5.4.4 Upscaling Battery Projects

- Batteries at scale, such as deployed in ESO, should be seen as a core component of the energy infrastructure in the future, so there needs to be a significant upscaling of **skills associated with battery design and deployment**, including the knowledge of changing energy markets and how to engage in flexibility, balancing and trading.
- With the growth in new types of localised infrastructure, the **installation skills** also need to exist locally across construction, cabling, electrical connection, transmission connection etc. As noted earlier, there is a particular need for TP141 registered transmission-qualified commissioning engineers to enable greater use of large-scale grid connected infrastructure.
- New entrants to the energy sector bring new ways of working and **new business models** which then need to grow and develop, so good business skills and a broad understanding of energy markets and how they are changing is essential for scaling of SLES. Incumbents are also changing their business models and need to be able to be increasingly flexible in order to work with these entrepreneurial innovators entering the sector and help to address Net Zero targets.

6 Transport and Mobility Subsystem: Findings from Data Analysis

Electrification of transport is a significant part of the ESO project and consists of:

1. the installation of different types of EV chargepoints and associated infrastructure
2. trialling of electric vehicles within the City Council fleet (managed by Oxford Direct Services – ODS) and with taxi drivers.

6.1 Barriers and enablers for the transport and mobility sub-system

Factors impacting the roll out of EVs and associated infrastructure are summarised in Fig. 6 below.
Local and central government policy A key enabler for the project is local policy implementing a zero emissions zone for the centre of the city which makes EVs a necessity both for "Oxford direct services [which] need vehicles to go into the city centre to collect rubbish, clean the street, work with the homeless, go to the parks" (E2) and also for taxis. The zero-emission zone also means that businesses and the public wanting to drive into the city centre will need appropriate vehicles and "it makes sense to have a couple of these high power hubs around the city centre and the Park & Rides and the accessible area so that drivers can really meet the needs of the zero emission strategy" (E15).
Disjointed policy:
Planning policy, however, does not always join up with climate policy so it can take time to get planning consent for infrastructure which is directly addressing net zero needs.

EV charging infrastructure:
In order to accelerate EV take-up, charging needs to be accessible and suitable to the location but there are some barriers:

- **City centre housing with no personal charge point space**: Cities like 'Oxford, Bristol, London, … where you've got lots of old streets, expensive housing but no one has got a driveway. They need reliable public infrastructure … rapid charging, that is as quick as 20 minutes at the petrol station' (E12).

- **Lack of charge point interoperability**: 'Tesla …. They've got their super charger … [but] surely we want infrastructure to be able to charge any EV. But that's a matter of regulation, you need a government to step in and say 'We want the charging infrastructure to be for the common good' (E13).

- **Visibility of EVs and chargers**: the more visible and commonplace the EVs and their charging points are, the easier it is for further adoption of this technology by the wider population. As stated by E8: "until there's a bit more infrastructure in place, sometimes it can be difficult to think about even transitioning… By the time that infrastructure is in place… there might be more people charging on the road or at home. They may have seen people charging at other hubs and ask them questions".

- **Poor Motorway EV Charge Point (CP) infrastructure** in the UK, which is lagging behind the current state of technology and customer expectation. Motorways are "… great locations that really need quality charging provision as a matter of urgency… Ecotricity has exclusive rights to the vast majority of motorway service area locations. … but the lack of competition is genuinely now posing a barrier to uptake of EVs …. It needs to be just as easy as driving a petrol car…" (E15). The motorway network is key for enabling long distance coverage and chargers need to be plentiful, rapid and under cover – as with petrol forecourts.

