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Smart Ultra Low Emission Mobility in Dundee

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Executive Summary

Dundee is a city being transformed by ultra low emission vehicles (ULEVs) and with an ambition to become a global test bed for new smart mobility technologies and services. This paper describes the comprehensive electric vehicle programme that has been implemented in the Scottish city, which includes the UK's largest public sector fleet of ULEVs, the UK's largest electric taxi project and one of the most extensive urban rapid charger networks in Europe. It also explains how the city is positioning itself to become a living laboratory to attract investments and pioneer new mobility solutions that address complex social, economic and environmental challenges facing cities today.

Keywords: electric vehicle, smart mobility, innovation, policy

1 Introduction

Dundee is a city being transformed by smart ultra low emission mobility. As a compact city in the midst of a £1 billion waterfront redevelopment, the scale of this change is difficult to miss and offers an exciting window into the future potential to integrate electric vehicles (EVs) into a modern and dynamic city.

Known locally as the City of Discovery, Dundee rests on the banks of the River Tay estuary on Scotland's East Coast. With a population of 147,800, Dundee is Scotland's fourth largest city and the principal employment, retail and service centre for a regional population of over 400,000 in the wider Tayside area. The city benefits from a central position at the heart of a national transport network, which connects to Perth, Stirling, Fife, Aberdeen, Inverness, Glasgow and Edinburgh; 90% of Scotland's population live within 90 minutes travel distance of the city (see Figure 1).

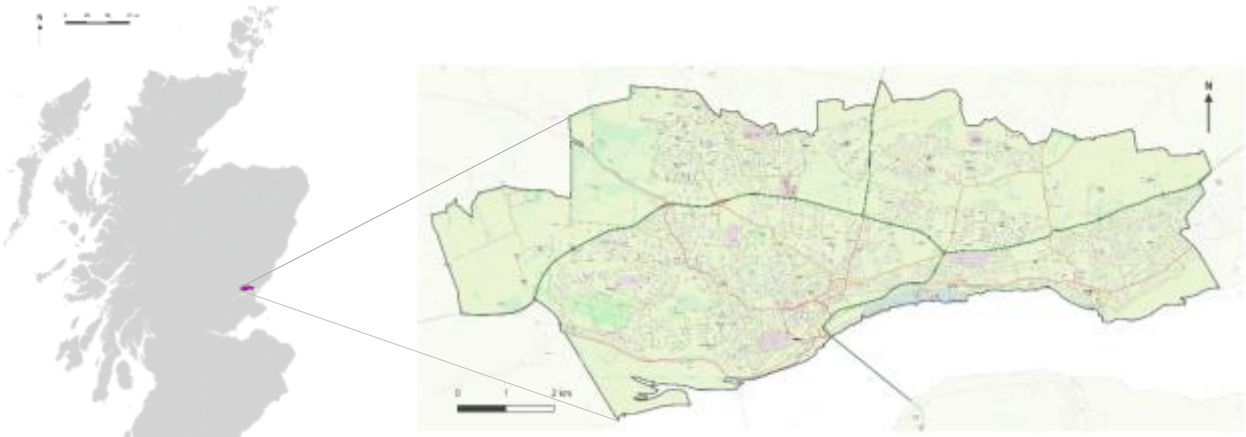

Figure 1: Location of Dundee

EVs are already a highly visible presence on the city's roads, creating a tangible buzz amongst the local population and winning the city an international reputation as a hotbed for EV adoption. Dundee City Council has invested almost £1 million to establish the largest local authority fleet of electric vehicles in the UK. With 83 of its cars and vans now electric, the Council is also reaping the benefits of significant daily operational savings, saving up to 70% on fuel costs.

Building on the Office for Low Emission Vehicle's Plugged in Places project, and with additional funding from Transport Scotland, around a million pounds has been invested in EV infrastructure in Dundee, providing Scotland's most extensive charging network and the UK's first urban rapid charger network. This currently consists of 86 charging points, of which 13 are rapid chargers located across the city (including the highest used rapid charger in the UK) and a Tesla Supercharger hub.[1]

The city also boasts the UK's largest electric taxi project with 38 taxi fleet vehicles by the end of 2016[1] and one of the largest and fastest growing fleets of electric car club vehicles. Funding awarded in spring 2017 from the UK's Office for Low Emission Vehicles is set to further enhance Dundee's taxi project.

