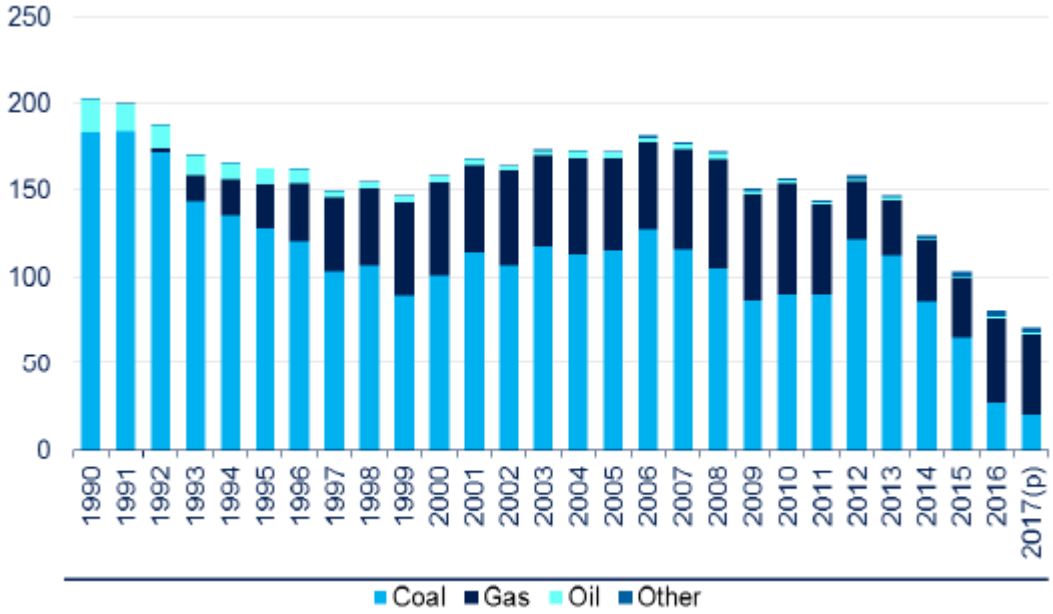


Figure 5: Carbon Dioxide Emissions from Electricity Generation (source: Department for Business, Energy & Industrial Strategy, 2017 UK Greenhouse Gas Emissions)

Overall, emissions from electricity generation have decreased by 65% since 1990. This is expected to rise with the UK aiming to meet the EU target of generating 30% of electricity from renewable sources by 2020.

The Department for Business, Energy & Industrial Strategy energy and emissions projections also indicates increasing the use of renewable sources for energy production, reducing the use of gas and eventually eradicating the use of coal altogether by 2027 as shown in figure 6 below.

Projections of Generation by Technology for all Power to 2035

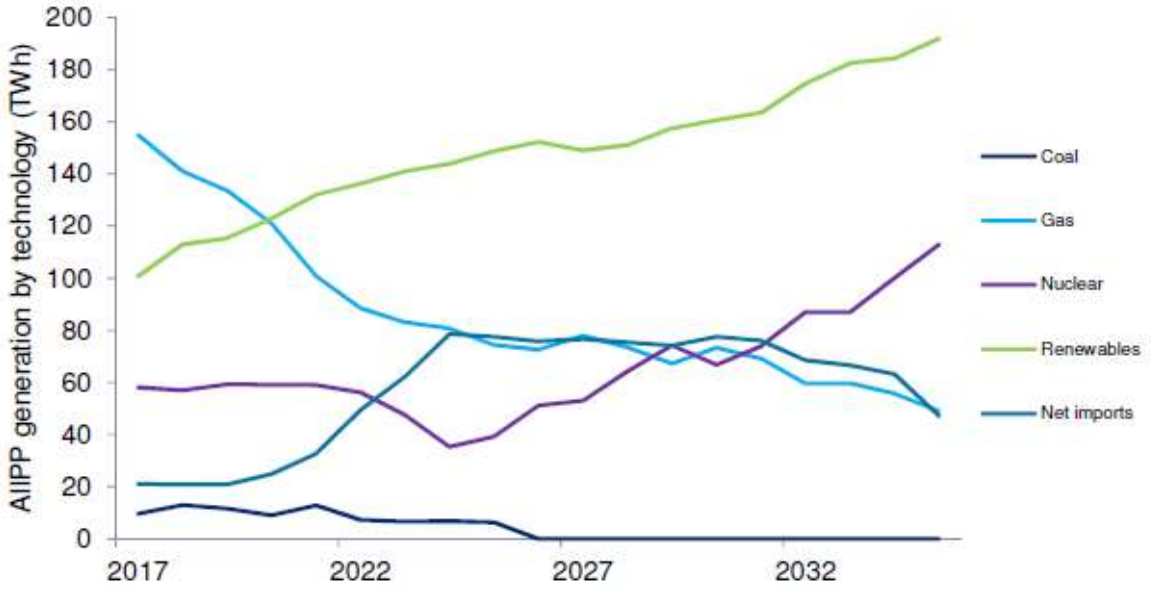


Figure 6: Projections of Generation by Technology

While currently carbon emission produced when generating electricity is still a major concern; evidence suggests that the reduction in CO_2 since 1990 can be seen as positive for the future production of energy. The combination of increasing the use of renewable sources of energy and also reducing the use of fossil fuels which contribute to greenhouse gases can be seen as a step forward and suggests a positive outlook for the future power generation of EVs.