However, there are areas where EV CPs are growing rapidly, with new business models and approaches to charging which will provide much better results for consumers:

- **Drive-through rapid charging** where dedicated EV service stations are being developed, following a similar model to petrol / diesel filling stations 'essentially a service station that only has EV chargers….. Like a service station you can plug in, charge and then go and have a cup of coffee, get your laptop out.' (E12) These tend to be 'just off busy carriageways, so motorways, A roads, dual carriageways, … alongside … coffee, sandwich shops, that kind of thing. … really about the short stay stuff.' (E15)

- **EV charging alongside retail**: The retail model is where you leave your car for a lot longer and [the CPs] are the secondary amenity. So you do your weekly shop for example and … in 45 minutes to an hour, even on these relatively slow 50 kilowatt charges that are installed on retail sites, you will get the equivalent of a weekly average drive for example' (E15)

Energy system connections

All EVCP infrastructure needs connecting to power supplies. In the case of ESO, the EVCPs in the car park are connected via private wire to the transmission network, necessitating, at the connection end, interaction with National Grid.

More conventionally, EVCPs are connected to the local distribution network and there are, potentially, issues to do with grid capacity as well as capacity of DNO to respond to various requests on the grid as electrification of both buildings and transport increases: 'the Distribution Network Operators, you're at the mercy of their overall programmes, they're much in demand, they've got

plenty of other things to do in terms of upgrading local distribution networks, larger projects. So that can be six months, it can be 12 months potentially (E15). The other related issue is grid capacity where 'If we then wanted to do more from that site, we're into huge amounts of infrastructural change. So would it be cost prohibitive? Yeah, absolutely (E19)

EV growth and barriers

In parallel with improvements in EVCP infrastructure, EVs are also growing across different user and vehicle types.

- **Business growth**: in Oxford, 'Oxford Bus Company, a classic example. Already very, very keen to take power to electrify their fleet of buses for Oxford, so that's a great example. But there could be lots of others. Mail companies, logistics companies etcetera, or employers nearby who want to have a good value connection (E1).

- **Domestic growth**: There's a big demand in home [charger] installs because lots of people are now buying electric cars and therefore want a charger at home (E12).

There are barriers to EV take up relating to cost – both of infrastructure and vehicle purchase: 'all life capital costs, and cost of infrastructure. They are the two things that I would say are, would be limiting the rollout of electric vehicles (E19)' This cost difference is more apparent in the larger vehicles where for example 'you're spending double the money on a refuse vehicle to get an electric one. But the savings in terms of emissions would be phenomenal. But councils can't afford them (E14).

A further barrier is a nervousness about the unfamiliar new and a lack of knowledge about how to develop an electrified fleet strategy or to change facilities or car parks in order to accommodate charging infrastructure: 'They've been in their job, in their industry for years. This is how they do it and they're ten years off retirement and they don't need the hassle' (E12).

At a more general level, there is growing public acceptance 'Everyone now feels they can talk to me about electric cars in a way that they just didn't three years ago, let alone ten years ago (E12) although there is still an attitude of 'they need to have 300 miles in the tank.… Even though an 'average mileage is probably under five or ten miles a day, … [so] then it is about longer journeys, that's what everyone's hesitation is at the moment, when would they be able to charge and how long would it take them on those longer journeys? (E8).

6.2 Skills for the transport and mobility sub-system in relation to ESO

In our analysis of current and future skills needs and shortages, we have aggregated these into different generic skills areas, identifying specific types of skills required in transport and mobility in the ESO context.

6.2.1 Energy skills for the transport and mobility sub-system

From the energy system perspective, the skills needed to develop an effective and functioning electrified transport system can be split into issues to do with fleet electrification and charging infrastructure, and implications for local and national transmission grids.