Dundee's progress is being guided by a comprehensive and integrated strategy set out in Transport Scotland's Switched On Scotland roadmap. This establishes EVs as a key enabler of Scotland's ambitious commitments to climate change, air quality and renewable energy.

Dundee is also working to realise new economic opportunities from its status as an EV pioneer. This includes becoming an international test bed for smart mobility technologies and business models through the recently established Mobility Integration Living Laboratory (The MILL). In addition, the Shared Mobility for Resource Efficiency (ShareMORE) programme see the convergence of smart mobility and the sharing economy with an aim to create the UK's first 'Sharing City'.

Smart ultra low emission mobility can promote wellbeing, enhance quality of life and create new economic opportunities.[2] This paper explains why Dundee is committed to making this transformation, summaries the progress made to date, and outlines the city's ambition for the future.

2 Why Dundee is Changing for the Future

There are a number of important factors motivating the city's investments in smart ultra low emission mobility:

2.1 Air Quality

Road transport is the main source of air pollution in Dundee and is acknowledged as having an adverse effect on the population's health. Dundee City Council has declared the whole of the local authority area as an Air Quality Management Area (AQMA) and around 1 in 30 residents were estimated to be living in areas at risk of exceeding national air quality standards for NO_2 and PM_{10} in 2009[3].

Road traffic accounts for 74-91% of the total NO_x concentrations within the city and 41-72% of the total PM_{10} concentrations.[3] Light duty vehicles (LDVs), which include cars, taxis and vans, make a significant contribution to this pollution, with tailpipe emissions accounting for 11-44% of NO_x concentrations and 7-24% of PM_{10} concentrations. In addition to tailpipe emissions, brake and tyre wear contribute around a further 13-29% to the total PM_{10} concentrations. As well as impacts on air quality, private vehicles account for 95% of carbon emissions in the Tayside area.[4]

Nearly 2,100 people are estimated to die every year in Scotland as a result of fine particulate matter ($PM_{2.5}$) alone. High levels of air pollution have also been strongly linked to increases in cardiovascular and respiratory diseases.[5] The population of Dundee are exposed to higher mean anthropogenic $PM_{2.5}$ than the Scotland average[6]. Dundee also has the 4th worst age-standardised death rates from cardiovascular disease (CVD) in men and women, under 75, amongst local authorities in the UK[7].

Dundee city council and its local partners are committed to improving air quality and have already begun to implement a comprehensive set of measures to deliver improvements of which electrification of transport is a key component.

2.2 Decarbonising Energy

On a national scale, Dundee is also party to the Scottish Government's commitment to decarbonise the power sector. Today, over a third of the UK's total renewable electricity output comes from Scotland and there is a commitment to achieve the equivalent of 100 per cent of Scotland's gross electricity consumption from renewables by 2020[8], and a 12 per cent reduction in Scotland's final energy consumption by 2020. The latest data from 2016, highlighted that Scotland is on track to meet this target with 53.8% of electricity demand deriving from renewable sources.[9]

The abundance of green electricity in Scotland to power electric vehicles and other elements of mobility projects will maximise their carbon reduction benefit and it will also support increased generation from renewable sources.

2.3 Regeneration

Dundee is in the midst of one of Europe's largest regeneration programmes. The £1 billion waterfront transformation is a strategic, focused and forward-looking 30 year project (2001-2031) that encompasses 240 hectares of development land stretching 8km along the River Tay. With it expected to generate 7,000 jobs, it has helped Dundee to transform itself into a dynamic modern city with an international reputation as a centre for energy, engineering, digital media, arts, life sciences and the creative industries. Set to open in 2018, a key architecturally striking element of the development, the V&A museum is also expected to attract a significant number of visitors to the city, with 500,000 in the first year of opening and 300,000 per year thereafter.

Due to the forecasted growth of the city and increase in visitor numbers, Dundee City Council has recognised that improving mobility across the city is a crucial goal. Therefore, the incorporation of smart ultra low emission mobility into the very heart of this development is essential.