6.2 Electric Battery Production

Concerns were raised in the consultation regarding how environmentally friendly the production of batteries is which are used in EVs. Currently the most common type of battery used in EVs is lithium-ion batteries which necessitates the use of lithium and a substantial increase in use of lithium will be required to meet the expected growth in EVs.

It is claimed that producing an electric vehicle contributes, on average, twice as much to global warming and can use double the amount of energy compared to when producing a traditional combustion engine vehicle. This is mainly due to the production of the battery which uses a lot of energy which can contribute to carbon emissions, from the extraction of raw materials to the electricity consumed in manufacture. However, it is argued that while an EV has a higher carbon footprint at the start of its cycle, over the life of an EV, it is cleaner than a traditional combustion engine vehicle.

The main issue with the mass production of hybrid and electric vehicles has been a shortage of batteries with the main material lithium growing in demand. While lithium is classed as a rare element and at a supply risk in regards to an element of economic value, it is currently quite an abundant element and recent studies have indicated that current reserves of lithium are sufficient so that increased production of electric vehicles will not be affected. However, lithium does not naturally occur in its pure form due to its high reactivity and while there is not any particular impact to the environment directly from the lithium contained in batteries as it is contained safely, indirect impacts occur through the mining of lithium and the manufacturing process.

The mining process for lithium produces dust, fumes and uses large volumes of water which can be environmentally damaging. There is also the risk of chemicals which are produced through the lithium production process being released into surrounding land and water, damaging ecosystems and causing health issues. Lithium is mainly found in South America where the cheapest extraction method involves evaporating salt brines which uses cheap and toxic PVC and can use large quantities of fresh water.

Lithium mining and production is a cause for concern however, better investment and use of technology in the future could reduce the impact of the requirement of lithium such as by prolonging the life of a battery or reducing the amount required to power vehicles. The outlook is also positive for research to develop battery technology. The Road to Zero Strategy states that the government will work with industry and partners to address

environmental concerns and this is also a priority for vehicle manufacturers. Positively, the UK will also commit to providing a £246 million fund to research next generation battery technology.

6.3 Disposal and Recycling of Batteries

Concerns were also raised regarding the disposal of batteries used in EVs. As explained above, most batteries used in EVs are made with lithium which is liable to lose capacity throughout its life following continuous cycles of charging and discharging. The life span of the batteries depends on the type of vehicle and the usage however, on average the life of electric vehicle batteries tend to last with a 70% capacity between eight to ten years. The more cycles a battery undergoes, the more it tends to degrade and lose capacity hence some manufacturers offering warranties covering 8 years, 100k miles or if the battery is less than 70% efficient they will replace it.

As batteries contain toxic and corrosive materials such as lithium, they can be hazardous waste and carry a risk of giving off toxic gases and so is rightfully a cause for concern due to the damage it can pose to health and the environment if not disposed of properly.

The government and car manufacturers are working to reduce the environmental impact of batteries by producing designs that are more recyclable and contain fewer toxic materials. There are also alternative initiatives or re-using the batteries in other electronical goods.

The government are currently considering how to deal with batteries once they come to the end of their life and can no longer be used in an electric vehicle. A project has been set up with multiple businesses and University College London to try and tackle this issue. The project will look at taking end-of-life, automotive lithium-ion batteries, and either reusing, remanufacturing or recycling them. It will build a complete supply chain network and legal and regulatory knowledge in the UK. The project will help to optimise battery design and increase use in second-life applications, improve recyclability and whole-life environmental impact, while building UK capabilities.

The re-using of batteries is an option in the recycling of batteries where once the battery capacity drops below 70%-80% and is no longer strong enough to power a car; it still retains enough capacity to be used for stationary storage such as household items or for home energy storage.

In regards to the monitoring and enforcement of recycling and disposal of batteries, the UK could take example from China who hold carmakers responsible for the recovery of batteries and require them to set up recycling channels and service outlets where old batteries can be collected, stored and transferred to specialist recyclers. The car manufacturers must also establish a maintenance service network allowing members of the public to repair or exchange their old batteries conveniently.

6.4 The Electricity Grid

It is believed that shortly in the future, if the demand and adoption of EVs increases as predicted and vehicles were all to charge at the same time, it would put significant strain on distribution networks and peak generation of electricity capacity.

Some industry experts argue that the UK's electricity grid system currently would not be able to cope with the rising uptake of EVs and could even cause power shortages without billions of pounds worth of investment in new power plants, however the National Grid's EV Lead disagrees stating that, 'not a tremendous amount of new generation is needed' and that even if the uptake of EVs is faster than the National Grid's modelling suggests, the grid system would be able to cope. These issues could also be averted through smarter charging, consumer education, or incentives in diversifying when consumers should charge their vehicles.