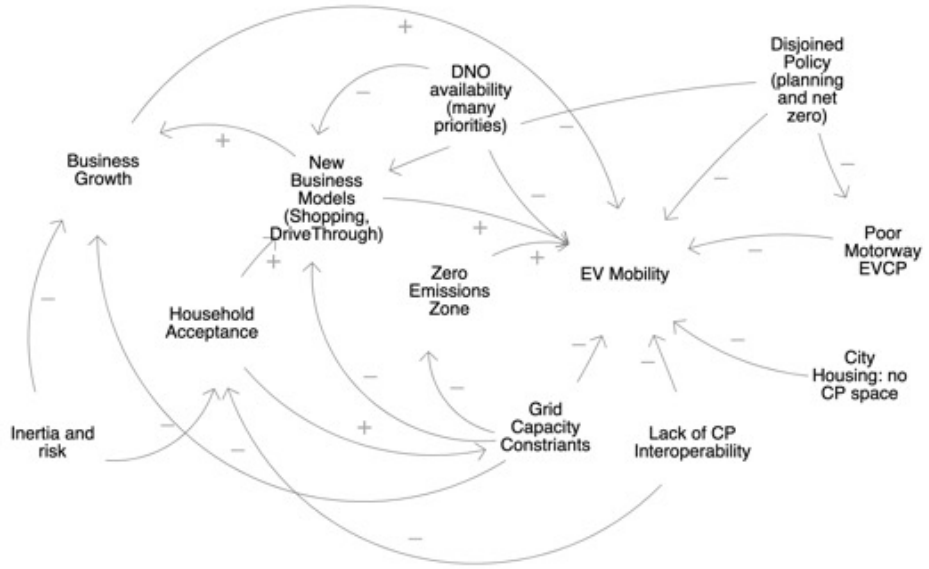

Figure 6: EV Adoption and Scaling Up

- textbfUnderstanding EV charge point infrastructure and how it works, knowing "about the energy feed coming into a depot and then what kind of cabling and ducting that you need to … feed to your charge points..." (E2) is necessary for a manager to develop a fleet electrification strategy. Understanding power load is essential across all installations of EVCPs, 'we needed to know what charge points we were likely to have … what kind of energy capacity we were going to have. And then we needed to work out what kind of software we needed to balance the load that we had available or how we were going to set out that load" (E14).

- **Local grid connection** is necessary to provide power to a new charging point. This is the "element that takes time" (E15) and this requires liaison with the network operator as it may require sub-station upgrades. As noted by E12: "we had to have a DNO upgrade at the Cowley site, which is not uncommon when you're putting in that number of chargers. There's basically not enough electrical supply if you were to plug them all in". There is no shortage of skills in grid connection, but this task can be both expensive and slow to be addressed due to the other demands on the relevant DNO.

6.2.2 Engineering skills for the transport and mobility sub-system

Engineering skills cover a wide spectrum in the transport and mobility sphere in the context of ESO, from electrical and mechanical to construction and design to software and data – with some quite specialist new skills needed as these areas scale up.

Civil Engineering

- **Charge Point Site Design** is a new area specific to the setup of EV CP networks. As this grows, more bespoke EVCP charging stations are developing. There is a whole area of knowledge around "location design …the footprints of the stations. We look at how access

and egress are dealt with. We look at groundworks, all aspects necessary to deliver a successful planning application for example. We don't design chargers, but we make sure of course that we're designing to standards around things like accessibility, traffic management, gradients in highways" (E15).

- **Ground investigation** skills are needed "to make sure our foundations will be able to deal with the challenges… For ESO, it's an old landfill that we're building on, so incredibly unstable. So we need to pile down 20 to 30 metres or so to get to stable ground and deal with the contamination risks and the pollution risks" (E15). While these skills are not rear, their relevance to EV CP installation is often overlooked.

Electrical Engineering

While none of these skills are in short supply, some upskilling of electrical engineers in handling the EVCP equipment is required.

- **Electrical engineering** skills are needed in understanding the substation, connections and cabling required to serve the superhub and chargepoint installations "…. pretty heavy electrical engineering in the connections and putting this cable through the city" (E1). "Quality of the kit is also important, and that's not just the charge points, it's the cabling structure. If you're putting a transformer or an LV switchboard in, the technology behind that [should be] the latest. [for example, in ESO,] we've actually gone for an eco-cooling transformer rather than a chemical one" (E2).

- **Electrical design and installation** of EVCPs requires "understanding the different types of charge points and what type of output they give. So with ACs you can have anything from a … 3 kilowatt or up to a 50 kilowatt. At which point the 50+ starts becoming a DC. And then you go all the way up to 150" (E2). It's also necessary to have the "electrical connections to chargers. Getting that installed properly to good standards" (E15) requires electrical knowledge specific to the EVCP industry.

