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Technological Forecasting & Social Change

journal homepage: www.elsevier.com/locate/techfore

How do cities support electric vehicles and what difference does it make?

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ARTICLE INFO

Keywords:

Cities
Strategies
Technology
Cars
Infrastructure
Electric vehicles

ABSTRACT

Many cities publish climate change mitigation strategies and other policy measures to support the wide spread uptake of Electric Vehicles (EVs). This paper investigates the effectiveness of these strategies and the provision of infrastructures in 30 UK cities, with a specific emphasis on those strategies that are within the remit of cities and local authorities. The climate mitigation strategies and supporting documents were obtained from 30 UK cities recommended by the Urban Audit Methodology. We show that 13 cities mention EVs in their strategies. Analysing EV registrations and the EV infrastructures that is provided by cities we found that there is no statistical difference in the number of charging points or EVs between the cities that have EVs as part of their climate change mitigation strategy and those that do not. It was shown that EV uptake was more generally associated with other factors (such as local vehicle population or income) rather than any documented EV/climate mitigation strategy. We demonstrate that local strategies are failing in achieving the much needed step change and make suggestions how to improve EV uptake as an even more radical thinking and policies may become necessary to achieve carbon reduction targets.

1. Introduction

It is generally agreed that the global atmospheric concentrations of Greenhouse Gases (GHG) such as CO₂ have increased markedly as a result of human activities since the industrial revolution and humans are clearly influencing the climate system (IPCC, *Climate Change 2013: The Physical Science Basis*, 2013). The largest growth in anthropogenic GHG emissions between 1970 and 2004 was attributed mainly to energy supply, industry and transport. Transport in particular relies strongly on fossil fuels and accounts for about a quarter of global energy-related GHG emissions (IEA 2016). Transport is a key enabler for economic growth that supports the productivity within conurbations and their catchment areas, by getting people to work and allowing the transfer of goods and services, which are all keystones of the economy. It is therefore important to reconcile the need for travel with the need to reduce carbon emissions from transport. This is particularly challenging in a post-2008 age of austerity where economic growth and productivity have, at least, as high a political priority as decarbonisation.

There is an urgent need to concentrate on cities and their sustainable transport strategies for dealing with the challenges (and opportunities) that climate change may bring. Today 54% of the world's population live in urban areas which is anticipated to increase to 66% by

the year 2050 (United Nations, 2015). International and national commitments influence European city strategies positively (Heidrich et al., 2016). Urban areas in general and cities in particular are the hub of innovation, power and wealth (Bettencourt and West, 2010) and can shape socio-technical transitions (Hodson and Marvin, 2010), but are also responsible for some 70% of global energy related carbon emissions (IEA, *World Energy Outlook*, 2008). Nevertheless, a self-reported survey of 36 megacities demonstrated that cities believe that they have the power and opportunities to take action to mitigate climate change (ARUP, 2011).

In the UK, the Climate Change Act (AoP, *The Climate Change Act, and Acts of Parliament (AoP)*, 2008) placed a duty onto the country to ensure that net carbon account for the year 2050 is at least 80% lower than the 1990 baseline. The Act aims to improve carbon management and help the UK's transition towards a low carbon economy. Whilst the country's total GHG emissions were 29% lower in 2013 compared to 1990 levels (DECC, 2013), the emissions from the transport sector remained nearly constant in 2013 compared to 1990 levels. 58% of the GHG emissions from the transport sector are attributed to cars and taxis, 12% to light vans and 21% to other road vehicles such as buses and Heavy Good Vehicles (HGVs) (DfT, 2013). It is evident that emission reductions from the transport sector are required to meet the

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0040-1625/ © 2017 Published by Elsevier Inc.

overall reduction targets and since a large share of the emissions are coming from cars and light vans, climate change mitigation strategies are promoting the uptake of ultra-low carbon vehicles for road transport (DfT, 2011; OLEV, 2011).

One potential strategy for the reduction of emissions from cars and light vans is the electrification of the fleet through the replacement of existing vehicles with an electric equivalent. Research within this field has shown that EVs produce a decrease in the well to wheel emissions for CO₂ in a country with a less carbon intensive power grid (Doucette and McCulloch, 2011; Ensslen et al., 2017) but demonstrate a reduced benefit when the full life cycle assessment of the EV is considered (Hawkins et al., 2013). Despite the larger amount of embedded carbon within the life-cycle of the EV it is possible that recent developments regarding the acknowledged gap between test cycle and real world emissions may show that the on-road benefits of EVs may be even greater than previously calculated (Duarte et al., 2016).

A recent study has highlighted the current state on policy goals in the UK and Germany to decrease GHG emissions with the fast introduction and diffusion of low emission vehicles and simultaneously the development or preservation of their automotive industry and its competitiveness (Mazur et al., 2015).