National Grid expects "smart" energy use, which uses digital algorithms to charge and release energy from storage at the most cost effective time, will play a major role in shaping the energy system by the end of the next decade.

The National Grid recognises the developments in electric vehicles and the impacts to electricity grid which will lead to the requirement for more flexible energy systems. While technological advancements in EVs will drive up the demand for electricity, the technology is also a potential enabler for reducing demand, particularly at peak times, by the use of smart applications for example, Vehicle to Grid (V2G) services which could spread pressured to the grid.

Vehicle to Grid services would involve smart chargers which allow the EV to draw power only when it is readily available, avoiding peak periods, while ensuring that they are fully charged when their owners need them. This can immensely vary the capacity required from the grid and in the future, electricity companies can offer different tariffs at different times of day to make create a financial incentive for EV owners to charge their vehicle at off peak periods. Because EVs are in effect energy storage systems, while they are parked, they could be a useful tool for managing demand when vehicles are parked by helping to smooth out the peaks and troughs in energy demand charging. The energy storage in EVs can put energy back to the grid system using software to regulate the charging level of multiple vehicles so when the grid needs extra power, it can draw very small amounts from each individual vehicle and when energy is abundant, energy can be put back to the system again. Again, a financial incentive could be offered as EV owners can get paid for the electricity they provide.

As explained above in the energy production section, the increase in energy generated by sustainable and renewable methods such as solar or wind power is steadily increasing and will help any pressures placed in the electricity grid. In particular people are moving away from the grid and generating their own energy in their homes and businesses though solar to wind energy. These self-generation systems can provide a direct source of power which owners can use to charge an electric car.

6.5 Hydrogen

A number of responses raised from the consultation questioned whether hydrogen powered vehicles will be an option for the future and questioned their viability. Although hydrogen cars were first introduced to the UK in 2014 by Toyota, they have since kept quite a low profile however, they are considered to be one the next biggest trend in automotive technology.

Hydrogen vehicles are also called Fuel Cell Electric Vehicle (FCEV). A fuel cell electric vehicle (FCEV) uses hydrogen gas as a fuel which is converted to generate electricity to power the vehicle. The FCEV benefits from zero tailpipe emissions emitting only pure water, however their scope is limited as they require special infrastructure to refuel the hydrogen, with only 12 refuelling centres currently in the UK. The refuelling process is similar to that of conventional diesel and petrol refuelling and so offers the advantage of refuelling quickly, however it is limited as FCEVs cannot be charged or refuelled at home. The FCEV uses fuel cells which convert hydrogen to electricity, and so is different to a standard battery powered EV as it does not store energy in its battery. Hydrogen vehicles benefit from fast refuelling compared to battery EVs with typical filling times of just five minutes and typically have a range of 300 miles.

Hydrogen fuel cell technology is an area of the automotive industry that is becoming increasingly important as more manufacturers commit to developing this type of power for vehicles , however there are currently only three FCEV models available to own in the UK; the Hyundai ix35, Honda FCV and the Toyota Mirai.



There is not currently enough reliable evidence or forecasts to determine whether or not hydrogen powered vehicles are the future of automotive technology. Similar to electric vehicles, hydrogen vehicles are yet to stand the test of time and are still developing and so it will take time to educated buyers to switch to hydrogen powered vehicles and convince them of the potential benefit. Also, the requirement to install the necessary infrastructure such as filling stations to power the vehicles is expensive which can create a barrier to hydrogen vehicles production and uptake. However, the governments Road to Zero strategy suggests that the ‘transition to zero emissions vehicles does not just require the vehicles to be available and affordable’ and that ‘an infrastructure network needs to be in place that is easy for current and prospective drivers to locate and use, and is affordable, efficient and reliable.’ This includes the development of the infrastructure for hydrogen fuel cell electric vehicles where the market is at a much earlier stage of development.

£4.8 million has been committed so far since 2014 to address the refuelling and infrastructure barrier for hydrogen vehicles and while hydrogen technology is at an early

stage of development, the government have committed to the development of hydrogen technology and wish to retain the UKs leadership position in hydrogen through a £23 million Hydrogen Transport Programme. This programme aims to increase the uptake of hydrogen vehicles and grow the number of refuelling stations by 2020.

Like the development of electric cars, hydrogen fuel cell vehicles will get more advanced over time, with the technology getting cheaper and the range increases. This could possibly make hydrogen cars more appealing in the future and become more widespread.

6.6 Rapid Charging Points

Numerous concerns were raised generally regarding the charging times for EVs which can vary depending on the type of charging point used however this report will focus on the rapid charging points, a technical aspect raised in the consultation. Public charging points are primarily one of three main types;

Types of Charging Point			
	Low	Fast	Rapid
Power	Up to 3kW AC	7 to 22kW AC power outputs	Between 43k Wand 50kW
Charging Time	6-12 hours to charge a battery electric vehicle	3-4 hours to charge a battery electric vehicle	30 minutes approximately for 80% charge

Figure 7: Types of Charging Points

Rapid chargers are the fastest way to charge an EV however, can still take between 20-40 minutes to recharge an EV to 80% capacity, and can only be used on vehicles with rapid charging capabilities. Currently in the UK rapid chargers can mainly be found near to main roads or at motorway service stations. The number of charging points in the UK is increasing and more specifically, so is rapid charging points as displayed in the diagram below.