Dundee is also home to a number of businesses that have potential to greatly influence the future of smart mobility technologies also has a vibrant digital and creative cluster with expertise that could help shape future mobility services.

3 A City Being Transformed by ULEVs

Dundee is making significant progress today on its path toward smart ultra low emission mobility and could make a strong claim to be the UK's leading ULEV city. As of Q4 in 2016, there were 429 licensed ULEVs (10% of Scotland's total fleet) across the Tayside region, comprising of Perth and Kinross, Angus and Dundee. Of these, 190 are based in Dundee (44% of Tayside Region/4% of Scotland's total for licensed ULEVs).[10] There has also been over 4 million miles driven between Dundee University, NHS Tayside, Dundee & Angus College, the private sector, Dundee City Council and the Dundee taxi fleet with the period

of 2012-2017. Considering average car emissions estimated at 146g/km, this has realised savings of 947 tonnes of CO_2 and a saving of 70% on fuel costs compared to diesel vehicles.[11] Given this evidence, there is an ideal opportunity to continue the integration of ULEVs into a city that is enjoying a radical transformation. This section examines why Dundee is a city well suited to this change and its current progress so far.

3.1 Geography and population

Dundee is a relatively compact city, covering a total area of around 55 sq.km and is only 15km across at its widest point, with a maximum drive time of 20 minutes between points within the city. This makes the city especially well-suited to the widespread EV use, with the drivable range of current vehicles sufficient for practically all journeys within the city. The compact nature of the city also makes ULEVs highly visible, providing a level of exposure to the general public in the early market that would not be possible in much larger cities.

Dundee's size also makes it an ideal representation of the kind of place where most of us live. Over 77% of the UK population currently lives in cities with fewer than 250,000 residents and 87% of EU citizens live in cities with a population of under 500,000. The urban fabric of small and medium-sized cities can be very different to larger metropolises, with pronounced differences in: housing, the built environment, transport infrastructure, spatial planning, industrial composition, renewable energy potentials and natural resources. Hence, solutions pioneered in Dundee offer greater potential for replication across the UK and Europe, providing increased opportunities for major emissions reductions and widespread commercialisation.

3.2 A strategic approach

The city's ability to deliver large scale ULEV projects has been facilitated by high level support from both politicians and senior management within the council. This is based on a strong commitment to improve air quality and to reduce CO_2 emissions in the city and recognition of the related opportunities for business and job creation that higher levels of ULEV adoption could achieve.

It is also a lead city in the implementation of Transport Scotland's Switched On Scotland Roadmap. This comprehensive strategy sets out the important changes that need to occur in cities and communities across Scotland to realise a step-change in the uptake of ULEVs.

3.3 Established partnership working

An important element of Dundee's success to date has been its partnership working. The City Council has formed valuable partnerships across the private, public and third sectors that have both supported ULEV activities within Dundee and inspired action in the wider region, nationally and even internationally.

Linked public sector partners in the city have been extremely active and are central to the city's success. With 40% of its fleet now electric, Dundee University has the largest ULEV fleet of any university in Scotland. Dundee University and NHS Tayside has also recently let pioneering procurement frameworks that incentivise the provision of ULEVs for external transportation services.

Furthermore, Dundee City Council and its partners are active in a number of national and international networks, such as EV4SCC and have developed global reputations for their achievements and expertise in ULEVs. The City Council and its partners are also actively engaged in a communications and outreach campaign, which has the twin purpose of building the city's reputation as a hotbed for ULEV adoption and sharing knowledge to help other cities overcome early market challenges and inspire progress.

3.4 Ultra Low Emission Taxis

Dundee taxi firm 203020 Electric runs the largest all-electric taxi fleet in Scotland. After launch in April 2015, the firm reported to have driven over a million all-electric miles by February 2016, with each driver saving between £120 and £130 a week on fuel.[12] As such, the city boasts the UK's largest number of electric taxis with 38 electric vehicles (5% of the total taxi fleet) by the end of 2016. By May 2017, taxis in Dundee had completed over 2.5 million miles.

