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Lessons Learned from Ultra Low Emission Travel Hubs

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Executive Summary

This paper presents insights gained from feasibility studies and business model planning carried out for 12 different low carbon travel hubs across Scotland and the north of England. The proposed facilities at each hub ranged from rapid charging infrastructure for electric vehicles, to multi-modal hubs incorporating cycle hire facilities and hydrogen refueling infrastructure.

Despite the range of infrastructure considered at each location, there were several common challenges posed and opportunities identified. These common themes indicate that a flexible approach to provision of multi-modal low carbon transport facilities, which are tailored to meet local need and demand, can offer an efficient and commercially successful model for stimulating modal shift to low carbon travel choices.

Introduction

In response to a growing understanding of the negative effects of vehicular emissions on climate change and public health, the UK Department for Transport issued the 2009 Low Carbon Transport Strategy stipulating the need for a modal shift to low carbon transport.[1] Ambitions of the strategy are a greater take up of alternative fuels, a dramatic reduction of emissions from new cars, more active travel and better-quality travel information by 2022.

Gearing up for this new phase, the UK government has already pledged £890million[2] to the development of the electric vehicle market. Further commitments have also been made to establish of a number of Low Emission Zones (LEZs) across the country. These commitments are encouraging the exploration and implementation of a range of solutions focussed on providing low carbon transport enabling infrastructure in innovative ways that facilitate uptake of sustainable modes and reduce the long term public cost of provision.

Low carbon travel hubs are one concept being explored across the globe. They bring together a range of facilities related to low carbon modes of transport, from walking and cycling to electric bicycles, cars, taxis and buses, and hydrogen vehicles. The facilities offered can range from information and educational materials, to equipment hire, storage or fuelling infrastructure provision. The exact configuration is often dependent on local needs and opportunities, and the commercial and environmental setting. Facilities can be provided at a single centre, or as a combined offering over a wider geographical area, such as a university campus. They can also be linked to local activities, groups or third sector organisations as a way to boost the use of facilities or reduce ongoing operational costs.

Such hubs present an opportunity to stimulate the transition to low carbon forms of transport by offering choices to travellers which are relevant to the local context, and which complement and benefit from existing local assets and behaviours.

Urban Foresight have recently carried out feasibility studies and business model planning for 12 different low carbon travel hubs across Scotland and the north of England (Figure 1), each of which considered a different range of low emission travel modes. Each study considered: site location; scheme design; infrastructure specifications; community engagement to determine local needs and opportunities; demand forecasts; operating models; and, wider links to existing travel and transport infrastructure.

Figure 1: Location of feasibility studies in Scotland and North East England

This paper presents the insights derived from these studies, by identifying ten key considerations to be addressed in the successful development of any low carbon travel hub.

1. Determining the range of facilities

Key to establishing a successful hub is determining the correct range of facilities to be provided. These need to reflect the local environment, demands, community needs, and capitalise on existing behaviours and local interests. Engaging with a range of stakeholders is important in understanding these factors.

In several of the feasibility studies undertaken by Urban Foresight, the concept for the low carbon transport hub often started with ambitious aims about the range of facilities that were to be included and the broader benefits that they were expected to achieve. However, they often had a fixed location, with availability of land generally limited in the area under consideration. Working with stakeholders to explore local behaviours, examining the location of the site in greater detail, and considering operational costs often led to a focus on a smaller range of facilities that were likely to generate the most significant impact.

For example, Angus Council were keen to establish a low carbon travel hub adjacent to the council's offices and beside the A90, the main north-south route between Aberdeen and Dundee. Their initial aspiration was to include electric vehicle charging facilities and to provide a cycle hub, with bike hire, end of trip facilities and maintenance facilities. While the provision of end of trip facilities and bike parking could encourage staff of adjacent businesses and organisations to cycle to work, the plentiful parking on this out of town site, and the limited connections to adjacent residential areas meant that the location was unlikely to generate a strong demand for cycling. Given the distance from the town centre and residential areas there was also little

community value of cycling facilities. As a result, the low carbon hub was re-designed around the site's strength, its connectivity to the road network. Recommendations were therefore made for a series of rapid electric vehicle charger units connected to a café which would help cover operational costs and provide facilities for those charging their vehicles to use while they waited.