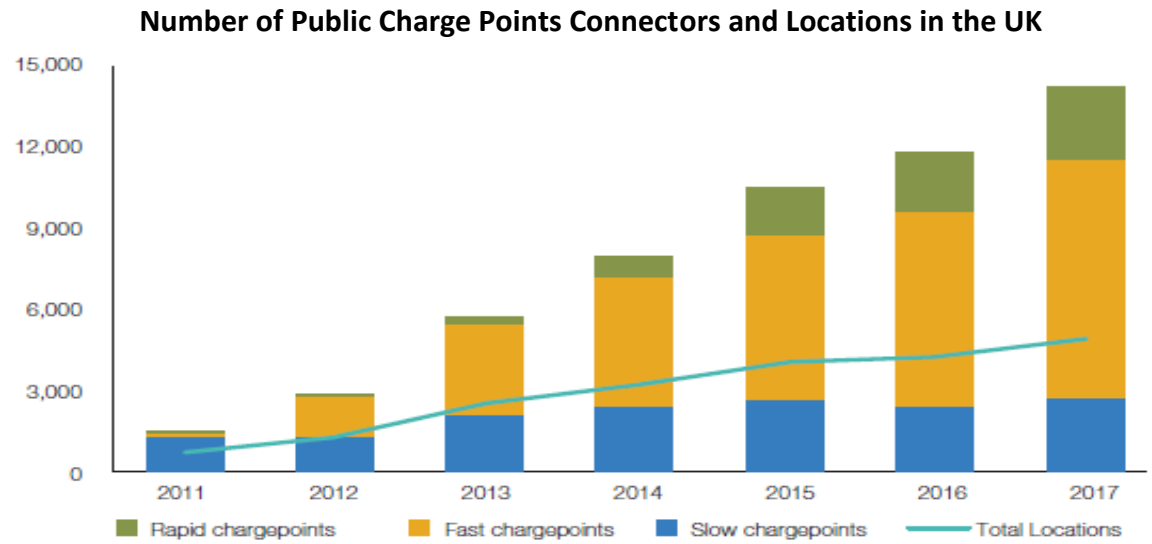


Figure 8: Number of Public Charging Points in the UK (source: Road to Zero Strategy, 2018)

Rapid charging is becoming vitally important in the take up of EVs as give EV owners confidence of making longer journeys with good access to a rapid charging point. In the first Road Investment Strategy (2015-2020), Highways England committed £15 million to ensure that its users are always within 20 miles of a rapid charging point along 95% of the Strategic Route Network and are delivering a programme that will install at least 65 charging points in 2018/19. Highways also intend to install rapid charging points no more than 2.5 miles or 5 minutes' drive away from the Strategic Route Network by providing grants to local authorities to install rapid charging points and running procurements to install charging points at alternative locations.

There has also been further investment for rapid charging points in recent years in the UK from large companies such as Shell and BP who have made high profile acquisitions into charging networks.

In regards to rapid charging points in urban areas, the launch of the Go Ultra Cities scheme is intended to provide hundreds of rapid charging points in participating cities and initiatives will be shared across other cities in the UK.

6.7 Location of Charging Points

The consultation queried the location of charging points. As mentioned in the rapid charging point section of this paper, charging points are being considered by Highways England and the government strategically and in urban areas and cities.

In the case of Hertfordshire, while the Local Transport Plan supports the adoption of EVs and its infrastructure by stating that the council intend to 'facilitate the installation of charging infrastructure and other facilities to support low emissions schemes', more studies are required to determine exactly where the council should concentrate their efforts in providing charging points strategically. Whilst the Local Transport Plan positively aims to 'ensure that any new parking provision in new developments provides facilities for electric charging of vehicles', it does not determine other public locations in urban and rural areas, or retrofitting in current homes. Again, more research and studies is required to determine where the council wishes to place its focus on new locations for EV charging in particular, as the technology develops. For example, as EV battery technology develops, EVs might be able to cover more range and therefore, one charge at home overnight could cover a longer distance and the number of charging points and locations may need to be considered differently.

The map (figure 9) presents an overview of the current public charging location in Hertfordshire and the driving time to these locations. It clearly shows that charging locations are mainly in urban areas and so this could be a focus for the council to determine whether it would be beneficial to study whether further charging points are required in rural areas such as East Hertfordshire, or if home charging is adequate for these areas. Also, Hertfordshire could take advantage of Highways England's proposals of working more

closely with Local Authorities and look to increase the number of rapid charging points in particular for the M1, M11, A10 and A1(m) and adjacent urban areas.