6.2.2.3. Software engineering and data management

- **Charge optimisation software development**: software systems sit at the core of the EVCP network to help manage the infrastructure and 'all chargers have to be smart, they've all got a SIM card in them so that they're communicating certain levels of data' (E12). This can provide data on usage and support optimisation of the network. In ESO, at the ODS depot they have "power based software that manages charges…. when the charger is installed, it's added onto [the supplier] backend… the user can do quite a lot with that… you can download all the management information, how much kilowatt hours are going in, when it's being used, to then make informed decisions going forward" (E12).

- Data management, as data needs to be protected and shared/used in accordance with regulations (e.g., 'we're sharing usage data with the council…" (E15).

- Data analysis "…model future demand, understand utilisation and where, when and how they'll make further interventions in terms of local charging provision" (E15). The analysis also will "… help set ongoing fleet strategies …[like] which vehicles were the best to electrify and then what vehicles we could buy as replacements that would work for us" (E14). So

there needs to be not only data collection capability but also data analysis in order to make informed decisions for the future of the EV fleets and CP network.

- Skills for heterogeneous EV CP **device integration through APIs** (E3).

6.2.3 Trades skills for the transport and mobility sub-system

- **Chargepoint technical support and maintenance** skills are relevant for engineering above but also for on-site maintenance: 'If you're going to … manage the charge points onsite, you need to make sure you've got a team internally that can literally do the first checks. So if a charge points fails and it shows up on the back office system that its failed, you've got somebody onsite that can go out, reboot it, check it to see what the fault might be. And repair it if it's a basic issue... This needs to be thought about at the start, setting up a 'service and maintenance agreement' so that 'when the warranty runs out' it is clear 'who is going to look after it' (E2)
- **EV maintenance** is both necessary and requires continuous upskilling: "…training that needs to be done and needs to be reviewed each year to make sure they're up to speed with new bits of technology that come with EVs. And not all electric vehicles are the same" (E2).

6.2.4 Managerial skills for the transport and mobility sub-system

As well as the expected management skills around projects and stakeholders, SLES mobility initiatives require some additional skills and knowledge and there are potential bottlenecks to scaling.

- **Partnership development**: In developing new approaches for SLES, new innovative organisations are being formed and relationships with others developed, so a key managerial skill is in being able to manage fluid and dynamic partnerships with diverse organisations: "building those relationships… is important" (E1).
- **Standards compliance, health and safety** requires upskilling, though it is not a new skill per-se: As new transport technologies emerge, new standards are developed and managers need to keep abreast with changes and legal requirements and 'do the due diligence on designs and local civils because we've got to make sure we're safe and operating within standards" (E15).
- **EV Fleet management**: Whilst fleet management is not a new skill, managing an electrifying fleet does require new knowledge and upskilling with respect to:
  - **Capabilities of different electric vehicles**/ options for different vehicle classes and 'working out which vehicles were the best to electrify and then what vehicles we could buy as replacements that would work for us.' (E14)
  - **Charging capacity**, i.e., different charger speeds and durations, compatibility with vehicle types (e.g., as stated by E2: 'you've got to understand which charge points you need for which vehicle based on what the task for that vehicle is'). This is further complicated where 'some of these technologies are still emerging. So, for example, the electric RCV, it wasn't known until quite late on, [what] the power consumption requirements would be in terms of charging (E19)

- **Developing an electrification strategy** "looking at going forward. Do you need as many vehicles as you've got? And then getting data fed back to you, which vehicle is actually the most appropriate to switch to" (E2);
- **Ensuring sufficient power supply infrastructure**, as currently there is a 'lack of knowledge of understanding energy, charge points and electric vehicles. And the whole energy connection between all three from supply and demand (E2);
- **Planning fleet usage and optimising charging schedules** with available power, for example 'with an electric RCV, it's got to come offline and recharge for 12 hours (E19) – and, ultimately, connecting with renewable sources and V2G potential.

6.2.5 Finance and Business skills for the transport and mobility sub-system

In this fast-moving area of new technologies and business models, new skills are needed to help develop and scale up appropriate solutions to net zero mobility.