2. Selecting a site

As highlighted above, the value of potential facilities provided at a travel hub are often strongly linked to the site location and its connection to the surrounding transport network. However, finding a suitable location to accommodate a travel hub can be a challenging proposition with a need to identify a suitably sized parcel of land that meets relevant planning permissions, contains suitable links to the transport network and is connected to relevant utilities and services.

There are a number of examples where adopting a flexible approach to the delivery of target infrastructure can be beneficial, with the potential to deliver a range of smaller interconnected facilities across a geographical area to achieve the same outcomes as a consolidated singular facility.

The Highland Council were looking to establish a cycle hub within the centre of Inverness city which would be linked to another hub located on the western edge of the city close to Inverness College, the Raigmore Hospital and the Highlands and Islands University. Working with stakeholders, it was recognised that a singular hub on the western edge of the city would be challenging to locate, given the spread of organisations and the availability of land. However, each major organisation proposed to be serviced by the western hub had slightly different active mode requirements. As a consequence, a series of smaller satellite "hubs" were identified with facilities specifically tailored to each of the major organisations, next to which they were to be located. This navigated the land issue with the satellite hubs having much reduced footprints. It also reduced the overall cost of installation and still enabled the overarching objective of improving active mode use to be achieved.

3. Consider key infrastructure

Considering key infrastructure requirements and specification early on is beneficial, particularly when seeking to identify potential locations for hubs. Issues such as capacity of the electric grid can have a big impact on the cost of providing a facility, with a potential need to upgrade substations and upgrade grid connections. Other infrastructure also often requires significant space for enabling equipment or has servicing arrangements which may not be immediately obvious. For example, hydrogen refuelling requires significant space above and beyond the refuelling pumps, to accommodate local onsite storage, on-site compression of hydrogen, specialist maintenance activities and delivery tankers.

Aberdeen City Council were investigating a low carbon travel hub to include a hydrogen refuelling facility. The hub was to be located close to the new Exhibition and Conference Centre in the Bucksburn area of the city. The hydrogen was to be generated on site through a new power and heat facility and piped to the low carbon hub for vehicle refuelling. However, a key part of the process would require the hydrogen to be compressed at the location where the refuelling activity was to occur. While it can be mitigated somewhat, the compression activity is noisy. With proposed hotel and office blocks located on the Conference Centre site, a location for the low carbon hub needed to be found where out of hours noise would not have a significant impact.

4. Futureproofing

Consideration should be given to futureproofing the facilities. The cost of delivering a facility that can be quickly adapted, to accommodate envisaged technical developments or demand scenarios, can be a relatively minor increase over a facility that cannot. It will also mainly be significantly cheaper than retrofitting an established facility.

A number of the sites that were examined have taken care to consider the potential future of infrastructure. Working with the North East Combined Authority to develop a rapid charger hub in the centre of Newcastle consideration was given to the future direction of vehicle charging power. While the highest rated (non-Tesla) charging infrastructure is currently rated at 50kW, it is expected that next year, chargers and vehicles will be

capable of 150kW charging, with many manufacturers currently aiming for 350kW compatible solutions.[3] These higher power units will increase the power demands on the local electricity grid and, with the proposed site part of the flagship Science Central[4] development, it was felt appropriate that grid capacity was provided to accommodate future upgrades, enabling the site to remain a state-of-the-art electric vehicle filling station.[5]

5. Consider opportunities for renewables

The delivery of new infrastructure brings with it ongoing operational and maintenance costs. Since most local authorities are under significant pressure to manage services within tight operational budgets, a high degree of consideration has been given to minimising the ongoing cost of operating any new travel hubs.

With sites typically requiring access to power, particularly for electric vehicle and bike charging infrastructure, consideration has been given to the feasibility of incorporating micro-renewable power generation.

