agile streets

Agile Streets – the future of flexible charging

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Foreword from Chris Pateman-Jones, Connected Kerb

Enabling equal access to electric vehicle (EV) charging points is essential to achieving a full transition which is why the Agile Streets project is so important.

It is incumbent upon the whole EV industry to demonstrate how public EV charging infrastructure can be deployed so that it is affordable and accessible for all, wherever they live.

Agile Streets takes these aspirations to the next level. The combined deployment of smart charging, charger management software and smart metering to enable scheduling of public charging activities - to both reduce consumer costs and minimise the impact of charging on the grid – is ground-breaking. It provides a reliable, convenient and affordable way for people without driveways to charge their vehicles while allowing them to save money by matching the length of time they are parked to the speed of charging.

Everything we do at Connected Kerb has an eye on the future. We plan on deploying hundreds of thousands of our charging points across the UK. At this scale it is critical to be smart in the way networks are built. This whole project centres around the intelligence with which networks should interact with the grid – taking more power when it's available, for example when renewable generation is high and dialling back demand when supply is constrained.

It has been a wonderful project and I give huge credit to my innovation team, Samsung, Octopus and our other consortium partners who have worked with us on this. As we continue striving to deliver a seamless charging experience for all, we intend to deploy this technology across our entire network and hope others follow in embracing the success of this initiative.

1 Introduction

The Agile Streets project, funded by the Department for Business, Energy & Industrial Strategy (BEIS), demonstrated the use of the smart metering system and a new business model to manage Electric Vehicle (EV) charging, incentivising EV drivers to allow a flexible charging schedule on public infrastructure. With the Agile Streets system, EV users, who have no access to home charge points, get the opportunity to make use of off-peak tariffs to charge their EVs.

The Agile Streets trial was the first major trial in the world of flexible agile public charging, with 368 trial participants using 100 new chargepoints in 4 local authority areas in England and Scotland.

Over the five month field trial, the project delivered 2451 charging sessions totalling 51,618 kWh of energy (enough to drive 14,027 miles).

- Users had a choice between flexible ECO (agile) charging and non-flexible BOOST (immediate) charging. In over 80% of charging sessions drivers opted for an "ECO" charge;
- By opting for an ECO charge drivers got a cheaper rate, and helped reduce system costs by nearly 10%. The ECO charge also avoided charging at peak times when more carbon intensive forms of electricity generation are in use.

A total of **368 trial participants**

using **100 new chargepoints.**

The project delivered **2451 charging sessions**

totalling **51,618 kWh** of energy, enough to drive **14,027 miles.**

Department for Business, Energy & Industrial Strategy

During Phase 1 of the project, various components of the Agile Streets system were tested in a lab environment at the PNDC. These components were designed and developed by different consortium partners and several tests were completed to verify that each component worked as expected and that the data flowed seamlessly between systems. This helped to de-risk the system and ensure a smooth transition to Phase 2, where the Agile Streets system was installed in a real-world environment.

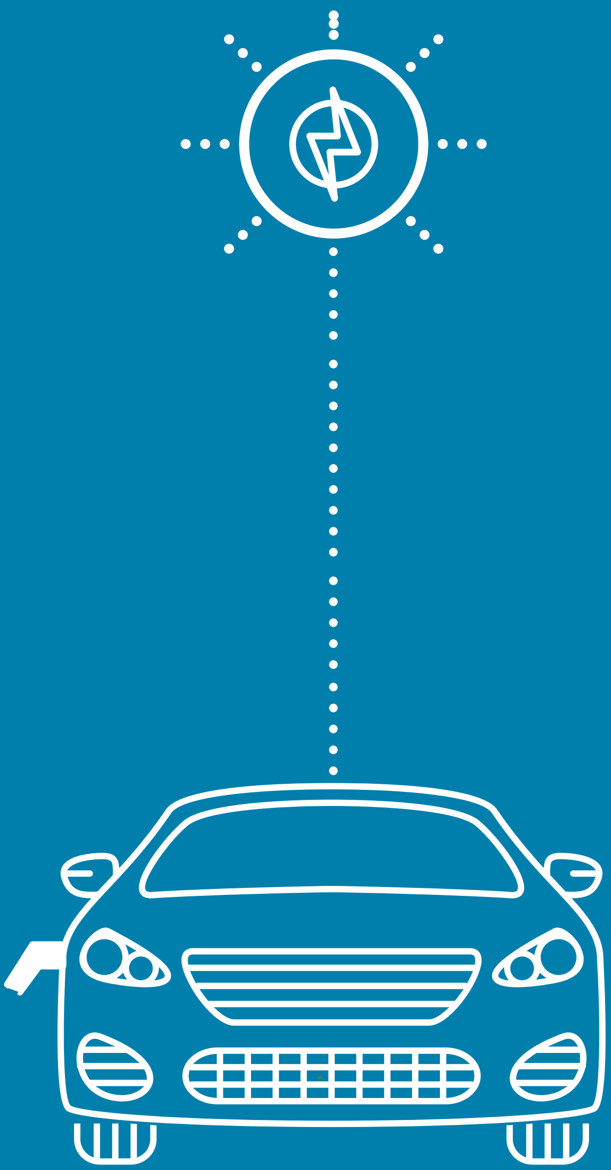
Phase 2 of the project saw a real-world field trial of 100 on-street charge points deployed at 17 locations in four different areas of the UK.

Trial participants were recruited and used the Agile Streets charge points between November 2021 and March 2022. This allowed real-world testing of the Agile Streets system.

Figure 1 – Map of Agile Streets charge point locations

Delivery partners

This report has been written by project delivery partners Samsung, Connected Kerb, Octopus Energy for Business, SMETS Design Limited, Energy Saving Trust and PNDC.



Samsung Research UK (SRUK) led the consortium. SRUK has an energy innovation team with years of experience building software platforms and user applications. Samsung data scientists developed the optimisation algorithm and managed the integrations of Connected Kerb, Samsung and Octopus Energy systems to deliver messages down to charge points. As project-lead Samsung worked closely with the consortium partners to ensure that the project was delivered successfully.

Consortium member Octopus Energy for Business (OEB) is a market leading energy supplier. Octopus managed the installation of Communication Hubs, Electricity Meters and HCALCS devices. Octopus used their software platform, Kraken, to issue the schedule provided by the Samsung algorithm down to the HCALCS devices. Octopus provided a dedicated "non-domestic Agile" tariff for the project to pass through flexibility savings to the non-domestic customer. For the purposes of this project, the OEB customer is the charge point operator.

Consortium member Connected Kerb (CK) is a market-leader in residential on-street EV charging infrastructure. Connected Kerb developed the Agile Streets mobile app and worked closely with key stakeholders to install the 100 trial charge points, support the Smart Metering set-up, as well as on-going customer support during the trials.

Consortium member SMETS Design Limited (also known as SLS) is a market-leading manufacturer of HCALCS and SAPC devices. SLS provided fully certified SMETS2 HCALCS devices to the project which delivered secure load control to a specification which is optimal for the project and for installation in the on-street control cabinets. SLS provided expert support to support the architecture, design, installations and commissioning of the Agile Streets system.

Consortium member PNDC is part of the Institute for Energy and Environment at the University of Strathclyde and as such has access to world leading academic researchers and collaborators, including specialists in power systems, communications, and energy markets and economics. PNDC supported final testing and quality of the installations and led on technical testing, evaluation and reporting work.

