Recognition justice and the evaluation of low carbon innovation projects

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Abstract

Evaluations of energy system innovation projects serve multiple purposes. They inform funders and stakeholders of project performance against key indicators and targets; assess value for money; document lessons learned; and provide insights for future innovation initiatives. Against the backdrop of the climate emergency, issues of equity and inclusion are being increasingly incorporated into living laboratory projects, reflecting a broader shift in energy discourse and governance towards concern for a just transition. Evaluators are key actors in assessing the justice implications of energy innovations, representing those voices and perspectives with less influence in innovation discourse and governance. However, their success in doing so depends on a range of internal and external factors. Internal factors include those frames of reference, motivations and methodological practices which vary amongst different kinds of evaluators, while external factors include the availability of data, access to users and participants, and the prioritisation of justice and inclusivity by project partners and funders. This paper draws on evidence from three energy system innovation projects in the United Kingdom to analyse the practice of evaluation as a key determinant of recognition justice. The projects, of strategic national importance, involve trials of innovative technologies and practices, including on-street electric vehicle charging, heat-pumps with load-control, and neighbourhood-scale flexibility. Each has explicit aims to address issues of energy justice, including tackling energy poverty and demonstrating the potential for demand-side practices to contribute towards grid balancing. We discuss examples of how the motivations, methods and expertise of particular evaluators influences the ways in which users are represented and issues of justice addressed, as well as practical barriers such as gathering quantitative data on electricity usage and vehicle charging data. Given the changing nature of evaluation for energy innovation, we highlight the need for critical reflexivity amongst evaluators, relating to their positionality, motivations, capabilities and limitations. Evaluation is an essential, but under-acknowledged, component of energy innovation and effective policy making. This article highlights its potential to address issues of energy justice and calls for further research and policy attention.

Introduction

In the last two decades, there has been a proliferation of locally focused, energy innovation projects across Europe. Often described as ‘living laboratory’ experiments, municipalities (often city-based) have been pursuing energy system innovation by trialling new technologies, business models and forms of governance, in efforts to accelerate sustainability transitions and achieve climate related goals (Bulkeley et al., 2018; Marvin and Silver, 2016; Voytenko et al., 2016).

In what has been described as the ‘projectification’ of local governance (Hodgson et al., 2019; Nylén, 2021), innovative technologies and business models often feature prominently. Examples include electric vehicle charging and vehicle-to-grid infrastructure, smart transport scheduling, peer-to-peer energy trading platforms, and heat-pumps using demand-response controls (Sengers et al., 2019). Projects typically involve multiple partners representing the public, private and civil society sectors. Learning is a central feature of living laboratory experiments, as partners and funders seek to test, monitor and assess various activities and technologies. Evaluations are one of the principal means by which learnings are codified, and evaluators are considered key actors. In addition to their conventional role as assessing impact and value for money against a range of key performance indicators, they also document lessons learned and review the effectiveness of governance processes (Voytenko et al., 2016).

The scope and nature of evaluation practice is changing in the context of the climate emergency, which places new urgency and a broader set of expectations on energy system innovation projects (Hampton et al, 2021). Pressure is mounting on evaluators to rapidly identify insights and provide formative feedback to project teams, as well as advice for funders, innovators and policy makers. Conventionally, evaluators have been guided by answering the question: *what works?* with a focus on financial, technological and practical considerations. Increasingly however, they are being asked to consider what works, *where, how, why, to what extent,* and *for whom*? (Pawson and Tilley, 2004) As such, issues of justice are becoming increasingly important for evaluators when assessing energy innovation projects, as stakeholders seek to ensure that the energy transition is inclusive, affordable and fair. Evaluators are being tasked with assessing the nature, extent and success of user engagement and impact on a wider set of stakeholders than the previous usual suspects (governance institutions, energy sector organisations). And beyond those directly engaged in the project, questions are being asked about what sort of impact projects have on urban transitions, placemaking and efforts to create sustainable communities (Castán Broto and Bulkeley, 2013). In summary, there are two trends which are redefining the role of evaluation in energy systems innovation: (1) the preference for place-based living-laboratory projects as the preferred model for experimentation and learning; and (2) the greater urgency and wider scope of evaluations, incorporating principles of energy justice. As evaluators find themselves having greater influence in helping to guide a rapid and just transition, there is a need to reflect on their responsibilities, capabilities and limitations.