In developing the low carbon hub concept for Aberdeen, consideration was given to the integration of PV panels to support electric vehicle charging. Analysis highlighted that, due to low feed in tariffs, the incorporation of PV panels was economically beneficial when included alongside a battery storage facility, allowing any power generated on site to be stored and used locally.

Work on a number of other low carbon hubs also demonstrated that, while solar irradiance levels in Scotland are low in comparison to the rest of the UK, parts of Scotland such as Perth, Dundee and Edinburgh (see Figure 2[6]) received comparable levels to that of areas around London.

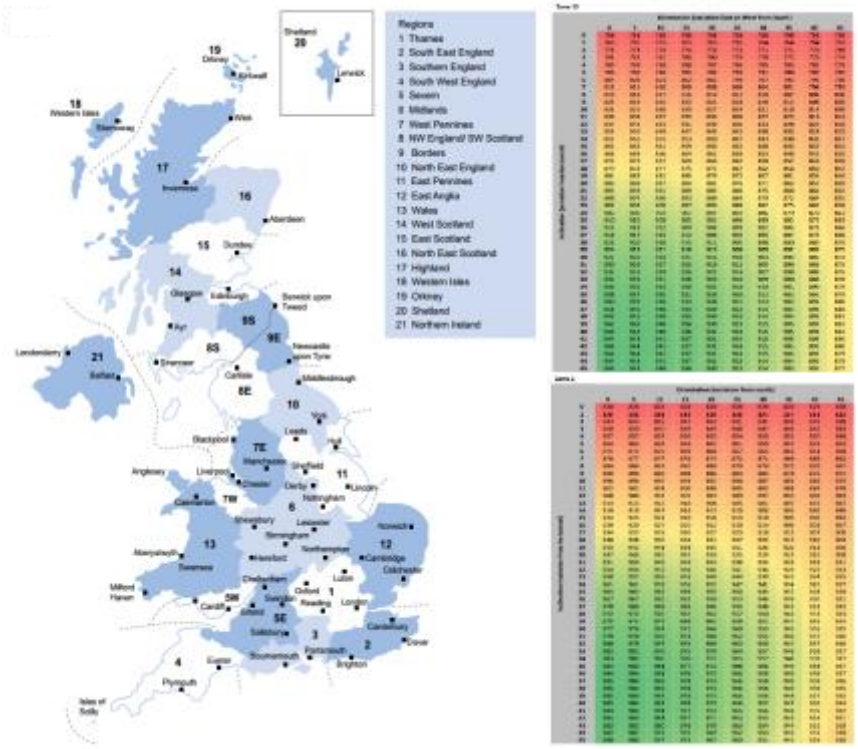

Figure 2: Solar irradiation levels between Zones 1 and 15

6. Commercial case for active travel

Active transport has been a focus of investment for a number of years. As a result, the market for active travel based infrastructure and facilities is well understood, particular when compared with more recent developments such as electric vehicle charging and hydrogen refuelling.

As a result, there are a number of examples of cycle hubs which have established successful business models that allow the facilities and services to be provided with minimal or no subsidy. Consequently, the financial case for investment in active travel based travel hubs is often easier to determine.

A good example of this is the Velocity Café in Inverness. This is a well-established social enterprise working to promote and support cycling and walking activity within the region. The organisation runs free workshops, undertakes community outreach work, offers cheap long-term bike loans and acts as local advice centre for cycling journey planning. They currently operate without subsidy, using revenue generated from the onsite café and bike maintenance activities to cover the costs of operations.

7. Commercial case for EV infrastructure

As highlighted above, the commercial case for investing in EV charging infrastructure is not as established as active modes. The majority of charging infrastructure in the UK installed to date has been provided by local government bodies. While growing significantly, the market for EVs is still within its early stages and levels of demand for charging infrastructure is not yet significant enough to prompt widespread private sector investment. Furthermore, to incentivise early adoption of the technology, most of the charging infrastructure delivered to date can be utilised without users paying for the service or the electricity being consumed. This creates a distorted market where facilities provided by the private sector, who would need to generate revenue from usage, would be competing with free existing facilities.