- **New business model development**: In order to identify opportunities as technologies mature, chargepoint operators are taking a new look at how they develop their business models. One approach is trying to move away from comparisons with conventional filling stations: 'the thing with EV chargers is trying to turn it on its head from instead of thinking where do you fill up your car? And therefore where do we put a charger? It's more about where is your car parked? And where is there electricity? So there is already electricity in the street, next to the lamppost for example. There is already electricity in your home or your place of work.' (E12). Conversely, there is another school of thought that suggests those comparisons are useful 'developing a drive through station concept in the same way that you would charge at a petrol filling station. But for electric cars, underneath a branded solar roof …high powered drive through stuff, off busy junctions, off major roads' (E15).
- **Procurement and tendering**: EVCP infrastructure requires different forms of tender documents and processes, which necessitates upskilling of the procurement teams. E.g., for the ESO project: 'They [City Council] have to tender on something they've never done before' (E12) and, in fact they 'worked through the full tender to go out … planning initially to put the AC charge points out at the same time as the DC charge points. …, but realised that was so complicated that [they] broke it down and ended up just going out for the auto rapid, the DC charge points first. And then followed through with the AC afterwards' (E14).

6.2.6 Legal skills for the transport and mobility sub-system

- **Contracting in compliance with changing regulations** is not a rare skill, but requires continuous upskilling: e.g., in relation to cabling routes "getting through the highways authority" (E1) is requires solicitors to keep abreast of the changing legal and regulatory landscape.

6.2.7 Policy skills for the transport and mobility sub-system

Engaging with government is important in an emerging sector. In transport and mobility, we see how a legacy of non-regulation requires government intervention to facilitate scaling up, the skills required here are:

- **Standardisation** to tackle lack of interoperability between chargepoints: "Our biggest bugbear as a team is what's called OCPP, Open Charge Point Protocol. … if you took delivery of an electric vehicle today and turned up at a charging point to charge it, you would find it very difficult. … It's a legacy of the charging network being set up many years ago without any sort of regulation …. we want infrastructure to be able to charge any EV. But that's a matter of regulation, you need government to step in and say 'We want the charging infrastructure to be for the common good" (E13).

- **Capped policy on grid connection costs**: currently the costs can vary "anywhere from about 40,000 to 600,000 or so" (E15). This uncertainty can block scaling up so there have been suggestions to government to "make that cap the same for all grid connections, because then you as an operator know, I can build here, I can build there, get my kit to ground, there's less uncertainty and it's all within my business model" (E15).

- **Planning for EV CP infrastructure accommodation**: building structures associated with charge points requires lengthy planning permission '…every single location that we build, we have to get planning permission and …it will take at least a couple of months to get granted …it's one of the bottlenecks …" (E15). Thus a simplified planning strategy for CP associated buildings is desirable.

- **Development of local mobility plans**: as "Many authorities don't have any strategy in place for this at the present time or a very nascent strategy" (E17) which slows down development and delivery of EV and smart mobility projects.

6.2.8 Soft skills for the transport and mobility sub-system

Soft skills are all about engagement, from provision of information to the general public to building stakeholder buy-in, liaising internally and communicating future visions to investors and stakeholders.

- **Public engagement**: There is insufficient information available in a form that works for different sectors of the population, 'I've now got to get an electric car but how do I get that? How do I get the information? And the failing for the public is that, that information is out there it's just nobody knows about it' (E2) – this might involve social media for 'millennials' or open days for older users.

- **EVCP Customer engagement** involves both in-person and automated interactions, as with increasing automation, 'we have less and less ability to really understand individual customers behaviour. Because if it's working, we won't hear from them" (E15).

- **Stakeholder engagement**: it is important to 'engage with as many key staff within a local authority as possible. To sell them the whole idea of electric vehicle charging' (E17) and to be able to 'present the company well and really communicate the vision of what we're doing to a range of stakeholders' (E15) so that they provide their own support and participation to the project.