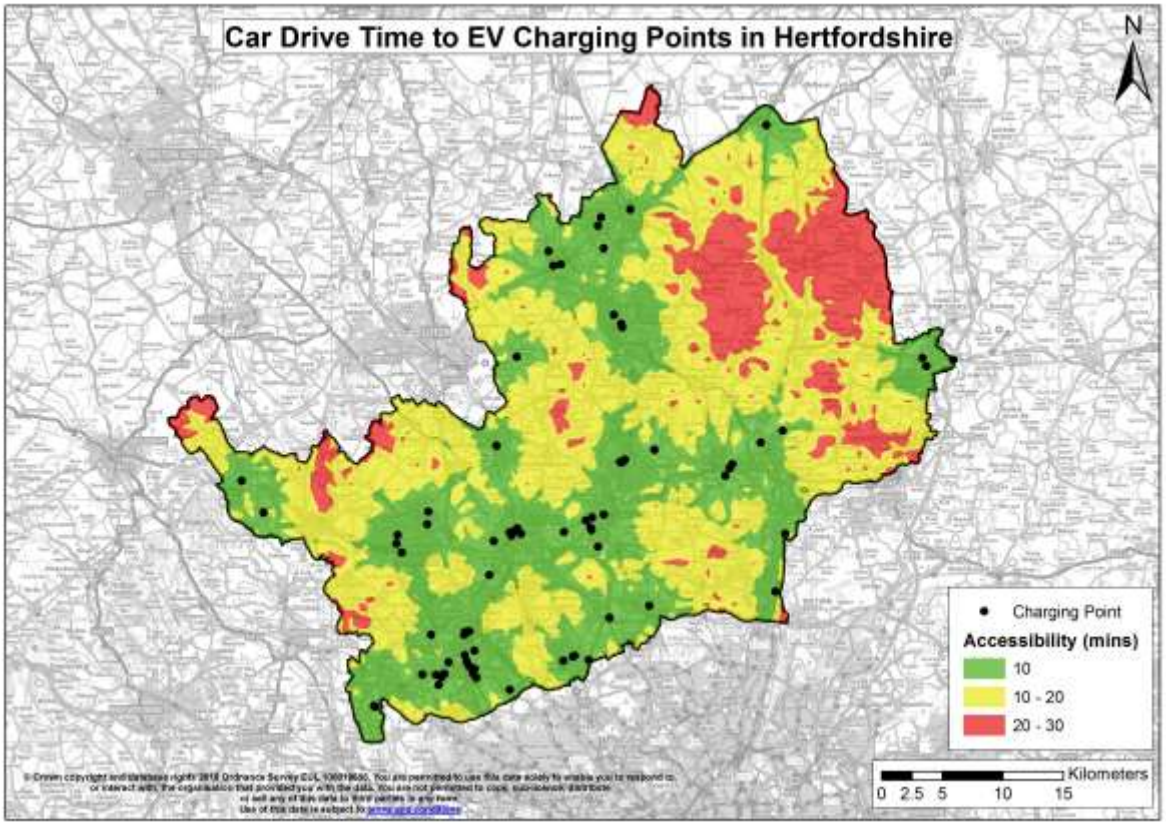


Figure 9: Car Drive time to Public EV Charging Points in Hertfordshire

6.7 Priority Lanes for Electric Vehicles

Priority lanes for EVs were mentioned in the consultation. While there are no immediate plans for Hertfordshire to introduce EV only or priority lanes, the Governments introduction of clean air zones does take a step towards priority for EVs, initially in cities with poor air pollution but which could be adopted in areas of poor air quality in Hertfordshire.

In a plan to encourage drivers to choose less polluting vehicles cars, EVs could be given priority at traffic lights and exempted from one-way systems under new proposals, as well as restricted older more polluting vehicles. Five cities were chosen for clean air zones for their high levels of nitrogen dioxide caused by diesel fumes however, other local authorities in England will be able to create clean air zones voluntarily. Within these clean air zones councils can create new road layouts allowing EVs to bypass one-way systems or get priority at junctions. They could also be given preferential parking spaces and lower charges.

In January 2016 the Government awarded Milton Keynes funding for being an exemplar city for EVs and received £9 million to open a city centre Electric Vehicle Experience Centre. The funding was also used for proposals to open up 20,000 parking bays for free to EVs, and co-

brand bus lanes as low emission lanes giving plug-in vehicles the same priority at traffic lights as local buses.