Coupled with pressure on operating budgets and rising levels of usage, many local authorities are now seeking to explore mechanisms to manage or mitigate the operating and maintenance costs of charging infrastructure. For example, The Highlands Council have introduced a charging fee of 15p per kWh with a minimum total fee of £1.50 in April 2017. This is marginally more than the cost of electricity. As shown in Figure 3, the UK's major private networks have also started introducing fees to help towards the capital and operational costs of the electric vehicle chargers. With these changes occurring within the last year, the effects of these charges on levels of use are yet to be fully appreciated and present a risk to estimating levels of demand.

Furthermore, with increasing capabilities in charging technology, the cost of installing the latest charging infrastructure is rising. The average rapid charger installed today, will cost around £45,000.[7] Our analysis of operational costs of EV charging infrastructure has highlighted that, even by extrapolating levels of existing usage, assuming high levels of growth of EV sales and adopting a 25p/kWh charge (similar to that required by current private sector operators), it would take around 7-10 years for the revenue generated through usage fees to meet operational and maintenance costs. Utilising the same assumption and taking the capital cost into account the payback period for rapid charging hubs is likely to extend beyond 40 years.

With rapid charging units taking around 20-30 minutes to charge a typical electric vehicle, there is obviously potential for advertising or complementary services to be provided at charging infrastructure to generate additional revenue, however, there are few existing facilities where these activities have been explored. With no demonstrated successful examples, and with the success of complementary service likely to be linked to demand level, this revenue stream can still be seen as high risk.

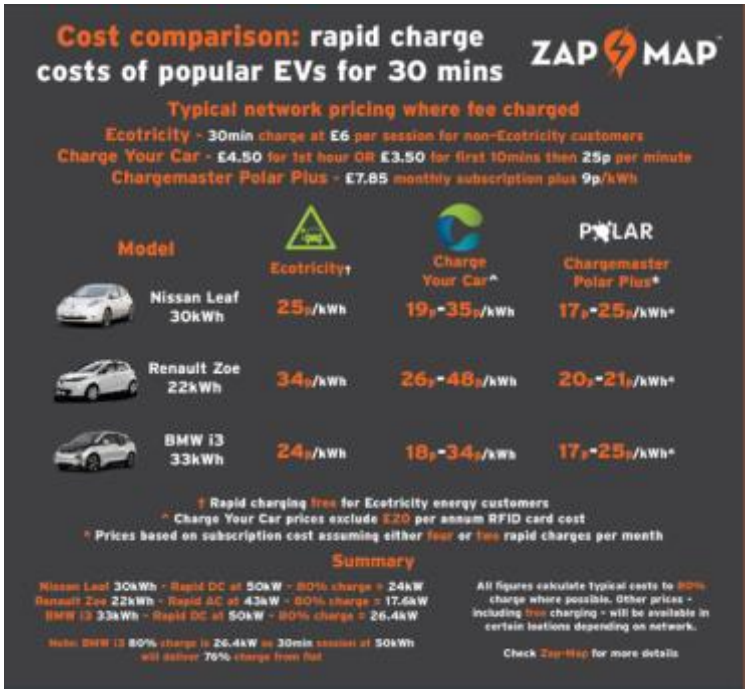

Figure 3: Cost comparison between UK rapid chargers[8]

8. Consider range of operating models

To continue to support the adoption of low carbon modes of transport, particularly ultra low emission vehicles, it is clear that there needs to be a greater exploration and understanding of potential complimentary commercial activities that could help support operational and maintenance costs. The delivery of charging infrastructure as part of a low carbon hub presents a significant opportunity to do this.

Operate & maintain contracts may lend themselves more to the exploration of commercial opportunities, particularly if established to allow the operator to benefit from any increase in revenue above that expected. Design, build, operate and maintain contracts may further improve the commercial focus with the operator able to consider, in greater depth, the impacts of design decision and site layout on revenue sources. However, carefully designing specification is required to ensure that the primary function of increasing the adoption of low carbon transport modes remains of paramount importance.