On 22nd March 2017, it was announced by the UK's Office for Low Emission Vehicles that Dundee was one of ten successful bids (to receive £515,000) to secure a share of the £15 million Ultra Low Emission Taxi Scheme. The funding will be used to install 10 rapid and 2 fast chargers at key sites, and will help the Dundee taxi industry increase the number of ULEVs in use. The funding will also support essential upgrades to electrical substations and allow the installation of solar canopies at the Queen Street and Lochee charging hubs shown in Figure 2.

3.5 Strategic charging hubs

Several million pounds has been invested in EV infrastructure in Dundee, providing Scotland's most extensive charging network and the UK's first free-to-use urban rapid charger network. This currently consists of 86 charging points, of which 13 are rapid chargers located across the city (including the highest used rapid charger in the UK) and a Tesla Supercharger hub. Consequently, Dundee consumes the greatest volume of energy for vehicle charging than any other city within Scotland.[13]

On 25th January 2016, it was announced that Dundee was one of eight UK cities to receive a £1.9 million share of £40 million of UK government funding under the Go Ultra Low City Scheme. This will see the development of three electric vehicle charging 'hubs' across the city to maximise the ease and convenience of using EVs and to pilot revenue generating opportunities that reduce the need for ongoing public funding. These will provide opportunities to access multiple rapid chargers at single location and are expected to increase the convenience of charging a ULEV. The hubs will be located at highly visible locations across the city, ensuring infrastructure is easy to locate and access. The location of these hubs (Figure 2) target pollution hotspots and has been considered with commuters in mind, the central hub will host a bank of rapid chargers and electric car club vehicles that shelter under a photovoltaic canopy.

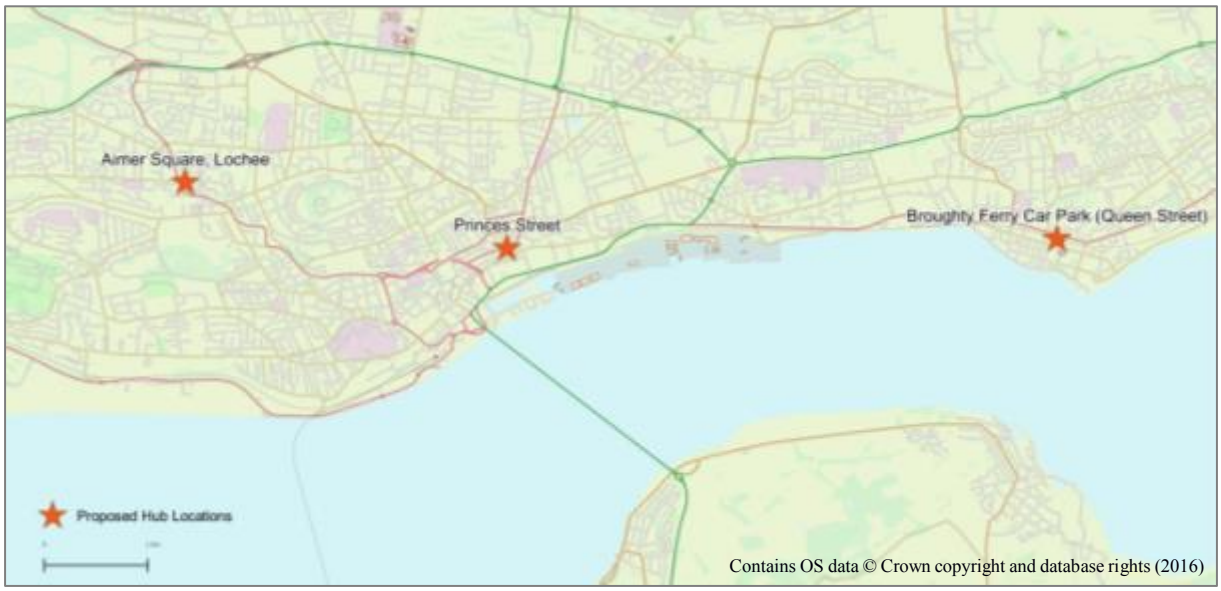

Figure 2: Proposed EV charging hubs in Dundee

4 Smart Mobility

Dundee's ambition is to build on the uptake of ULEVs and become a leading international beacon for smart mobility.

