TRANSPORT STUDIES UNIT

GO ULTRA LOW OXFORD

Policy Briefing, November 2019

Criteria to assess on-street electric vehicle charging options

Between 2017 and 2019, Oxford trialled various on-street electric vehicle charging technologies. This policy briefing discusses the approach to the identification of criteria for the evaluation of the charging technologies.

Go Ultra Low Oxford

On-street charging technologies can significantly improve access to charging infrastructure for owners of ultra low emission vehicles (ULEVs)[1] who live in housing without private off-street parking space. This can reduce one of the key barriers to EV uptake. A consortium of parties led by Oxford City Council in partnership with Oxfordshire County Council undertook Go Ultra Low Oxford Phase 1 (GULO), a pilot project funded by the Office of Low Emission Vehicles (OLEV).

The first phase of GULO trialled five different on-street EV charging technologies across 28 locations on public streets in Oxford. Private ULEV users and car club members using ULEVs participated in the trial.

A car-club vehicle charging from a converted lamppost in central Oxford.

[1] Cars or vans that emit max 75 g/km Co_2 in the New European Driving Cycle test, including battery electric vehicles, extended range electric vehicles and plug-in hybrid vehicles.

This report is available to download from www.tsu.ox.ac.uk/pubs/2019-Nov-GULO-Policy-Brief.pdf
See also www.goultralowoxford.org

Charging Technologies

Five different charging technologies were part of GULO's first phase. Chargers have a standard Type 2 socket and are capable of either standard or fast charging (see Definitions box).

29 **lampposts** were retrofitted with EV charging points in 11 streets throughout Oxford. No dedicated parking bays have been allocated. These installations can be accessed only by using an Ubitricity SmartCable, with an in-line meter and billing system. The cost (RRP £199) of the SmartCable was met by the City Council for all participants.

Three types of **bollard** chargers were included in the trial, with four installations of each deployed across Oxford. They are able to discharge over 7kW, and have been installed in Oxford alongside dedicated parking bays. Each of them is operated using an RFID card supplied by NewMotion, the company which operates payment and billing for the GULO trial.

Five households were provided with a **home charger**, paid for and installed on the front of their house with a dedicated meter. Billing occured via residents' electricity provider. For each installation, a channel was dug into the pavement to allow cables to run from the charger to the car without presenting a trip hazard.

Co-Wheels car club deployed ten electric vehicles across Oxford, each with an allocated parking bay close to a charger. These vehicles were mostly extended range vehicles, and make use of each of the bollard technologies and the lamppost chargers.

Lamppost chargers

Type:	Ubitricity Lamppost Charger
Power output:	3.2 – 5.5kW
Access:	Accessible with smart cable only
OPPC 1.5:	No
Payment:	Ubitricity payment account
Features:	Can be retrofitted into existing lampposts, 3 installations with 1 socket each per site

Bollard chargers

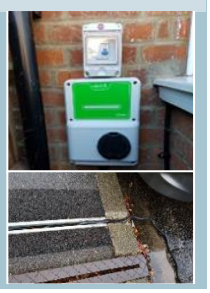
Type:	Zeta Smartscape Charging Bollard
Power output:	7.2kW
Access:	RFID card and app
OPPC 1.5:	Yes
Payment:	NewMotion payment account
Features:	Slim-line design suitable for narrow footways, 1 socket per bollard.

Type:	eVolve e-Post Charging Bollard
Power output:	7.4kW
Access:	RFID card and app access
OPPC 1.5:	Yes
Payment:	NewMotion payment account
Features:	Instructions available on-screen, 2 sockets per bollard.

Type:	Chago Station Charging Bollard
Power output:	7.4kW
Access:	RFID card and app access
OPPC 1.5:	Yes
Payment:	NewMotion payment account
Features:	Load balancing available to manage output, 2 sockets per bollard

Home chargers

Type:	APT eVolt Home Charger and Cable Channel
Power output:	3.7kW – 6.5kW
Access:	Smart energy meter
OPPC 1.5:	No
Payment:	Domestic electricity tariff
Features:	Resident can use own home power supply.