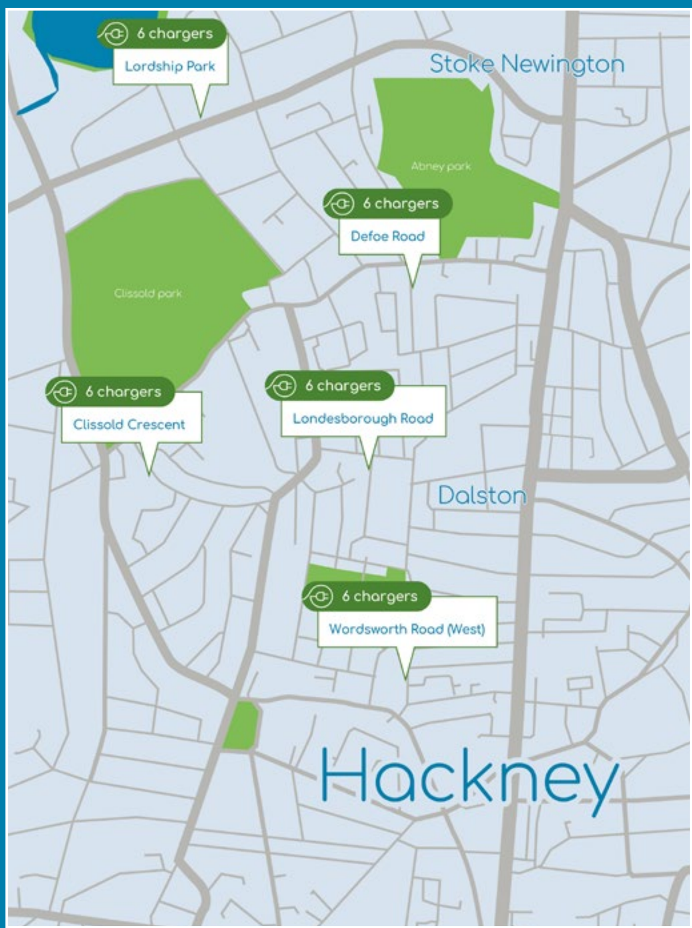
Consortium member Energy Saving Trust is a trusted, independent organisation with a proven track record of delivering transformative programmes working with governments to support the transition to low carbon transport. In the delivery of the Agile Streets pilot, Energy Saving Trust supported local authority recruitment, stakeholder coordination, marketing and publicity, evaluation and dissemination, end user acceptance support and digital surveys.


Springburn Park
Broadholm Street
6 chargers
Springburn
Ruchill Park
Possilpark
Cowlairs Park
Sighthill Cemetry
Woodlands
Kelvingrove Park
Park Street South
& Park Circus
4 chargers
Kelvinbridge
Glasgow
Glasgow Green
6 chargers
Terregles Ave
6 chargers
Prospecthill Circus
Strathbungo
Queens Park
Hampden Park
Toryglen


North Berwick Golf Course
12 chargers
The Glebe,
St Andrew Street
Lodge Grounds
North Berwick RFC
North Berwick


6 chargers
Promenade
Musselburgh Golf Course
Pinkie Playing Felds
6 chargers
Stoneybank Terrace
Hough Park
Musselburgh


6 chargers
Brownlow Street
Whitchurch
6 chargers
Oak Street Car Park
Oswestry
Shropshire
6 chargers
Abbey Foregate Car Park
Shrewsbury
6 chargers
Severn Street Car Park
Bridgnorth

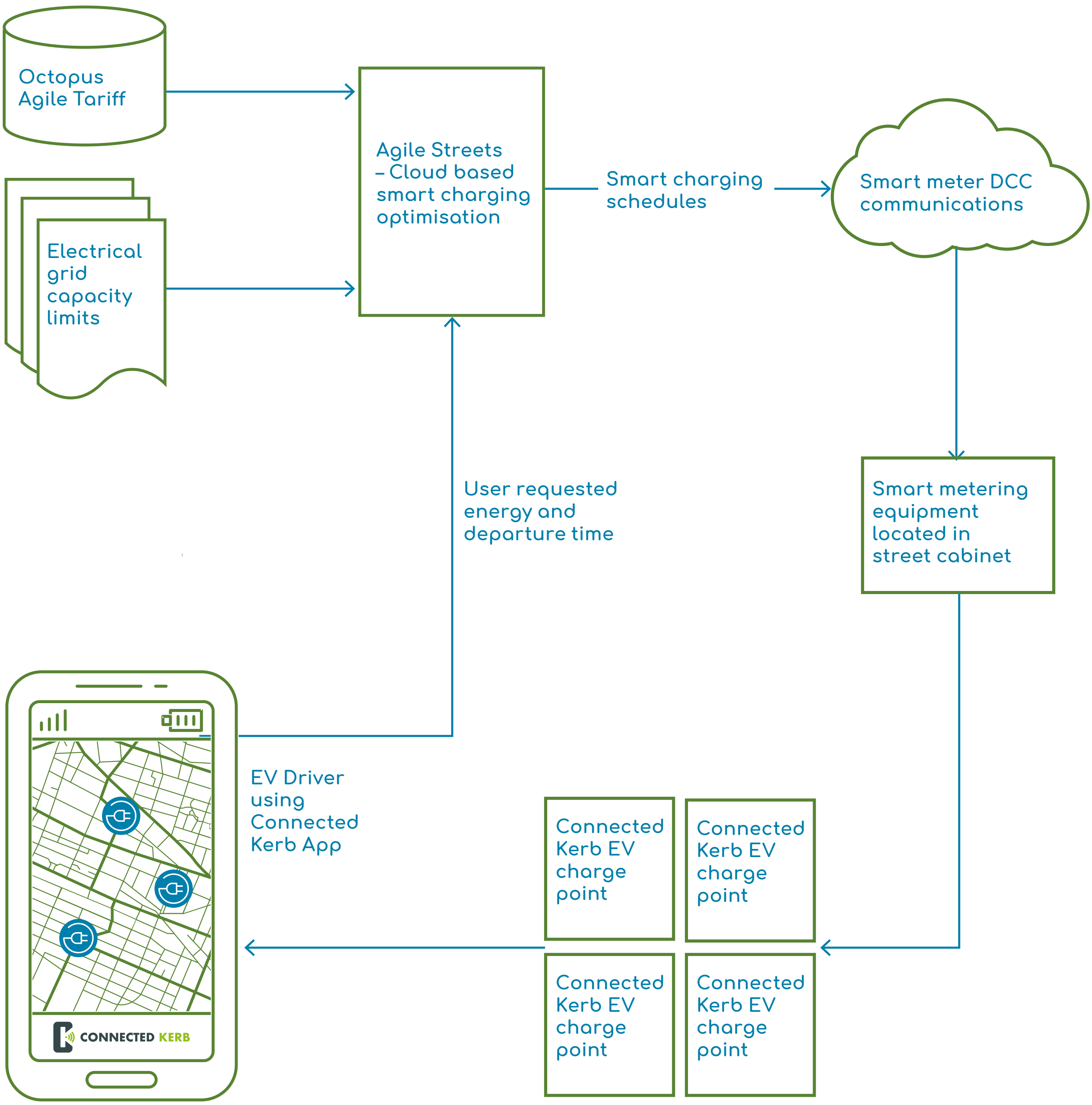

6 chargers
Lordship Park
Stoke Newington
Abney park
6 chargers
Defoe Road
Clissold park
6 chargers
Clissold Crescent
6 chargers
Londesborough Road
Dalston
6 chargers
Wordsworth Road (West)
Hackney

2. Agile Streets Phase 2 field trial

The Agile Streets project demonstrated that **the GB Smart Metering system can be used to effectively and safely control public EV charge points.**

The Agile Streets field trial optimised public EV charging profiles based on Energy Supplier costs, Distribution Network Operator (DNO) constraints, and EV driver preferences. The system incentivised EV drivers by offering them a cheaper price in return for flexibility about when energy is delivered to their vehicle. The conceptual architecture of the Agile Streets solution is shown in Figure 2