6.3 Training for the transport and mobility sub-system

6.3.1 Training needs

Particular areas identified as key training needs centre around the planning, installation and maintenance of EVCPs which is clearly a growing market:

- **ChargePoint installation**: The CP operators say that 'we train our installers thoroughly ... We don't just sell a box off the shelf to anyone for them to install, however much of an electrician they might be'. (E12) As the market grows this need will increase. It was also recognised that 'electric vehicle charging technology from an installation perspective is not super complicated. So it's definitely an area where you need … as an installer or an individual to see that actually all of your existing knowledge can be ported straight to this new tech. All specifications are written with existing stores in mind. It's really a grid connection, an LV switchboard, some cabling to a power converter and that's it. (E15)

  At the moment, there is no common standard or universal training approach which might allow an operative to become a 'registered EVCP installer' able to install any EVCP so this is "one thing that would be great from an industry perspective … if you are trained to install an electric vehicle charger, that you are therefore trained to install any electric vehicle charger. That isn't the case at the moment. But … that would be a very useful thing" (E12).

- **Chargepoint maintenance**: it is necessary to ensure that CPs are maintained and any problems resolved fast in order to engender consumer confidence in EVs. "..there will be benefits to hiring people who we can train up in our fleet of chargers. Because we have a range of different charger manufacturers… there's real added value for us in having the in-house team that know all the foibles of each individual charger … I think that's the main area for training for us" (E15).

- **EVCP / EV fleet strategy and planning**: There are two key areas where planning a future EV strategy needs new skills and where training would help. These centre around:

  - (Local authorities) developing a chargepoint strategy for the whole city, or a car park or a business and
  - Fleet operators developing a fleet strategy. There is no manual which says "these are the things you need to think about. These are the kinds of teams and people you'll need to get involved. This is how you can apply for the grants" (E12) so developing training in this area would be very beneficial.

- **Understanding EVs** by fleet managers, policy makers and the public needs education. It is suggested that 'the best learning is by living and breathing and driving an EV. …. I talk to people that are doing tenders, that are buying EVs. Responsible for massive budgets and they've never driven one let alone plugged one in. They have no idea of the quirks, the ease, the nightmare, the worry, the dream that is waking up every morning with a full car battery, until you live with it. (E12) This immersion in the EV experience is not always possible but facilitating it where it can be, such as the OCC taxi trial, is a great way of building that knowledge.

6.3.2 Training Modes

ESO focusses on EVs and charging to support the EV transition so modes of training in this context are relatively limited. We do, however note the following:

- **Professional courses**: At a fleet level, 'if your fleet manager is signed up to the ICFM, which is the Institute of Car Fleet Management, that institute does actually do fleet management courses which are quite intense but they are constantly evolving to incorporate fleet strategy' Also, 'Reed's pretty good on doing a basic understanding. They do a fleet course but it's so old school it uses Volkswagen diesels as an example' (E2).

- **Internal company training**: For chargepoint installers, training sessions are delivered to company employees either in person or (due to covid) virtually: "full day face to face and hands on… [or]…it's delivered virtually. They then have access to our installer portal that has all those training slides, supporting documents and everything they need that they can download at any time as well" (E12). This sort of training is also applicable to chargepoint maintenance where the employees are trained "to operate and deal with typical maintenance issues going forward, regular maintenance but also reactive maintenance …" (E15).

- **On the job training/ learning by doing** is often discussed within the local authority context, e.g., 'a lot of it, I've just learned on the job" (E2). For developing a fleet strategy: "You learn a lot by talking to charge point companies but you could also buy a consultant and he could work with your distribution network operator and talk to some charge point companies and then you could work out what your specification is for chargepoint installations or a fleet strategy" (E14).

- **Raising public awareness**, introducing people to EVs and myth-busting around perceived EV issues is best accomplished through providing opportunities for lived experience, e.g. through rental trial or EV loans and discussions with current/practicing EV drivers/owners, etc.