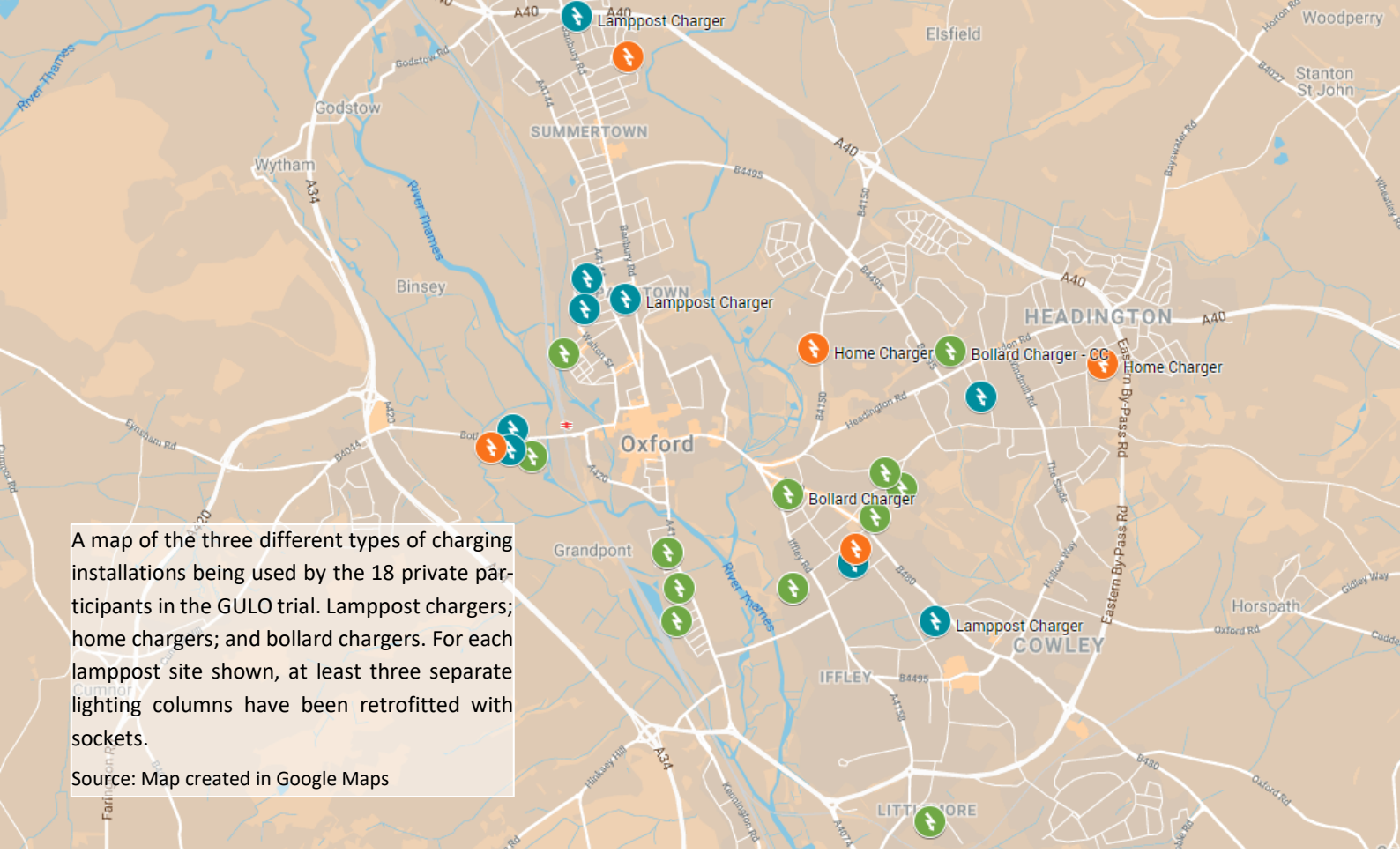


Definitions

A **standard charging** point (3-7kW) are used for longer charging times and can take approximately 6-8 hours to charge some models of battery electric vehicles (BEVs).

A **fast charging** point (7-22kW) can fully recharge some models of battery electric vehicles (BEVs) in 3-4 hours.

Open Charge Point Protocol (OCPP): is a protocol for how EV charging stations communicate with a central management system. If charging technologies comply, it means back-office services such as billing can be provided by a third party.



A map of the three different types of charging installations being used by the 18 private participants in the GULO trial. Lamppost chargers; home chargers; and bollard chargers. For each lamppost site shown, at least three separate lighting columns have been retrofitted with sockets.

Source: Map created in Google Maps

Evaluation of the trial

The first phase of the GULO project started in July 2017, when 30 locations were originally planned for installations throughout the city of Oxford. 20 would be located close to the dwelling of private households who had signed up to the trial. The remaining ten would be provided for car-club users. In the end, 46 charge-points were installed across 28 locations.

The Transport Studies Unit (TSU) at the University of Oxford was commissioned by the Oxford City Council to monitor and evaluate the trial. The evaluation has four objectives (see box below).