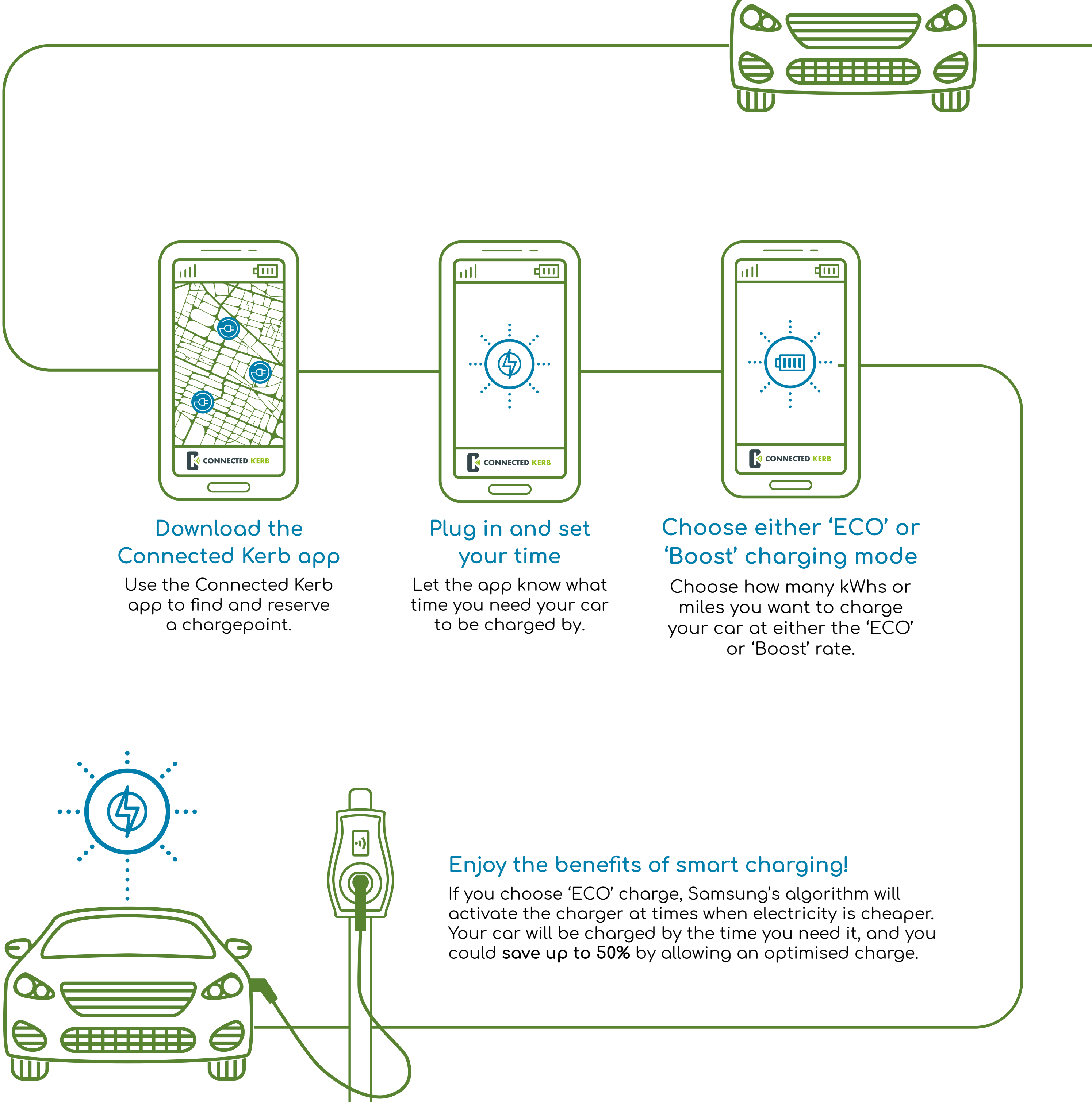
Figure 2 – Conceptual architecture diagram of the Agile Streets solution



The project deployed an innovative on-street control cabinet housing Smart Metering technology at 17 on-street charging locations. Each location supports between four and six 7kW AC charge points.

The graphic below illustrates the customer journey.

Figure 3 – Customer journey



To use the system, users are asked to select a charge point and enter a "charge-by" time in the Connected Kerb charging App. This triggers a calculation, which considers the half-hourly Agile business tariff rates between "now" and the charge-by time, to tell the user how much energy can be made available at a cheaper "ECO" rate (19p/kWh), and how much at a more expensive "Boost" rate (33p/kWh). Given the charge-by time of 9.30pm, and following the calculation, a maximum of 30kWh is made available at the ECO rate through the app as seen in Figure 4. If the user needs more than 30kWh they would either pay the Boost rate (for the entire session) or they would need to extend the charge-by time.

The user selects how much they need using the slider and then hits "charge", sending a request to the Agile Streets' cloud based central systems. The Agile Streets algorithm, developed by Samsung, then calculates the optimal charging schedule. The schedule provides the requested energy at the cheapest periods, minimising the costs according to Octopus Energy's Agile business tariff. The algorithm also respects a maximum DNO demand limit set for each charging site (with multiple charge points) when calculating schedules. Calculated charging schedules are 24 hours long, comprising of 48 half-hour binary charging states where EV charging is set to 'low-power' or 'high-power'.

Calculated charging schedules are sent to charge points using smart metering system capabilities available to the energy supplier, Octopus Energy.

Octopus Energy uses its in-house control platform, Kraken, to format and issue Service Request Variants (SRVs) to the Communication Hub and Han-connected Auxiliary Load Control Switch (HCALCS) device associated with a given EV charge point. The SRVs update the HCALCS' Auxiliary Load Control Description label with the charging schedule. This label is then serialised and sent to EV charge points in the street via an RS232 serial communications network.

The charging schedule is received, stored and executed by the charge point.

The charge point cycles through low-power and high-power states of the charging schedule until completion or until the user returns and ends the charging session manually using the Connected Kerb App. Upon completion, the charge point reports the volume of energy delivered to the EV to the Connected Kerb charge point management system (CPMS). The user is billed for this energy volume according to the Eco or Boost tariff rate as appropriate. Connected Kerb charges the user for the energy delivered using the payment method (usually a bank card) registered in their Connected Kerb account.

Figure 4A – Agile Streets App screenshot showing user requested inputs for Eco charging