The Clean Air Zone Strategy states the following incentives for EV use in clean air zones;

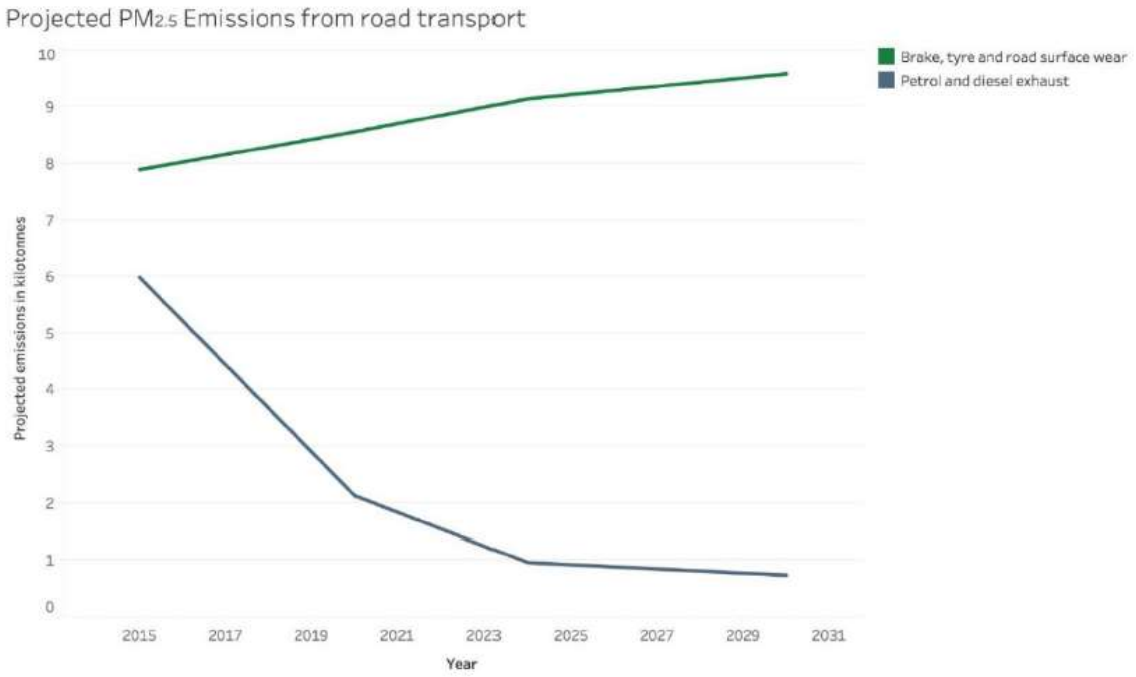
- Provide preferential parking bays or access for ULEVs.
- Lower parking fees for ULEVs.
- Allow access to bus lanes, and exemptions from other restrictions.

There is the potential that over time EVs could become more popular and create congestion impacts therefore, these incentive measures could no longer be appropriate and therefore, local authorities should continue to monitor and review any type of priority access for EVs regularly.

6.8 Particulate Matter (PM)

Concerns were raised in the consultation regarding EVs continuing to release dangerous particulates in the air similar to a conventional vehicle. Exhaust emissions from road transport have decreased due to increasingly stringent emission standards however; the relative proportion of non-exhaust emissions will rise and already represents more than half of the PM2.5 emissions from transport as Figure 10 shows.

While EVs release far less particulate matter from their tailpipes than conventional vehicles, electric vehicles still emit relatively high levels because of their relatively high weight. EVs are generally heavier than conventional internal combustion engine vehicles largely due to the weight of batteries and as a result, total PM2.5 and PM10 emissions from EVs can be equal to those of modern conventional vehicles. If a vehicle is heavier, more kinetic energy needs to be dissipated in stopping the vehicle and as a result, if such a vehicle were to use only conventional braking, the increased weight may increase the rate at which brake pads and disks wear out, increasing particulate emissions.



Projected PM2.5 emissions from brake, tyre and road surface wear, and exhaust emissions, 2015-2030 (Source: DEFRA Call for evidence on brake, tyre and road surface wear, July 2018)

The Road to Zero Strategy sets out a long term ambition to deliver cleaner vehicles by 'launching a call for evidence on particulate emissions from tyre, brake and road wear to improve our understanding of these emissions and consider options for how they might be reduced.' Regenerative braking technology for example, as it advances, is likely to produce less particulate matter as emissions of brake particles from EVs will be greatly reduced because much of the deceleration will be achieved through regenerative braking which recovers the kinetic energy without particulate matter emissions as opposed to the application of mechanical brakes.

6.9 Retro-fitting EV Charging Points to Existing Homes and Homes with On-Street Parking

Queries were raised regarding the Local Transport Plan mentioning the installation of charging points at new developments however, little mention of retro-fitting charging points to existing homes and in particular, apartment blocks with communal parking and homes without off-street parking. There are currently no specific plans for Hertfordshire in this context other than plans to install more charging points generally around the county however, the Road to Zero Strategy does expand on this point of retro-fitting at existing homes with future plans to increase the provision of charging points at existing homes.

As part of the Road to Zero Strategy ambitions to development of one of the best electric vehicle infrastructure networks in the world, it supports the reviewing of the provision of residential charging point infrastructure for those who have communal parking facilities, or do not own their own home.

The strategy intends to consider how all types of residential property are able to access charging points and not be disadvantaged merely on the basis of having communal parking facilities. As part of the commonhold tenure, charging point infrastructure will be reviewed.

In regards to enabling EV charging on residential streets, the strategy recognises that more than a third of households in England do not have access to off-street parking and that there remain barriers for owners living in households without off-street parking.