With the EV charging industry still in a relatively early stage, the different actors involved in delivery, operation, and maintenance, have often been procured separately. Efforts may be needed to bring actors together and attract further delivery partners with the experience and capability of exploiting potential revenue generation opportunities.

However, there are a wide range of operational models that can be utilised in delivery of low carbon hubs. An understanding of the objectives of the hub, the risk tolerances of the procuring authority, requirements of any funding bodies, and the current market have helped us to identify the most appropriate models for the different low carbon travel hubs we have been involved with developing.

9. Forecasting Demand

Accurately forecasting demand is a significant challenge in establishing a robust operating model at present, particular for electric vehicle recharging and hydrogen refuelling infrastructure. As highlighted these markets are still relatively new, and while levels of use are expected to grow significantly in the future, the current low levels of use, limited growth trend data, market subsidies and combination of charging infrastructure with other incentives (e.g. free parking) mean that forecasting future demand robustly is difficult. This presents a significant risk around revenue generation opportunities and is limiting the short term interest of the private sector.

However, current market growth and commercial modelling undertaken by Urban Foresight for a range of low carbon travel hub studies suggests that within five years the increasing use of EVs, greater transparency of charging data and the conclusion of a number of trial deployments by both government and private sector bodies, should create greater market confidence and encourage greater investment in charging infrastructure by private sector organisations.

10. Ancillary services

As highlighted in points 7 and 8, a key focus of a number of feasibility studies for low carbon travel hubs has been to ensure that an operational model can be developed that helps to manage the ongoing operational costs of the transport facilities or services that are being supplied. In all cases, the provision of ancillary services has been identified as beneficial. Not only does these generate additional revenue but they can also add additional services or facilities that can in themselves attract more use of the associated transport facilities.

The Velocity Café in Inverness is a good example. Not only does the café and maintenance services generate revenue but they have helped to attract people to use the café as a base for cycling. Being able to stop for a drink or have your bike checked has encourage more people to access other services such as advice on bike routes or rental of bikes. It has helped build a more vibrant community atmosphere which is encouraging a broader segment of the city to get active.

The Angus example, where EV charging facilities are combined with a café and conveniences is also likely to result in increased use of the charging facilities. Located next to the A90, the site is likely to be a convenient stop on longer distance routes, and made more attractive by the ability to have refreshments. It should also be a convenient location to undertake a quick charge while picking up a coffee or lunch for more local users.

Conclusions

Our involvement in the planning and development of 12 different low carbon travel hubs has identified several common challenges in the development and delivery. It has also highlighted the potential that such multi-modal hubs can offer both in supporting the uptake of low carbon transport and in lowering ongoing operational costs of transport infrastructure.

The location of the site, its connections to the transport network and proximity to the local community is critical in determining how effective different low carbon facilities will be. Facilities can also benefit from leveraging local non-profit groups to build upon existing behaviours or activities.

While historic investment has led to the development of a number of sustainable business modes for active mode based travel hubs, the business case for low carbon vehicle refuelling is less well established. There is clearly an opportunity to utilise investment in new facilities to explore the commercial potential of refuelling activity and of compatible ancillary services. These ancillary services can also serve to increase the attractiveness of the transport facilities and service provided at the hub. The integration of micro-renewable energy sources and consideration of potential future upgrades during the design phase can also lead to reductions in future operational and maintenance costs.

With a need to address climate change and air pollution, the need for greater use of low carbon transport technologies will continue. Low carbon transport hubs provide an ideal opportunity to deliver infrastructure in a sustainable and cost-effective manner. This will enable the flexibility of tailoring solutions which will maximise their benefit to the local environment.

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Authors

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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 5 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 is Chair of the Electrombility Initiative of the European Innovation Partnership on Smart Cities and Communities. He has also led two global task forces on electric vehicle business models and EVs in smart cities for the International Energy Agency (IA-HEV). David holds a PhD in Technology Management from University of Cambridge, where he pioneered new roadmapping and strategy techniques. He has also gained two Masters degrees in Engineering and an MBA.