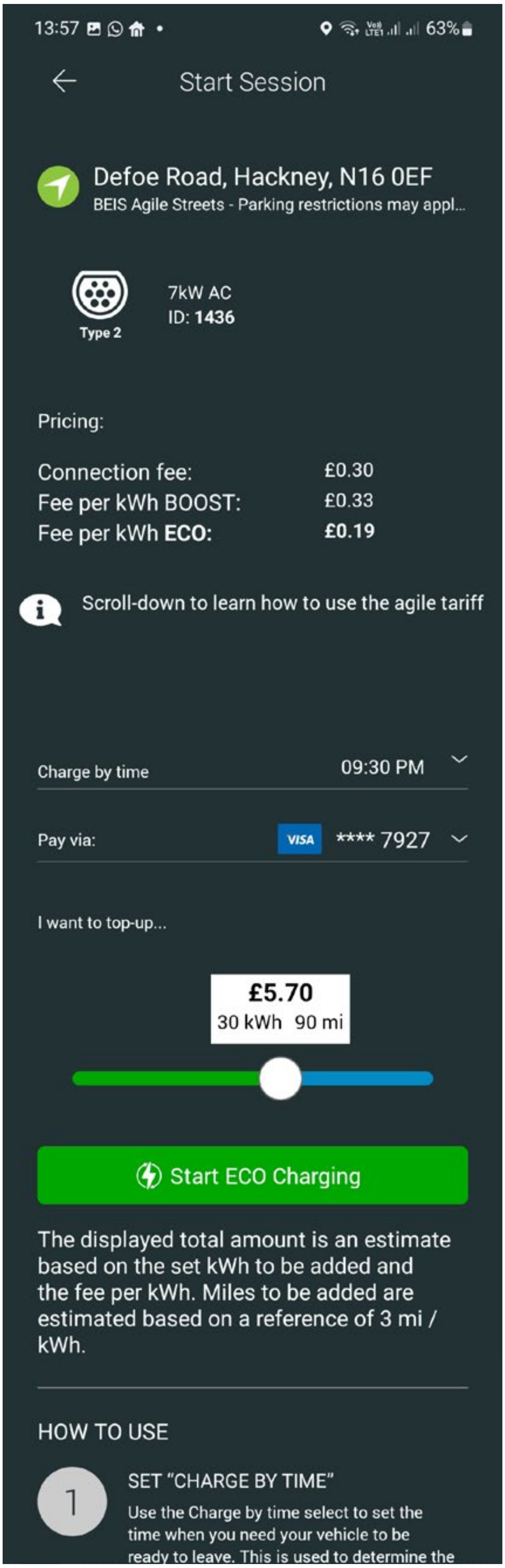
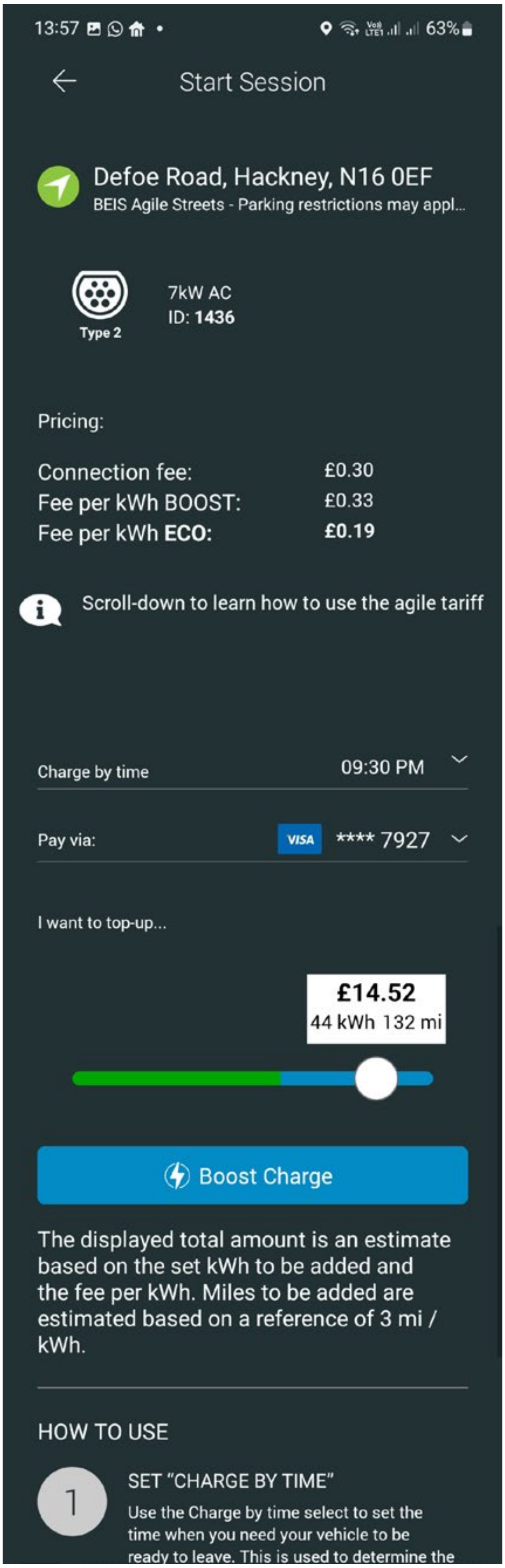


Figure 4B – Agile Streets App screenshot showing user requested inputs for Boost charging



3. Achievement against project objectives

The Agile Streets project successfully designed, tested and trialled an EV smart charging system for on-street EV charge points, which delivered energy at the cheapest available rate.

The Agile Streets charge points made use of load control features of the GB smart metering system, specifically the SMETS2 HCALCS device. The project demonstrated retail energy price optimisation – delivering energy at the cheapest available half-hourly periods of a charging session. Retail price optimisation also includes an element of network optimisation as the Agile tariff includes a distribution charge element based on DNO time-of-use charges.

The project deployed 100 on-street EV points at 17 sites across 4 local authority areas. As of 08/06/2022, over the course of a six-month field trial, the project delivered 2451 charging sessions totalling 51,618 kWh of energy. These charging sessions were completed by 368 trial participants.

The smart charging system provided EV drivers 36% savings on average.

This saved a total of £4,788 by permitting them to charge flexibly at a lower Eco charging tariff of 19p/kWh rather than pay a Boost charging tariff of 33p/kWh.

The smart charging system saved the charge point operator, Connected Kerb, energy retail costs of 9.8%. The system achieved this by delivering energy to users' EVs at times when the Octopus retail tariff was cheapest. These savings were made possible by Smart Metering which allows half-hourly settlement of the electricity used.

Agile Streets offers a balancing mechanism that can support government's plans for EV uptake

The Government plans to support the UK market to reach 300,000 public electric vehicle (EV) charge points by 2030. If these charge points do not adopt an ECO charging option, our analysis suggests that this will increase peak demand by around 240MW. This would mean that the grid would need either 240MW of additional peaking plant (e.g. OOCT or CCGT) (at around £16.8m per annum for construction and fixed operating costs) or additional storage (a 240 MW 240 MWh Lithium ion battery could cost up to £83m for installation and an annual operating cost of £1.5m).

A total of
368 trialists
used the charge points
2451 times.

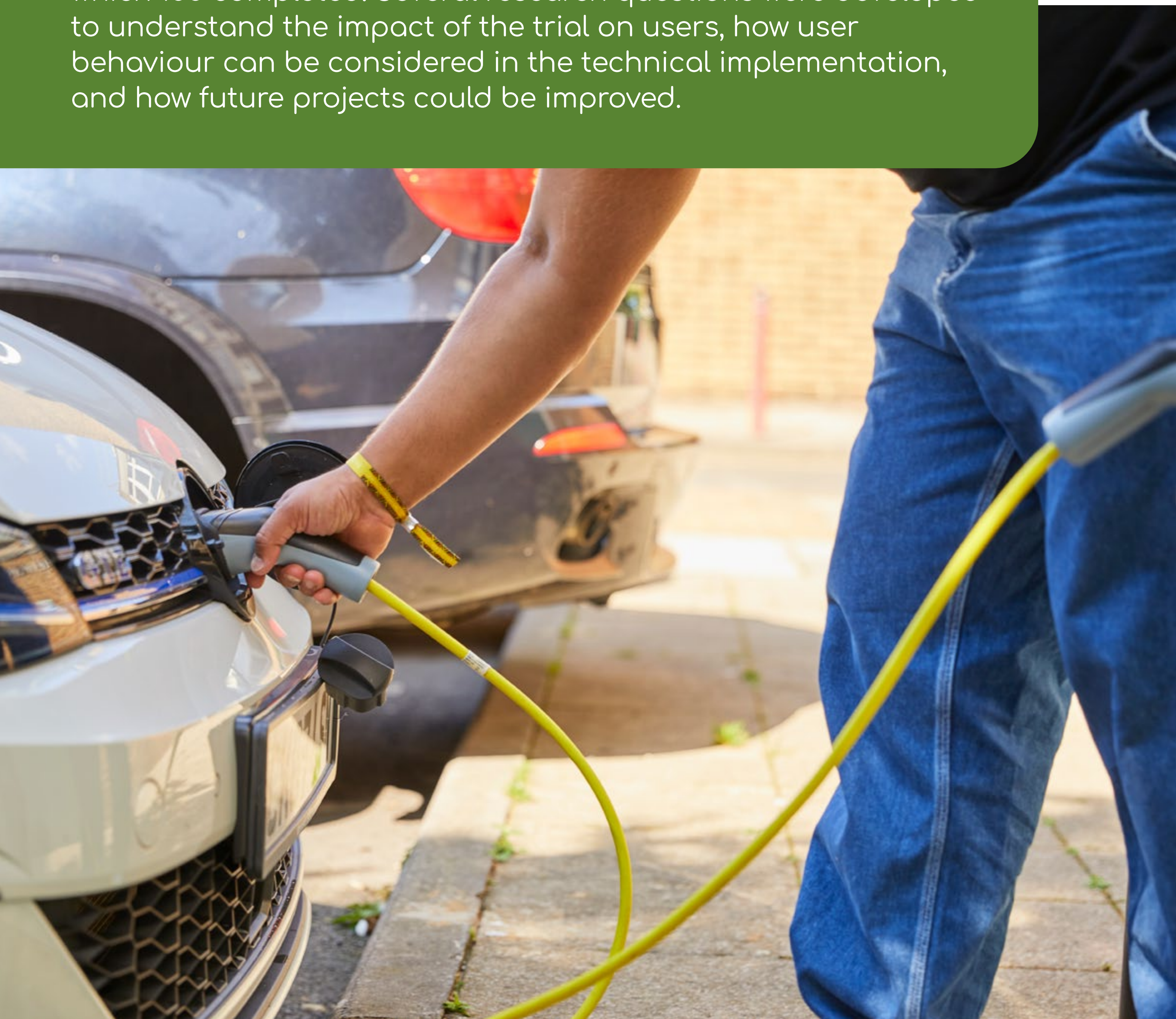
The smart charging system provided EV drivers
36% savings
on average.