In Oxford, trials are currently taking place in regards to on-street charging funded through OLEV's Go Ultra Low City Scheme. Different charging technologies have been applied at different locations for residents living and parking on narrow streets, these include;

- Domestic chargers using pavement cable channel to enable residents to use their own electricity for charging without running cables across pavements;
- Fitting three lamppost chargers per vehicle to avoid the need for dedicated parking bays;
- Discreet, slim-line standing charging points which can provide a higher rate of charge and better manage residents' concerns over street clutter.

It is recognised that on-street charging is a challenge faced for local authorities and so to encourage the development and deployment of such infrastructure a £4.5 million grant funding is available to 2020 for the On-street Residential Charging Point Scheme (ORCS) for local authorities who remain best placed to support infrastructure roll-out on publically owned residential streets.

There is also intention to support local authorities in 'future proofing' streets with on-street parking by enabling all street lighting columns to include charging points. There is also intention to fund the Energy Saving Trust to assist more local authorities, share more knowledge and expertise and directly support the development of more EV infrastructure delivery plans and applications to the on-street scheme.

Wireless charging is also an option under research and development with a £40 million programme looking to develop and trial low cost wireless charging and on-street charging solutions.

7. SUMMARY

The aim of this report is to attempt to answer questions raised regarding electric vehicle technology and infrastructure from the public consultation for Hertfordshire County Council's Local Transport Plan 4, and offers a general overview of technical aspects regarding EV technology. Electric vehicle technology is relatively new in regards to production, sales and ownership to the mass market and therefore, the information in this report, while drawing upon existing sources of data and relevant and recent strategies and studies is speculative, and it is advised that further research and studies are carried to understand the benefits and effects from electric vehicles, particular due to their rapid development and unknown future impacts such as to the environment or congestion.

In regards to Hertfordshire, again further research and studies are required to specifically identify the benefits of electric vehicles to the county and impacts they may have. In particular identifying the most beneficial charging point locations, their efficiency and on-street parking could be made a priority. As electric vehicle technology develops, the county should seek to understand better how they intend to take this technology forward in relation to the benefits and impacts to the county, and determine where investment could be best spent, whilst taking into account the rapid technological developments. Caution should be made when investing in electric vehicle such as charging points as if/when the vehicles themselves begin to cover a far greater range, certain charging points could be made redundant.

The Local Transport Plan does covers the topic of electric vehicles and the council's high level strategy in relation to the technology, and is aware of the rapid changes and development in technology as noted in its 'Drivers of Change and Hertfordshire Futures' section. However, due to the amount of available funding and future opportunities to bid for funding, the County Council could consider developing a specific supporting document to establish its electric vehicle strategy and ascertain the county's position, aims, objectives and intentions for the future of electric vehicles to aid any future bids and potential funding opportunities.

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9. APPENDIX

Comments Received with Technical Questions

Energy production another elephant In the room is our reducing electrical generation capacity and increasing reliance upon unreliable sources such as sun or wind.
A dark, cold, windless night will see us trying to rely on imported electric from France or Norway to charge our ULEVs overnight.
If every new build property in Hertfordshire was compelled to have a minimum of 50% of its root covered with photo voltaic panels, have battery storage for 24 hours of its own electric consumption and all wiring and control circuitry built in then I'd support this more.

What happens to spent Nuclear processing fuel producing the electricity for all these anticipated electric cars?

With more charging points and better mileage amount per charge this would be a better option for people, but the electricity needs to be generated in an environmentally friendly way.

Electric cars are only a good idea as long as their electricity is made by sustainable energy sources. Otherwise they will only shift air pollution, not decrease it.

With regard to the adoption of EVs, has HCC ever stopped to think how electricity is brought to the cars in the first place?
This electricity comes mostly from burning fossil fuels (42%) and coal (9%) which is not environmentally friendly.
By increasing the use of electric cars, fossil fuels would be burned at an increased rate, depleting reserves quicker than petrol powered vehicles currently do.
Electric Cars are expensive and do have an environmental impact (manufacturing process, still need electricity to be generated) and do not have sufficient range - so please don't think this is the ideal solution, it is not.
What happens to the expired batteries from electric cars? They cannot be incinerated at the new Hoddesdon Plant.
Can the electricity infrastructure cope with large numbers of EVs?

In addition the batteries of electric cars are not environmentally friendly and many need replacing after 5 years (at enormous cost) - how will you deal with this as yet unrecognised environmental issue?
Will Hydrogen cars be an option in the future?
Please bear in mind that it takes 30 mins to charge an electric car to 80%, so installing any charging facilities in tows would require a lot of committed parking spaces.
And have you even considered how long EVs take to charge and where you would locate charging points at a time when parking is already at a premium?
Autonomous lanes for electric vehicles and possible inductive charging locations along the route
Allowing for the rapid growth of hydrogen powered vehicles and cleaner petrol vehicles this will help reduce pollution but as 40% of dangerous materials from cars come from brakes

and tyres this must be part of a many pronged attack that focuses primarily on alternatives to driving.