6.3.3 Recruitment

Across the interviews, we note that recruitment into EV jobs tends to be from a **variety of backgrounds**, motivated by joining an industry perceived as innovative ('we're a company doing relatively cool stuff so it's quite easy to attract applicants across the board' E15) and helping to address climate change and be a positive change for the future ('to really feel I'm able to make a direct impact on the future of a key aspect of sustainability in this country' E15). Those in **management** positions note the **cross-section of skills** and 'broad experience in terms of the energy industry. Comfort working with local authorities, governments from my previous project work. Clearly being numerate was important, being able to present myself and the company well and really communicate the vision of what we're doing to a range of stakeholders" (E15). For **trades** recruits, employers often look for **previous related experience**, e.g. someone who has "been installing chargers for a couple of years. … a lot of people in this industry have come from solar. …or from the smart meter industry. So any experience in a similar industry for us is very valid because there are some things that you can really learn from that that really help" (E12).

6.4 Insights and recommendations

The transport and mobility sector is more than EV / EVCPs which the ESO project focuses on. Overall, it is comprised of assets including the road and rail networks, traffic control equipment, vehicles, refuelling and maintenance stations, public transport etc. As we transition to SLES, the hard infrastructure will largely remain, with updated vehicles, refuelling and maintenance. In addition, new control infrastructure is being developed both to optimise within different parts of the transport sub-system and, ultimately, to integrate transport into the wider SLES.

6.4.1 Growing the EVCP Infrastructure and EV Adoption

The acceleration of EV uptake is reliant on good infrastructure at a range of levels. The public need to know that they can find appropriate charging facilities in the same way as they can find petrol and diesel fuel. This does not just mean similar facilities with rapid charging on the go, but also ease of charging, for example whilst shopping or using a gym, or facilities at work and home. This requires the co-operation of a whole range of bodies and organisations in order to ensure an effective charging network.

A. Upskilling (Local) Authorities:
Local authorities are at the core in bringing together different key stakeholders through policy and regulation as well as engagement. Thus they need upskilling in:

- **New business model development**, e.g., making land available in car parks and on streets, and facilitating installations through the planning system, working with innovative new businesses as they develop EV charging models – such as that in Oxford through Pivot, or Fastned - as they seek locations for rapid charge stations.
- **Joined up city planning**, i.e., integrating land use planning with accounting for net zero targets, along with fostering competition across charge network providers and regulation of standardisation of charging infrastructure.

As noted before, for wider adoption of EVs, infrastructure needs to be not only available, but also widely accessible and interoperable so that any EV can fill at any EVCP with the right power level. This would require the intervention of Government on regulation of the charge point standardisation, as well as lobbying from change point users and fleet.

B. Upskilling Public:
Public acceptance of EVs is the key pre-requisite of their wider adoption. While this acceptance is growing some barriers still remain; these could be tackled through raising public awareness. Different approaches to engagement for raising public awareness are required for different population segments. For example, younger people may be fully receptive to the idea and able to understand the implication of charging networks, use of apps etc, older people are starting from a lower base in terms of engagement with technology. This means that the **engagement approaches** should vary from using social media to in-person roadshows where potential users can see a range of vehicle and charging options together. Further barriers to uptake are initial **vehicle cost, and worries about availability and speed of charging** – which addressing infrastructure issues can solve.

C. Upskilling Fleet Managers

Moving to increasingly electrified vehicle fleets is key to accelerating electrification of transport. Fleet buyers can start to rapidly increase demand for EVs which will help to reduce costs for all buyers. However, fleet managers have to develop a range of new skills and knowledge in order to achieve this, from understanding electrical loads of different chargepoint choices, to charge times for different vehicles with differently rated CPs, to understanding replacement vehicle options and costs. Use of data analytics (sometimes referred to as vehicle telematics, i.e., data analytics with telecommunications and informatics) is the key in developing fleet strategies. We can group these new knowledge areas into the following:

- Electrical load, power supply, storage strategies (including vehicle to grid)
- Charging loads, and times in relation to different chargepoint capabilities and vehicle types e.g.rapid v fast charging AC v DC etc
- Vehicle replacement choices
- Fleet management incorporating charge-downtime
- Whole life vehicle costs, for example where initial cost is higher than petrol equivalent, what is the overall cost over a 5yr period, accounting for fuel and maintenance
- Whole fleet strategy over time
- Data analysis (with telematics)
- EV / EVCP maintenance – upskilling in-house maintenance and maintaining upgraded skillsets