The Government plans to support the UK market to reach
300,000 public charge points
by 2030.

Without agile charging, this would require
240MW of additional peaking plant.

4. User perspective of the Agile Streets system

As part of the monitoring and evaluation of the project, 589 registered users were sent an online survey at the end of the trial, which 155 completed. Several research questions were developed to understand the impact of the trial on users, how user behaviour can be considered in the technical implementation, and how future projects could be improved.



57% of survey respondents had used an Agile Streets charge point.

Those who hadn't used a charge point were individuals who were initially interested in participating but did not end up taking part. This group stated that the main barrier to using the charge points was an inconvenient location (see Figure 5)

The following findings focus on survey respondents that had used an Agile Streets charge point.

ECO charging proved to be very popular and most trialists would continue using it in the future

Almost all trialists used the ECO function at least once (see Figure 6) and over 75% could see themselves using it on a longer-term basis. Over the 6 month trial, 83.7% of the 2451 sessions were ECO charging sessions.

All trialists who didn't use the ECO function said that it was due to not having enough time to charge their vehicle on ECO.

Three main suggestions to improve ECO charging emerged:

1 Making the app simpler
2 Providing more charge points in residential areas
3 Providing clearer messaging on how it works and what the benefits are

Figure 5 Why have you not used an Agile Streets charge point?

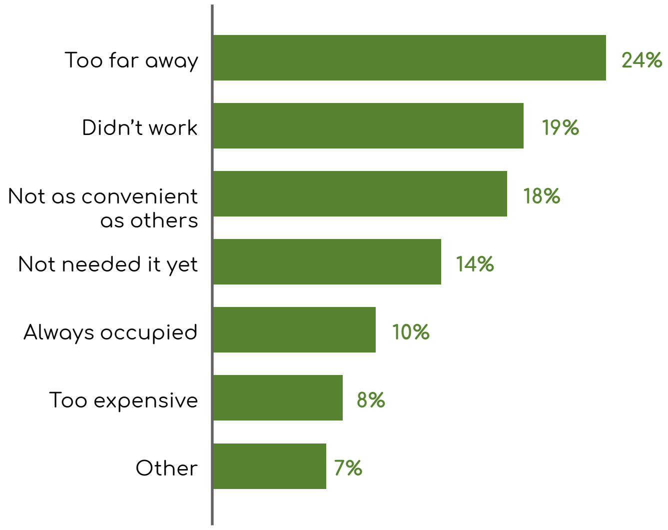
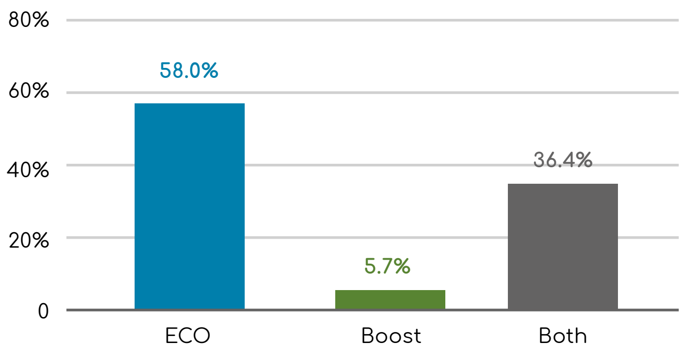
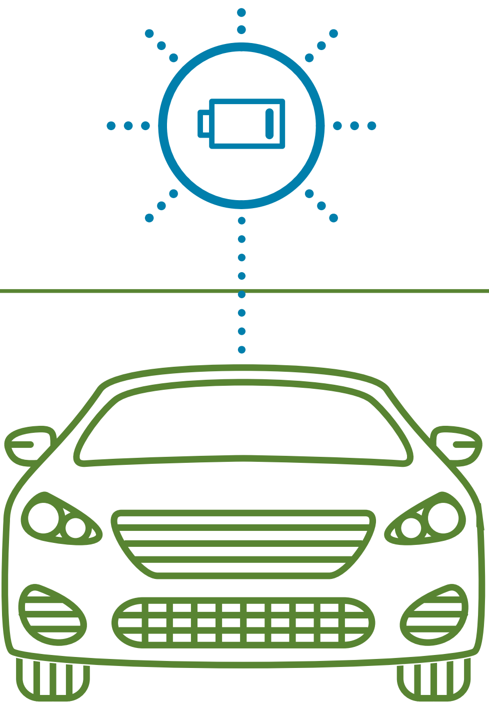


Figure 6 Did you use the ECO or Boost function when using the Agile Streets chargepoint?

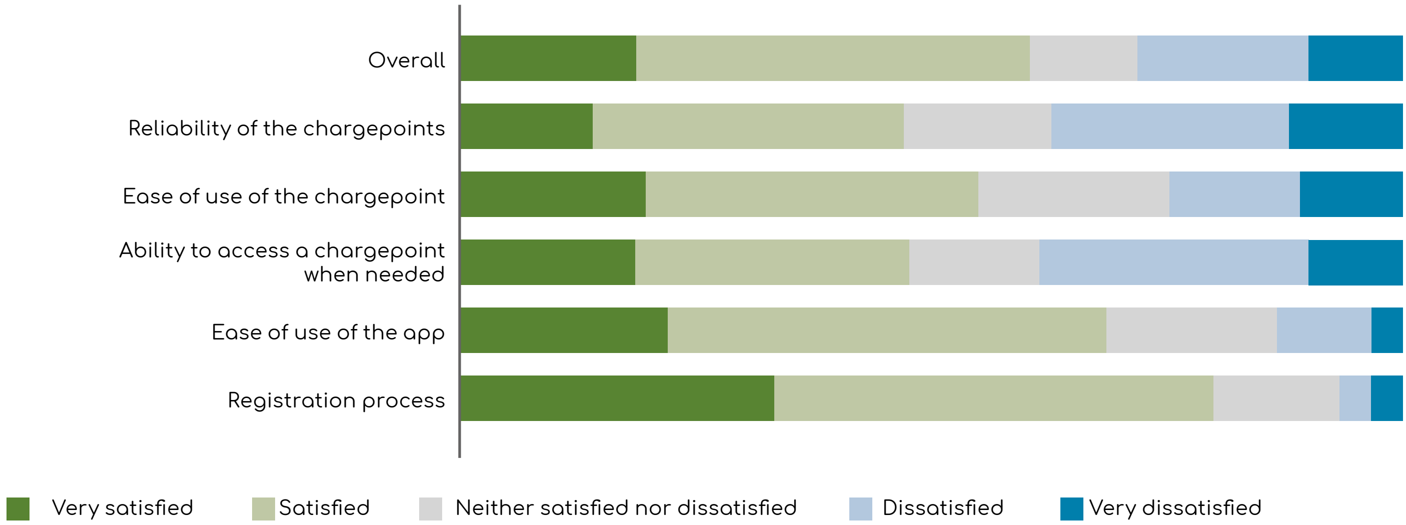




"I would use agile charging on a long term basis to preserve the car battery, to save money whilst charging and to feel I'm doing my bit towards a sustainable future."