Smart mobility can be described as the opportunity arising from the convergence of transport systems, ICT and energy.[14] The key components are: a holistic system that enables a strategic approach to transport

management in a city; a focus on user-needs rather than operator prescribed services; and the ability to realise economic and environmental benefits.

Smart mobility products and services are often motivated by the challenges associated with increasing urbanisation, congestion and urban emissions. Congestion costs the UK economy an estimated €24.5Bn a year in lost production[15], hence developing advanced solutions to address current and future mobility challenges offers considerable potential economic benefits. In quantifying the economic potential in this sector, Scottish Enterprise cite analysis by Frost & Sullivan that estimates smart city markets will reach $6.5 trillion by 2020 (global public sector procurement) and $13 trillion by 2020 (global urban logistics, rural logistics and supply chain).[14] Pike Research estimates that from 2012 to 2020, $117bn will be invested worldwide on smart city infrastructures, and $31.2bn of this will be invested in the digital systems and infrastructure for smart transport solutions.

Research and investment tends to be aimed towards larger cities, yet over 77% of the UK population currently lives in cities and communities with fewer than 250,000 residents, and 87% of EU citizens live in cities and communities with a population of under 500,000. Dundee is therefore an ideal test bed to demonstrate how integrated and replicable smart mobility projects and solutions can address many of the complex social and economic challenges facing today's cities.

4.1 Dundee's Mobility Integrated Living Laboratory (The MILL)

At the centre of Dundee's smart mobility agenda is The MILL, a programme office to deliver the necessary resources and expertise to establish Dundee as a real-life test and experimentation environment for smart mobility solutions. This encompasses new technologies, business models and regulatory frameworks that address current and future mobility challenges. The MILL is coordinating existing and future smart mobility projects in Dundee, as well as working to attract new projects and investments to the city. It brings together interdisciplinary experts to develop, deploy, and test – in actual living environments – new technologies and strategies to respond to current and future mobility challenges in a world with increasing globalisation, urbanisation and changing demographics.

As well as a Living Lab, The MILL is working to attract new projects and investment to the city. This is raising the profile of Dundee and Scotland as leading international locations for smart mobility projects and seeking to import and export products, services and expertise to boost Dundee's economy and keep the city at the forefront of mobility projects.

4.2 Shared Mobility for Resource Efficiency (ShareMORE)

A flagship project conceived under the framework of The MILL is ShareMORE, an initiative to develop new solutions that link Shared MObility and Resource Efficiency through innovative technologies, businesss models and policy frameworks.

ShareMORE specifically focuses on car use. In Scotland, an overwhelming majority of journeys are undertaken by car. Public transport accounts for fewer than 10% of all journeys and can only go some way towards realising the necessary economic, environmental and social improvements required of future mobility systems. An important challenge is therefore to make all journeys more resource efficient, minimising both emissions and costs.

The project has secured over £1 million of funding to pilot a range of innovative solutions, covering shared mobility services for the public, solutions for fleets, smart parking and big data platforms.

4.3 Dundee Travel Hub

In June 2017, further funding was secured from Transport Scotland to support the development of a circa £2million Travel Hub Project. This will see the development of an active travel and low carbon transport hub in the centre of Dundee's major new civic space at the city's waterfront. The Project will support Dundee City Council's ambition to encourage both locals and visitors to engage in active travel including walking and cycling, to learn about low carbon transport and to encourage behaviour change to more sustainable ways of travelling. The hub will offer residents and visitors bike hire and bike storage, host community outreach

activities and work to promote sustainable modes of travel in Dundee - including promotion of car clubs and electric vehicles.

Figure 3: Planned travel hub (shown in foreground by lake).

5 Conclusion

Dundee has already established broad and innovative actions to build a global profile as a model city for the demonstration of ultra low emission mobility technologies and business models. These initiatives are helping to address challenges associated with transport, in particular air quality and road traffic pollution in the city centre. They also support ambitions to decarbonise energy systems and promote economic regeneration. These goals are aligned nationally with the overall aim of the Scottish Government to decarbonise the road transport sector.