A total of 16 private householders and 5 car club members who use ULEVs stationed at four locations across the city of Oxford participated in the monitoring and evaluation. Of the 16 householders, 6 participated using 100% battery electric vehicles (BEVs); 8 used plug-in hybrid vehicles (PHEVs); and 2 had extended range vehicles (EREVs). At the time of writing (Aug 2019), the car club has 9 EREVs in Oxford.

A longitudinal, mixed method research design was used for the evaluation:

- Private ULEV users were interviewed four times, once before and three times during the trial (after one, five and 11 months) and were twice asked to demonstrate how they charged their vehicle using the installation they had been assigned
- Car club members were interviewed two times during the trial (after three and nine months)
- Quantitative information on charging point use, repeated observations of the installations, responses to City and County Council consultations, and interviews with stakeholders (e.g. technology providers, council staff) were also used.

Evaluation Objectives

- Evaluating the performance of the various on-street charging installations
- Examining the adaptations to car-use routines and the formation of charging habits among pilot participants
- Identifying local community responses to the charging installations
- Developing insights about how the pilot may be scaled up within Oxford and transferred to local authorities elsewhere in the UK.

Evaluating Performance

During the trial, it became clear that there are two key challenges when evaluating the performance of on-street charging technologies for ULEVs:

1. The definition of 'good' performance depends to some extent on people's relationship with on-street charging technologies. Residents, current ULEV drivers, potential ULEV adopters, technology manufacturers, charge-point operators (CPOs) and local authorities each have different hopes and expectations relating to chargers.

2. As is common with new technologies, there are no established criteria for evaluating performance for a particular type of stakeholder, and for (potential) users in particular.

The research team therefore adopted a two-step approach:

1. Instead of predefining a set of criteria, they adopted a bottom-up approach that allowed them to learn from trial participants. Criteria for performance were primarily derived from interviews with participants. In two rounds of interviews private participants were asked to demonstrate how they used the installation in the vicinity of their home. Analysis of the recorded demonstrations, alongside participants' narratives during the interviews, resulted in the identification of a preliminary set of criteria.

2. The criteria identified from the user perspective were then placed in the context of the concerns of two other stakeholders: local government and charging technology providers.

Performance from the user perspective

The table below summarises the eight criteria that were identified from participants' narratives and demonstrations. They can be scored on five-point scales, with 1 = very poor/low and 5 = very good/high. Notice that:

- Most criteria consist of multiple components.
- Scoring the criteria from a user perspective requires considering the charging installation in its context. How a given technology performs depends in crucial ways on its use environment. Ease of access, for instance, is shaped by parking pressure in a given street and neighbourhood, width of the street and the size of parking bays. A contextual interpretation and assessment of the criteria will be essential if it is to be meaningful to (potential) users. This means that abstract statistical measures will be of limited use in assessing performance from the users' perspective.
- Scoring the criteria from a user perspective also requires moving beyond a focus on the 'average' user. How easy an installation is to use, or how expensive it is, depends on (potential) users' bodily capacities – mobility, muscular strength, eyesight, digital literacy, etc. – and the prices they pay elsewhere. At a minimum, a range of ideal-typical users that vary on key characteristics should be considered in assessments of performance from a user perspective.
- No hierarchy of importance is indicated for the criteria: the research does not suggest that a stable ranking can be identified. Specific criteria will be more important to different users and at particular moments in time. This is also why no aggregation into an overall score is proposed

Ease of access	Proximity of the charger to residents' homes, availability of one or more dedicated parking bays, and ease of parking
Ease of use	User friendliness of cable, installation interface and smartphone app, taking account differences in users' bodily capacities (e.g. ease of moving around, ability to bend over/knees, muscle strength, eyesight, digital literacy). Installations need to be user friendly to as wide a range of human bodies as possible
Installation footprint	Integration into wider streetscape in terms of risks to vehicles and other street users (pedestrian trip hazard, hazard to cyclists and vehicles on the road) as well as aesthetics
Robustness	Reliable functioning of equipment and resilience to vandalism and minor collisions with vehicles (e.g. during parking)
Maintenance and repair	Ease and speed with which chargers are repaired, ability to report breakdowns, ability to see which (alternative) chargers are operational
Price	The cost of charging in absolute terms (£/kWh plus connection fee) and especially relative to other charging options, fossil fuels and electricity in one's home.
Data and billing	Accuracy and transparency of usage data and billing
Speed of charging	The actual electricity output of an installation

Performance according to other stakeholder

Assessing performance from a user perspective is important and useful, but this can raise three issues:

1. Other stakeholders, such as local authorities, technology manufacturers, CPOs and car club operators, may attach different meanings to the above criteria. They may understand, say, ease of use differently from how users tend to. The same term may thus indicate slightly different things to different stakeholders. Local authorities, manufacturers and operators may also attach different weights to the components of the above criteria than (potential) users do.