Agile Streets trialist

Figure 7 – How satisfied were you with the following?



Financial benefits were the main driver for using ECO charging

Financial savings were the primary incentive to sign up to the trial and for using the ECO function. Others stated that ECO charging was convenient for them and fit well with their charging requirements.

"If the ECO tariff remains at a competitive level, I will continue to use Agile Streets chargepoints."
Agile Streets trialist

Most users were satisfied with the overall Agile Streets service, including the app and registration process

60% of users were satisfied with the Agile Streets trial and its components, with 18% being very satisfied (see Figure 7). These are very positive results for a beta technology.

Users were most satisfied with the registration process and the ease of use of the app.

The areas with the most dissatisfaction was the ability to access the charge point when needed due to bays being blocked by internal combustion engined vehicles.

"Easy to use; much better to use via an app than an RFD card; very convenient..."
Agile Streets trialist

"Mainly they can't be used because there are non electric cars parked in front of them."
Agile Streets trialist

Almost half of all respondents changed their charging behaviour as result of using the Agile Streets charge points

Most users said they used the ECO function because it was available to them at the time they would ordinarily charge their vehicle, while almost 20% had actively changed the time they would charge their vehicle to ensure they received an optimised charge (see Figure 9).

Almost a third of respondents now wait until their battery reaches a lower level before charging their vehicle.

39% of users now think more about when it is appropriate to charge their vehicle.

Figure 8 – Did you change your charging routine after/ while participating in the trial?

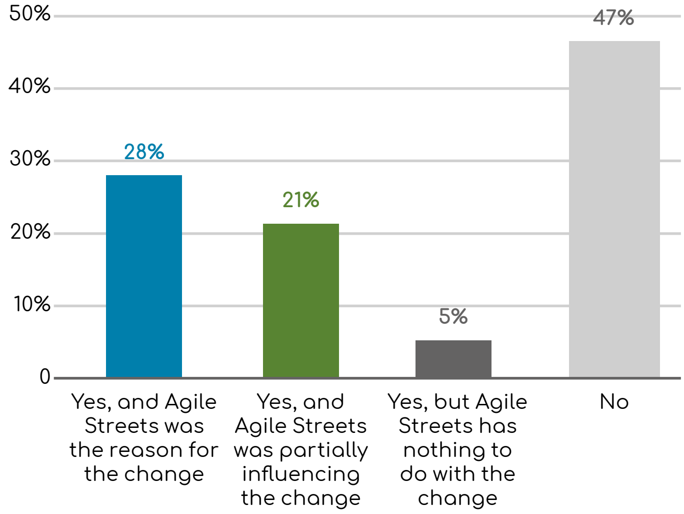


Figure 9 – Did you use the ECO or Boost function when using the Agile Streets chargepoint?

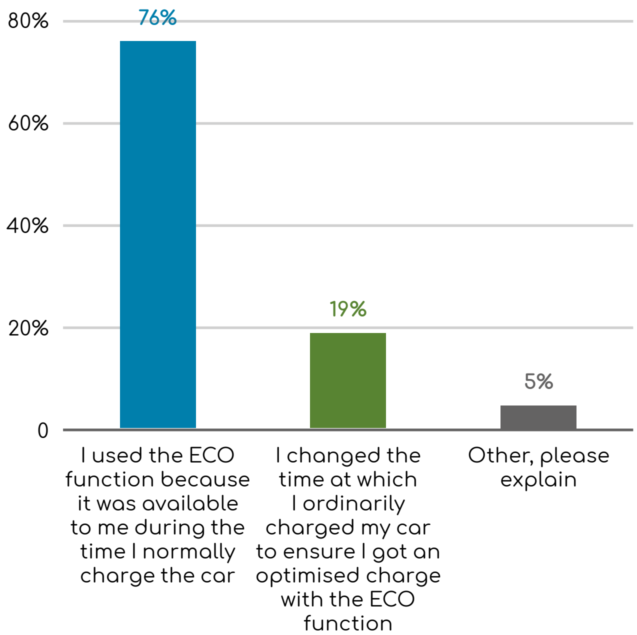
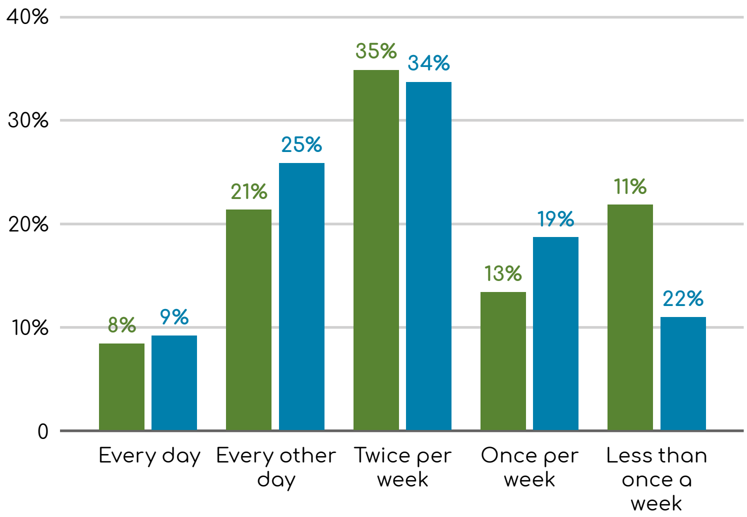


Figure 10 – How often did you charge your electric vehicle before getting involved in the Agile Streets trial vs. now?



> "I know that I can let the battery run quite low and still get to a charge point, and I prefer to charge overnight."
>
> Agile Streets trialist

> "I only used the charger once but we have thought about [which] times we charge our vehicle a lot more since using it!"
>
> Agile Streets trialist

To maximise benefits, users should be encouraged to charge overnight and when their vehicle's battery is low

We analysed the Agile Streets charging sessions from 16/11/2021 to 03/03/2022 to study the user behaviour. Almost half of the recorded sessions were ended at least 1 hour before the predicted departure time, including sessions where the user requested a large amount of energy, but then stopped the session after a few hours. These sessions were least profitable and can be explained by users over-estimating the energy required to fully charge their EV battery.

The most profitable sessions in the Agile Streets trial were the sessions where the dwell time was high (>10 hours) and the energy delivered was also high. As a result, EV users should be encouraged to opt for overnight charging and be further motivated to charge when the battery state of charge is low enough to guarantee a relatively large charging session.

Table 1 Simple analysis of charging sessions broken down by accuracy of return time

	Early	On-time	Late
No of Sessions	441	258	236
Total Energy Requested (kWh)	31,912	11,928	11,908
Total Energy Delivered (kWh)	5,200 (16.3% of requested)	7,000 (58.7% of requested)	6,886 (57.8% of requested)
Customer Energy Cost	£1,235	£1,408.9	£1,381.7
Customer Savings	£480.7	£901.4	£890.6
CK Energy Cost	£1,160.2	£1,330.3	£1,305.7
CK Energy Savings	£55.34	£136	£201.5
CK Saving/CK Cost * 100	4.8%	10.2%	15.4%

5. Lessons learned

The following key lessons learned are noted to be of particular importance.