Dundee is currently undergoing substantive regeneration which looks to enhance its physical, economic and cultural assets. These changes are likely to increase movement within the city and broader region and there is a need to continue to identify smart, sustainable mobility solutions that enable the development to be maximised.

As a core enabler of this change is Dundee's Mobility Integration Living Laboratory (MILL), which will help enhance the quality of mobility in general across the city of Dundee and create new economic opportunities in the rapidly emerging smart mobility market. The ShareMORE initiative also offers the potential to transform Dundee into the UK's first 'Sharing City', through a series of projects that will combine the principles of smart mobility and the sharing economy.

Dundee is on a path to becoming an international testbed for integrated and replicable smart ultra low emission projects and solutions, with the potential to address many off the complex social, economic and environmental challenges that face today's cities, both at a local and national government level. The skills knowledge and expertise being developed in Dundee will further establish the city as an internationally beacon for smart mobility.

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Authors

Dr. David Beeton, Managing Director, Urban Foresight. David is an engineer and strategist who is an internationally recognised expert in business models and solutions for smart zero emission cities. He has worked across five continents and is a regular keynote speaker at electric mobility conferences around the world. He has been Director of E-cosse, Transport Scotland's public-private partnership to advance EVs, since 2011 and Chair of the Electromobility Initiative of the European Innovation Platform for Smart Cities and Communities. David holds a PhD in Technology Management from Univresity of Cambridge, where he pioneered new roadmapping and strategy techniques. He has also gained two Masters degrees in Engineering and an Executive MBA.

Neil Gellatly, Head of Roads and Transportation, Dundee City Council. Neil graduated with Hons in Chemistry and Computing in 1994 and made the rather unexpected choice of joining Tayside Regional Council as a Transport Assistant! A wide range of experience was gained in all sectors of local authority transport co-ordination with Tayside Regional, Perth & Kinross and Dundee City Councils. He is currently the Head of Transportation at Dundee City Council. In recent years he was responsible for the delivery of major public transport related projects such as Bringing Confidence into Public Transport and SmartBus which delivered a 100% barrier free public transport infrastructure for the city. He has also managed travel behaviour change through measures which include lift sharing, staff travel planning and marketing initiatives. Recent efforts have been targeted at ensuring Dundee's successful Smarter Choices Smarter Places city status continues and Dundee is now leading on maximising the adoption and city benefits of Low Carbon Vehicle technologies and collaborative smart and sustainable city development working within Scotland, the UK and with European Cities.

Gary McRae, Corporate Fleet Manager, Dundee City Council. Gary is currently the Corporate Fleet Manager at Dundee City Council. He graduated with an Honours Degree in Business Studies in 1995 before working in the Offshore Catering Industry in Aberdeen for a number of years. Gary then spent a number of years in the Transport Industry in Dundee gaining a wide range of experience in National Haulage. In 2011 Gary was appointed as the councils first Corporate Fleet Manager and was responsible for bringing together all the councils various fleet activities for the 1st time. This included moving all workshops to one central site and bringing the various staffing functions together. Gary has been involved in ensuring that the councils fleet continue to reduce its environmental impact, with a major part of this being the introduction of electric vehicles and charging infrastructure to the city. He has been involved in promoting the use of EVs for 4 years both locally and nationally.

Fraser Crichton, Assistance Corporate Fleet Manager, Dundee City Council. Fraser is currently the Assistant Corporate Fleet Manager at Dundee City Council. He spent many years working within his families farming business before he travelled to Australia where began working in the transportation sector. He returned to Scotland and joined Dundee City Council in 2001. Fraser has a wide range of experience gained in all sectors of local authority transportation playing a leading role in the councils' fleet capital replacement program. In 2011 he was appointed Assistant Manager of the newly formed Corporate Fleet Department. Part of a small management team he has overseen the amalgamation of all Dundee City Council's Transportation Operations including major structural and staffing reorganisation. With the expansion of the corporate fleet departments size Fraser has continued to focus on fleet procurement taking a proactive approach to reducing carbon emissions. Since 2010 he has been at the forefront of developing and implementing EVs and infrastructure within Dundee. Pro-active in both private and public sector of EV adoption he has presented at many events and attended European conferences where he has articulated his knowledge and expertise in the practicalities of electric vehicle adoption.