2. Those stakeholders may consider criteria for evaluating a charger's performance that have little or no relevance to (potential) users. The most important that were identified in the study are summarised in the box below.

3. Tensions and conflicts may exist when performance is evaluated from the perspective of users, local authorities, technology manufacturers and operators. Consider utilisation: local authorities and operators may want to see charging points in a local network being used on average at least two times per day for commercial reasons and thus be keen to encourage use by ULEV drivers who do not live in the immediate vicinity of particular points that are otherwise used little. However, (potential) users dependent on those specific points may worry that their own ease of access is compromised by greater use by others.

Utilisation	Extent to which a given charging point is used over a given time period (24h, week)
Adoption capacity	Potential for adoption by new/extra users, which depends on the number of ports available, arrangements for interoperability (e.g. RFID access & payment systems) and whether the location of the installation places any restrictions on who is able to access and use the charger (i.e., parking permit holders, private households, a local business).
Neighbour complaints	Frequency with which neighbours, including users and non-users in the vicinity of an installation, raise objections with the local council, and the nature of their complaints (e.g. increased parking pressure)
Commercial sustainability	Extent to which there is a 'business case', sufficient profit can be made by the manufacturers and operators, and direct or indirect government subsidies are justified

Reconciling different perspectives

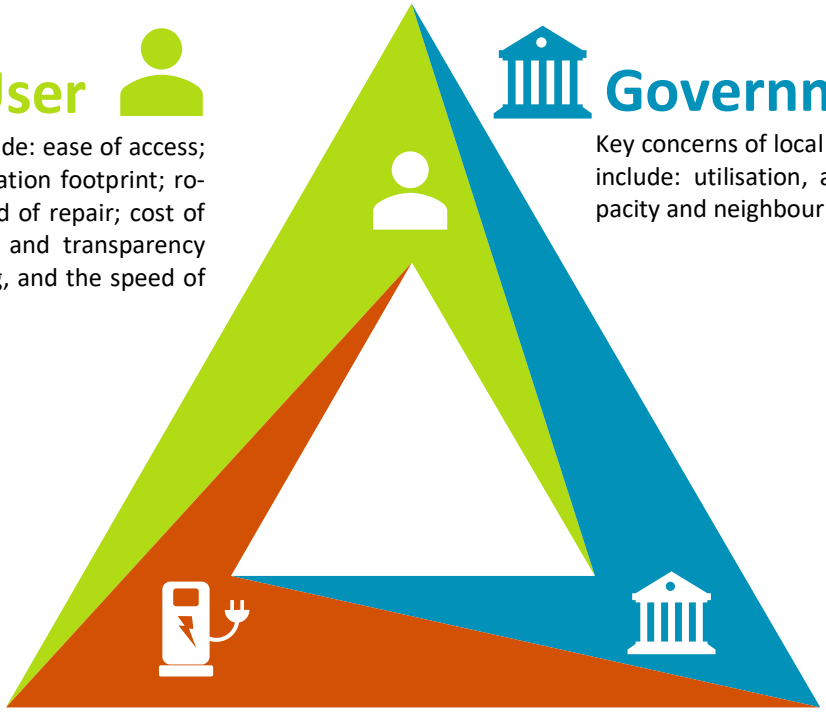
Assessments of the performance of on-street charging technologies should not be seen as simple technical exercises to be completed by a single actor. Performance is best evaluated in a participatory process involving the relevant stakeholders: (potential) users of the charging installations, manufacturers and CPOs, car club operators, council officers, and local councillors.

The precise nature of this process will depend on the number and type of charging installations, the local context (e.g. local policies, resident population, parking situation) and the specific stakeholders involved. An online survey in which (potential) users are invited to rate the installations they (might) use according to the above criteria will be insightful. Additionally, meetings, on site or filled demonstrations and discussions in which operators, council officers and local councillors assess performance from their perspectives should be encouraged.

There are no standard recipes for aligning the different perspectives on performance, but participatory evaluation alongside deliberative decision-making procedures will ultimately result in better decisions about the continuation or expansion of on-street charging installations for ULEVs.

User

User concerns include: ease of access; ease of use; installation footprint; robustness; the speed of repair; cost of charging; accuracy and transparency of usage and billing, and the speed of charging.



Government

Key concerns of local government include: utilisation, adoption capacity and neighbour complaints.

Private Sector

Key concerns for charge point manufacturers and operators include: commercial sustainability, utilisation and adoption capacity

About the authors

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