EV charge point sites, installation & commissioning

The majority of Agile Streets' charge points are installed in on-street residential locations without dedicated EV bay marking. The power to allocate dedicated EV bays to charge points lies with the Local Authority and their Road Traffic Order (RTO) process. The lack of dedicated bays was a frequent complaint of trial participants and ideally – from the perspective of the trial - these would have been allocated at all sites. Unfortunately, the RTO process can be controversial and time consuming, which is why most local authorities did not implement this during the 4 month trial. The lack of dedicated bays decreased trial participation. The deployment of dedicated bays for on-street charge points is not regulated, but is considered best practice by many local authorities who want to maximise the availability and value of deployed infrastructure to EV drivers. Dedicated bays deployed under RTOs can be marked out during commissioning or retroactively once the necessary approvals are granted. Since trials concluded some local authorities have taken this feedback onboard and have now either changed the demarcation and allocated dedicated bays or are trialling dedicated bays in some locations.

The Agile Streets project selected locations of mixed demographics and geography to ensure a mix or rural & urban charging. A mix of locations likely to have high EV adoption and low EV adoption were also chosen. This was requested by Local Authorities who want to ensure public EV charging infrastructure is not concentrated in wealthy areas which would further reinforce EV adoption imbalances. The challenge for the project was to support this aim while ensuring a sufficiently high average utilisation for the project to learn from. We expected a couple of sites in Glasgow, East Lothian and Shropshire to get less utilisation than other sites located in areas where EV ownership is more concentrated. Utilisation data confirmed this expectation, with Hackney sites seeing significantly more charging activity than the other local authorities.

Commissioning of the Agile Streets' sites required more visits to each site from a larger range of staff than is required for installation of a typical non-Smart Metering public charge point. Typical charge point commissioning would only require one site visit. The commissioning of charge points as part of the Agile Streets project needed at least four additional visits. This was partly due to dependencies on other partners and the need to follow the installation of smart meters, resolve snags and trouble shoot issues.

Outside of an innovation project such as this, these issues would be resolved in advance of deployment by creating a more integrated product and more streamlined commissioning processes.

Troubleshooting during commissioning and return visits to the sites created inefficiencies that are not compatible with efficient widespread rollout of public EV charging infrastructure. Troubleshooting-related effort would be expected to reduce as installation teams become more experienced with this solution. These inefficiencies were expected in a trial; however, the widespread rollout of any smart charging system will require the upskilling and training of engineers in any additional necessary steps for installation, configuring and commissioning of smart charging solutions. For example, electrical contractors not familiar with communication networks and troubleshooting would need training in these new skills. The development of efficient processes similar to those created for the smart meter rollout will need to be developed for any installation steps not covered under smart metering, including any interfaces between smart metering equipment and energy smart appliances.

The commissioning of the serial communications between the HCALCS and the EV charge point was a challenging part of the Agile Streets installation. This was due to the lack of experience of the electrical contractors of this type of installation, associated commissioning steps and troubleshooting. The common use of electrical sub-contractors for charge point installation meant that the system and commissioning knowledge held by the Connected Kerb team had to be disseminated to multiple third parties, many of which schedule specific staffing in a manner that cannot guarantee the same person at all sites.

Further development of the Agile Streets solution would look to minimise the on-site installation and commissioning steps, aiming for a solution that is as 'plug-and-play' as possible.

The installation of additional smart metering equipment required more space within on-street LV cabinets and the power pack boxes located underneath each charge point. Local Authorities and urban planners are encouraged to minimize street clutter to realise accessible and attractive public spaces. The use of a single three phase meter compared to three single phase meters for the Agile Streets setup would reduce some of the additional space needed for the trialled system. The direct integration of SMETS load control within charge point devices could further reduce space requirements.

EV charging tariff design for public smart charging

The nature of the Octopus Agile tariff means the charge point owner is exposed to daily fluctuations in the wholesale price. EV drivers need to be protected from this daily fluctuation by providing transparency, ideally in advance of arriving at the site, and by insulating them from any extreme prices. The Agile Streets project provided this transparency, obscuring the half-hourly wholesale price fluctuations behind a simplified Eco and Boost tariff rate. Regulation of the minimum expectations for tariff design processes like this should be considered while still allowing charge point operators to compete through pricing innovations.

The Agile Streets' Eco and Boost charging rates were set taking into account:

- An attractive tariff compared to local prevailing public EV charge points, including some that are partially and fully subsidised by local authorities; ensure good participation in the time constrained trial.
- A price difference between Eco and Boost rates that is sufficiently large to encourage EV drivers to be willing to be flexible with their charging schedules.
- Setting an ECO rate that reduced the gap between on-street charging and home charge pricing and support efforts to make charging affordable and government initiatives on levelling up.
- A tariff that covers the expected cost of energy as billed by the Octopus Agile energy supply contract.

At the time the tariff was designed in early 2021, considering the above factors, the Eco and Boost tariff rates were set at 19p/kWh and 33p/kWh. **As the project progressed, electricity wholesale prices have increased significantly** – according to Ofgem's Data Portal the weekly average wholesale day ahead contract for electricity increased 228% from (£90.94/MWh) January 2021 to January 2022 (£206.88/MWh). Due to the time limited nature of the trial and a desire to avoid potential confusion with users, it was decided to maintain the originally designed tariff for the duration of the 4-month trial, even if that resulted in lower cost recovery for the charge point operator.

As ECO charging moves from a trial-phase to commercialisation, the tariff will be reviewed to ensure that it is commercially viable. The outlined design principles will, however, remain the same. In a business-as-usual scenario, the financial risk to the charge point operators from sudden changes in wholesale prices could be reduced by securing longer-term fixed time-of-use energy supply contracts, or by sticking with a variable TOU contract (such as Agile) but introducing regular reviews of Eco and Boost tariff rates offered to customers. If the charge point operator takes a variable tariff such as Agile, the ECO and BOOST rates could be updated on similar timescales to the revision of the price cap (due to be every three months from October). This would allow charge point providers to ensure they can fully recover costs while maintaining a clear and transparent process from the EV driver's perspective.

Energy suppliers should consider developing a wider range of fixed smart TOU tariffs that provide more certainty to business customers whilst incentivising load shifting away from peak times. For example, a fixed hourly tracker would fix each hour's price for the fixed tariff duration (e.g. 1 year), but the fixed hourly prices would represent the average costs for different hours.

Technology performance

The average end-to-end latency of the smart charging schedule messages in the Phase 2 field trial was 31 seconds for Hackney sites, 44 seconds for Glasgow sites, 49 seconds for East Lothian, and 67 seconds for Shropshire. The longest observed latency was 144 seconds and the lowest 20 seconds. The latencies reported here are defined as the time taken for the charge point to receive the computed charging schedule from the Samsung optimization algorithm. The recorded latencies for Agile Streets messages compare with Internet-based smart charging communications of around 1 second.

The Agile Streets system is designed to start charging vehicles immediately at a low power rate, before the charging schedule is received through the smart metering system. This design feature allows the EV driver to confirm the charging process has started correctly and avoids them having to wait longer than with a non-smart charge point. Therefore, the latency of the smart charging schedules does not impact the user experience.

The latency of the smart charging control messages is important in how it performs with respect to the dispatch requirements of different energy and flexibility market products. Dispatch requirements are defined by the National Grid and Distribution System Operators, with requirements ranging from 1 second to 15 minutes for different products.

The smart charging schedule issued by the Agile Streets system comprises 48 half-hourly setpoints. Each setpoint represents a binary low-power (6A or around 1.4kW) or high-power (32A or around 7kW). The setpoint issued to EVs, according the charge point standards, represents a maximum permissible charging current. A number of factors influence how closely an EV's power consumption actually matches this value, including:

- Falling power consumption when an EV's battery approaches 100% SoC.
- The rating of the EV on-board charger – this commonly ranges from 3.6 to 22kW. If the on-board charger is rated lower than the setpoint then it is the limiting factor, not the smart charging setpoint.
- Component level tolerances in measurement and the actual power drawn: +/- 3% is not uncommon.