6.4.2 Accelerating Energy Infrastructure Upgrade

Alongside roll-out of EVCP infrastructure, there will be some electrical grid upgrades required to accommodate the additional loads. As we saw in the case of the fleet development at Cowley, these increased loads should be anticipated, and upgrade processes put in place early in the process. Distribution Network Operators are anticipating increased loads as a result of electrification both in transport but also in other areas such as heating of buildings, and the process to check load availability and improvements can take many months. Local co-operations across DNO, LA and other key parties can help to set out a coherent **plan for electricity distribution network upgrades** – alongside new inputs to the grid from renewables and storage. Moreover, to reduce uncertainty in the cost of the EV and CP adopting businesses, it could be advisable to set a single network upgrade cost model, whereby the costs of update for a DNO are averaged and set to a structured rate across various locations. This too could require **regulatory intervention and upskilling in development and use of new kinds of cost distribution and income use business models**. All EVCPs are smart, so data is generated to enable efficient use, troubleshooting and to monitor usage by drivers. All of this data requires good **analytics and interfaces** both front-end with users and back-end into wider systems. The data forms an essential part of the ECP network roll out, enabling future demand predictions and current use monitoring. As EVs become seen as essential components of the energy system and Vehicle to Grid (V2G) increases, another layer of data analysis is required in order to optimise charge and discharge of EV batteries within the wider energy system. Good ICT and data skills are required across the different layers of vehicle electrification – from CP design and operation to fleet management and maintenance.

6.4.3 Growth of EV workforce

We have noted how, in some of the new businesses in the transport and mobility sector, they value flexibility and a breadth of experience and that, in return, their new recruits are attracted by working for an entrepreneurial business that is addressing climate change and seeking to make a tangible difference. This is a strong selling point for **attracting workers from parallel industries or for upskilling those with relevant trades**. For example, electrical and construction skills, particularly as applied to renewable energy, are in demand as forming a good basis for upskilling. Similarly, managers in other parts of the energy system are useful, and, as one interviewee said, moving out of fossil fuel into EVs feels like a good move for the future. To maintain quality of service delivered through EV CP infrastructure, as well as to accelerate its installation, a growing **workforce of electricians and construction workers needs to be upskilled**, alongside well-trained IT technicians and maintenance teams to undertake data analysis and support fault identification and resolution, as well as ensure good customer experiences across the network.

7 Building and Retrofit Sub-System - Heat Pumps: Findings from Data Analysis

Within the ESO project, the buildings element is all about domestic heating and is effectively a separate element to the rest of the project, operating in isolation and independent of the progress of any other part. The aim is to install up to 300 ground source heat pumps into local housing. At the time of writing of this report, heat pump installation is nearly complete in one area of social housing, that of “Blackbird Leys’ which is owned by Stonewater Housing Association. Thirty heat pumps are being installed to replace outdated storage heating systems.

Kensa, who are leading this element of the project, are a UK-based heat pump company who design, manufacture and install heat pumps. For the ESO project, they are deploying a shared ground loop array approach where the individual heat pumps in each home are connected to shared boreholes. This approach is easier to deploy in social housing where there is a single customer.

7.1 Barriers and enablers for the building and retrofit sub-system

Factors impacting the roll out of heat pumps and associated infrastructure are summarised in Fig. 7.

Government policy

There are a number of areas of inconsistent or changing government policy which have hindered this (and similar) projects. During the writing of the proposal, ESO included ECO funding which is designed to support low-income households in becoming more energy efficient. Between writing the funding application and the award of funding, the ECO regime changed from ECO2t to ECO3 which meant different rules and a reduction in funding support. An inconsistency between demanding EPC D or below whilst also needing insulation to fund a heat pump meant mutually exclusive clauses (E3) which were impossible to reconcile, reducing funding. Similarly, Renewable Heat Incentives (RHI) funding has been reduced ‘three times since starting the project’ (E3) which currently makes installation of heat pumps expensive compared with conventional boilers and is a barrier to scaling up (E10). The announcement of the Green Homes Grant (GHG) might have been another avenue of funding support but has proved to be difficult to engage with, the more