In 2011, the DfT committed £400 million for the development, supply and use of ultra-low emission vehicles. This package included over £300 million funding for the Plug-in car grant which reduces the upfront cost of purchasing EVs and qualifying Plug-in Hybrid Electric Vehicles (PHEV) plus £30 million for recharging infrastructure provision through the Plugged in Places Programme (OLEV, 2011). The first eight Plugged in Places Project aimed to install up to 8500 charging posts across Central Scotland, the East of England, Greater Manchester, London, the Midlands, Milton Keynes, the North East of England and Northern Ireland. Since then, the UK Government has announced a further £37 million investment into public recharging infrastructure at train stations, on public sector estate and on-street and rapid charging networks (Office for Low Emission Vehicles, 2013a, 2013b).

Despite Government efforts to promote the uptake of EVs, their market share is falling short of Government and industry expectations (Steinhilber et al., 2013), with some authors suggesting that they will remain a niche market over the next 20 years (Tran et al., 2013). The UK market share of EVs in 2015 was just over 1% (IEA, 2016). If the UK is to meet its reduction targets, the Committee on Climate Change (the CCC) estimates that the ultra-low emission vehicles should reach a market share of 60% by 2030 (CCC, 2015) indicating that drastic measures are needed to reach these market shares.

A range of studies have investigated the incentives and policy requirements that can increase EV uptake (Bohnsack et al., 2014; Gardner et al., 2013; Pasaoglu et al., 2014; Tran et al., 2013), but little is known if and how local policies and/or strategies do impact on EV usage and its supporting infrastructure (Roelich et al., 2015). To our knowledge, this paper reports for the first time the impact local climate change mitigation strategies have on the EV uptake and the provision of public charging infrastructure. To achieve this aim, the paper addresses the following objectives:

1. Report on climate change mitigation strategies published by 30 UK cities,
2. Analyse car ownership, EV registrations and the provision of public EV infrastructure
3. Conduct statistical testing and modelling to determine the impact EV strategies have on the uptake of EVs and the charging infrastructure provided at the city-levels
4. Provide explanations of the findings and recommendations for cities to promote EV and infrastructures effectively.

2. Data collection and research methodologies

2.1. Cities policies and strategies collection

To facilitate the analysis of mitigation efforts, the climate change policies and/or strategies were collected at the city level, i.e. the city is defined by its administrative and/or political boundaries and can be referred to as an Urban Area. Cities (urban areas) were selected following the Urban Audit Methodology (Eurostat, 2010; Morais and Camanho, 2011; Schwarz, 2010). The Urban Audit aims to provide a balanced and representative sample of European cities and applies the following rules for including cities in the database (Eurostat, 2007):

1. Approximately 20% of the national population should be covered by Urban Audit;
2. National capital cities and where possible regional capitals are included;
3. Some large (more than 250,000 inhabitants) and medium-sized cities (minimum 50,000 and maximum 250,000 inhabitants) are included; and
4. Cities should be geographically dispersed within countries.

The Urban Audit lists 30 UK cities/urban areas that are deemed a good representation of the UK as a whole and we included all these cities in our research. The Urban Audit Cities represents a population of around 17,300,000, including two Welsh (Wrexham and Cardiff), three Scottish (Aberdeen, Edinburgh and Glasgow) and two cities from Northern Ireland (Belfast and Derry) alongside 23 English cities. By far the largest city (if indeed it could be referred to as one city) is London with a population of 7.6 million and the city with the smallest is Stevenage with a population 81,000 (Office for National Statistics, 2011). The greater area of London is most densely populated (4687.6 residents per km²) and Wrexham the least densely populated city with 257 residents per km² in 2006 (Eurostat, 2010, 2011). The 8 largest economies (outside London) in England are referred to as Core Cities (Birmingham, Bristol, Leeds, Liverpool, Manchester, Newcastle, Nottingham and Sheffield). These cities, forming the economic and urban cores of their surrounding areas, are major centres of regional and national economic growth (Champion and Townsend, 2011), are part of this research.

We gathered and analysed the climate change policies and/or strategies from the 30 UK urban areas (cities) by retrieving them from the website and/or by contacting the city directly (Heidrich et al., 2013). Of the 30 UK Urban Audit cities, 28 have published climate change policies or strategies outlining how they will tackle climate change mitigation. In the UK, cities are part of larger Metropolitan, District and County Councils and some cities do refer to regional strategies. For example Stoke on Trent Council does refer to the “South Staffordshire Council Climate Change Strategy” (South Staffordshire Council, 2008) and Gravesham Council to the “Kent’s Adaptation Plan Action Plan 2011-13” (Kent County Council, 2011).

In total, 307 documents were provided by the local authorities. Based on an assessment of suitability for analysis (i.e. strategies that state climate change in its title or abstract), 52 documents were analysed in detail. The documents are published at various dates and by different departments, for example, the Climate Change (CC) action programme for Aberdeen is the oldest ‘live’ document, published in 2002 (Aberdeen City Council, 2002). The mitigation and adaptation strategies for London underwent various stages of consultation over recent years and were finally approved and published in October 2011. Out of the 52 documents, 18 defined the scope as the activities that are controlled by the council and 32 are covering activities across the council i.e. household, industry and business activities. Only documents from Gravesham and Stoke have not stated the scope of the strategy i.e. if the strategy is for the councils own operation only or if it does cover households, industry etc. Derry-Londonderry (Northern Ireland) and

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