The above factors need to be considered in the design of any smart charging system, particularly how they impact the user experience and the accuracy of the smart charging logic. Furthermore, the above factors have a direct impact on the type and value of DSR services smart charging from this control method can provide. For example, if a flexibility provider is relying on DSR load shifting from smart charging, they may have to "over procure" load to meet their market committed obligations if these control uncertainties exist.

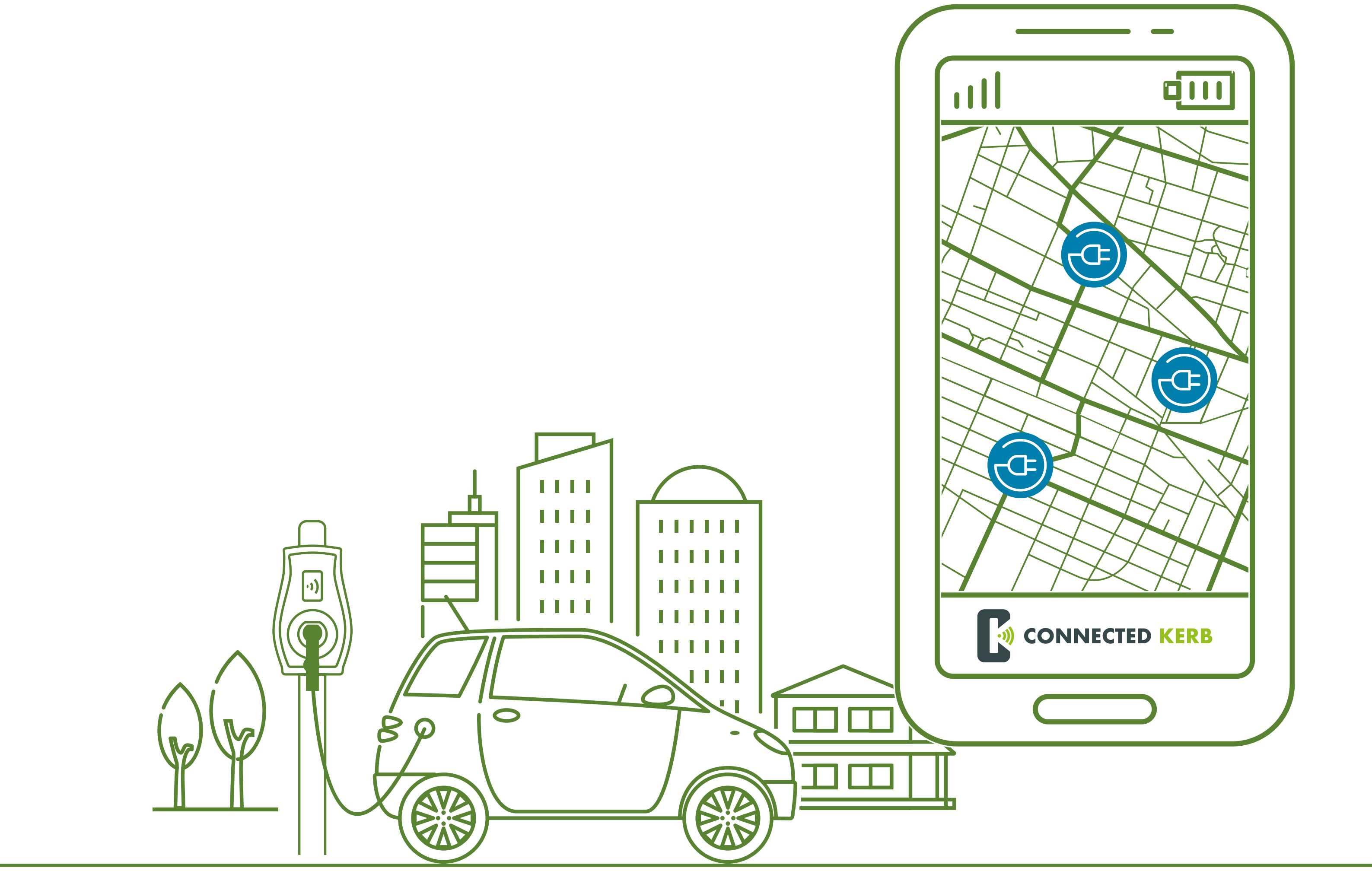
During the Phase 2 trial we had to make an assumption that EVs would accept the maximum offered charge; this is because it is difficult to get the State of Charge (SoC) of an EV's battery when using AC charging standards supported by most EVs and EV charge points.

Not knowing the state-of-charge also meant that we had to rely on user input, and users often overestimated how many kWhs they needed, reducing the potential smart charging benefits as smart schedules overestimated the number of high charging periods needed to meet the users' overestimated demand of kWhs.

A coordinated, industry wide approach to share this information between EVs and charge points could make the exchange easier and unlock further value from smart charging. Coordination and industry dissemination could be led by standards bodies and regulators.

Charge point user-related lessons

Many early adopter enthusiasts are well informed about the nuances and state of technology, other EV drivers have limited understanding. An important part of the Agile Streets project has been user recruitment, education and engagement. This took the form of online webinars, educational emails, and provision of telephone support. This education of users of the Agile Streets system about the new requirements to use the system was critical to a successful trial. As EVs become widely adopted it might be expected that the level of interest and understanding of underlying technologies will decrease on average; the theory being that early- and late-majority adopters will primarily want a vehicle that works with little thought. While it is expected that the underlying technology and EV user experience will improve, an **appropriate level of education of EV drivers is a crucial element of ensuring a successful transition to EVs**. This is more evident if the complexity of smart charging and variable energy use is partially pushed onto consumers.



6. Future work and next steps

The Agile Streets project has successfully demonstrated how UK smart metering technology can be used to undertake smart charging of public EV charge points. This report highlights the outputs and lessons from the Phase 2 field trial of this project. To build upon the outputs of this project the following future work should be considered by industry and government to further develop smart metering and smart charging technologies.

Test and demonstration of smart meter enabled smart charging that permits acknowledgement of the DSR control signals back to the energy supplier or the DSR provider.

This can happen either through the smart metering system or via an alternative secure communications path. An example of such a demonstration could see a non-mandated alert used to confirm a specific control action or via feedback data integration with the EV smart charger and the party responsible for smart charging control and scheduling.

Full integration of smart metering compliant DSR capabilities into EV charge point hardware.

An example of such a demonstration would be the funding of ALCS or SAPC functionality directly into EV charge point hardware in a way that complies with security requirements and requires no additional commissioning steps.

Test and demonstration of smart charging control with greater integration to EV on-board telematics including State of Charge and real-time power draw.

An example of such a demonstration could include the feedback of real-time EV state of charge to the party responsible for smart charging control and scheduling. This would permit reactive control to compensate for a number of known variables to charging rate, improving the user experience.

More work with Energy Suppliers to develop a sustainable combination of non-domestic tariff and user ECO vs BOOST pricing.

This ensures that the pricing allows Connected Kerb to make a return whilst offering a competitive ECO rate to incentivise flexible charging.

Work with EV manufacturers to allow low rate charging to drop to a minimum level (e.g. 0 or 1A) during peak times without the car ending the charging session or falling asleep.

Some car manufacturers use some of the electricity during a charge to heat-up the battery to a level where the charging will be more efficient so it is important to work with them on a solution that maintains the efficiency of electricity transfer to the battery whilst also optimising charging schedules.

Addition of a battery storage cabinet and integration of the storage capacity to the optimisation calculation.

Battery storage can help address constraints where more chargers need to be connected on a street, and can increase revenue from DSR services and from HH settlements.

agile streets

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