Use of ULEV, especially electric, needs to be a central policy decision and thereby part of that plan rather than LTP4, as it has an impact on national energy generation, provision of recharging points, and recycling of resources used in batteries all of which are outside the powers of a County Council.

Interestingly, electric cars are probably believed by most people to virtually wipe out emissions etc. But the truth is far from that. Yes they do virtually eliminate emissions at the point of use, but there are still significant emissions where the electricity is generated. Power stations are more efficient, but battery charging is not. I remember an article in Top Gear where they compared the Prius efficiency with a Ford Focus and found very little difference. (I know a Prius is not just an electric car and the electricity generation is done using a diesel(?) engine, but it did illustrate the misconceptions of the general public about such technology).

The huge predicted and encouraged growth in electric cars will mean more motorway / trunk road service areas will be needed (fewer miles in a battery range) where vehicles can stop and re-charge. Planners should be considering where these can be strategically located, especially on the M11, A1(M) and A10.

I am not convinced that electric vehicles are the answer without a further major improvement in batteries.
Also I do not think that the impacts on the electricity infrastructure are full planned and costed for in the future to enable this level of change.
Personally I think there should be massive paralell investment in the pursuit of Hydrogen powered vehicles

In the real world electric cars are not feasible unless the battery technology changes so that you can fully charge in 3 to 5 minutes and accomplish a 300 to 400 mile journey on one charge.
The government and county councils should be encouraging zero emission vehicles like hydrogen fuel cells by building up the garage infrastructure.

The downside of electric cars have been seriously overlooked
Their short range long recharge cycles and stress on the national grid will become untenable
More research is required to ensure sufficient resource and generating capacity will be available at all times or the whole system will collapse

Secondly, the generation of electricity to power such vehicles is no better as most of this energy is provided by the big power stations which no one wants on their doorstep so it is just swapping one environmental issue with another environmental issue.

If there were space in the system then LEV's could be encouraged effectively by dedicated bus and LEV only lanes policed by cameras but that space does not exist in many roads at present.

With more charging points and better mileage amount per charge this would be a better option for people, but the electricity needs to be generated in an environmentally friendly way.

Will Hydrogen cars be an option in the future?

It is entirely possible that the growth of electric vehicles, whilst reducing demand for oil, will increase the demand for certain very scarce metals, such as lithium.

Use of ULEV, especially electric, needs to be a central policy decision and thereby part of that plan rather than LTP4, as it has an impact on national energy generation, provision of recharging points, and recycling of resources used in batteries all of which are outside the powers of a County Council.

Electric cars still have to be powered somehow, electricity generation is hardly environmentally friendly.

Disposal of batteries is shifting pollution to a different outlet, so overall not environmentally friendly.

There is a need to consider how electric charging infrastructure will be retro-fitted into existing developments, such as terraced houses, flats and other homes without driveways, employment and retail areas. This is not currently addressed in the existing policies.

We would welcome more detail on the approach to meeting demand for ULVs including suggestions for how households without driveways might best charge vehicles.

We agree that the county council should encourage low emission vehicles such as electric cars but it has to be recognised that these cause just as much congestion as petrol and diesel vehicles and also that they generate dangerous particulate air pollution from the interaction of their tyres with the road surface.

Can the electricity infrastructure cope with large numbers of ev’s?

Electric vehicles aren’t as efficient as they make out. Electricity has to come from a power plant. The only difference is that the pollution isn’t coming from the vehicle but the plants instead.

Electric cars do pollute it is just the pollution is transferred form the tail pipe to the power station chimney.
The Li-ion batteries used in these cars have a heavy environmental impact where the Lithium metal is produces and is the dirtiest industrail process known to mankind.

Coal, oil and gas fired power stations all produce CO2 and we would need to build more power stations if we all changed to electric cars overnight.
Not to mention the enormous task of dealing with tens of millions of conventional cars being scrapped.
We need to find a way of converting, at minimal cost, the current car park, where possible to run on Hydrogen.

Car clubs are not safe and electric cars are not the future as they contain batteries which are not environmentally friendly, there will also never be adequate provision for charging them.

Care should be taken, there seems to be a feeling that Electric vehicles will solve all our problems, they still use significant energy that has to be generated, the pollution just moves to the power station, they still create congestion, their tyres and brakes still create particulate pollution, their apparent low cost and eco friendliness will encourage greater use and therefore greater congestion.

Ban all electric cars. They have to be charged by electricity which is mainly generated by fossil fuels.
Electricity systems were never designed to allow such heavy usage in households.

Electric cars seems a good idea, but again nobody has really come up with what do you do when you live in a town or village and it will not be possible to have a electric point put into your property.
Where is all the electricity going to come from? To charge these cars. No nuclear reactor been built yet?

Electric cars are only a good idea as long as their electricity is made by sustainable energy sources. Otherwise they will only shift air pollution, not decrease it.

ULEV's are the way forward, but are not fool proof. They are not road tested over long distances yet and have not been in service long enough to be considered totally reliable.