There are various forces which influence evaluators' capacity to address energy justice in the context of energy innovation projects, and these can be broadly divided into internal and external factors. Internal factors include those frames of reference, motivations and methodological practices which vary between different kinds of evaluators. For instance, there is a trend in living laboratory projects towards involving university-based social scientists as core project partners, tasked with a hybrid role which involves conducting primary research, assisting with project delivery and dissemination, as well as process and impact evaluation (Brennan and Cochrane, 2019; Hambleton 2014; Hampton 2020). University researchers often have specialist interests, niche expertise, and advanced, but relatively narrow skillsets. And while their motivations vary, they typically seek to publish in peer-reviewed journals with international reach. While this can help to disseminate project findings widely, funding is often unavailable for open-access articles, which can be inaccessible regardless, due to the use of specialist, disciplinary language. Other evaluators include commercially oriented consultancies, think-tanks, or publicly funded agencies. Each differ in their approach, frames of reference, and reach. Thus, representing a key mouthpiece for living laboratory projects, it is essential to critically reflect on the ways in which the methodological conventions, intellectual traditions, motivations, and spheres-of-influence of different evaluators can influence the kinds of learnings and messages which emerge.

External factors influencing evaluators' ability to address issues of justice include the practical issues of data access and availability, funder expectations, budgets, and resources, which vary for different kinds of energy system innovation. For instance, technical performance and financial data relating to the operation of a transmission grid-connected battery are highly prioritised by operators, as they constitute a fundamental component of its function. Such data are commercially sensitive however, and may not be readily shared with evaluators. By contrast, gathering information on user experiences, thermal comfort preferences and energy usage relating to heat pumps in social housing is not mission-critical, and responsibility can sometimes fall to evaluators to collect primary data (Calver et al., 2022).

Given the influence of internal and external factors on evaluators' capabilities, it is inevitable that certain data, voices, practices, technologies and obstacles are given prominence, while others are left unobserved or downplayed. This paper provides some critical reflections on those factors which influence what is monitored, documented and represented by evaluators on energy system innovation projects, and the implications for justice. It draws on evidence from three energy system innovation projects based in Oxfordshire, UK to provide insights into the opportunities and challenges of incorporating justice into evaluation.

The next section provides some background on the projectification of energy systems innovation and living laboratories. A brief overview of energy justice concepts as they relate to energy innovation follows this, highlighting the critical role of evaluation in addressing recognition justice. We then describe examples of such efforts in three living laboratory projects. The penultimate section discusses those examples with respect to how the inclusion of justice considerations are influenced by internal and external factors. The final section reflects on the implications for innovation research and policy.

Living laboratory scholarship

The notion of the 'living laboratory' goes back several decades, with origins in computing and information technology research (Kusiak, 2007). In general terms, living labs are experimental spaces which are user-focused, involve a range of partners, and in which both formative and summative learnings play a central role. In the last two decades, living laboratory projects have been increasingly deployed as ways to trial sustainable innovations in transport and energy systems.

There is now a significant body of interdisciplinary research on the role of project-based experimentation in sustainability transitions, largely emanating from The Netherlands and Scandinavia (Kemp et al., 1998; Geels, 2002; Hoogma et al., 2002; Fuenfschilling et al., 2019). In their systematic review of this literature, Sengers et al (2019) trace theoretical linkages with the Multi-Level Perspective (Geels, 2002), Strategic Niche

Management (Hoogma et al., 2002), and Transition Management (Loorbach and Rotmans, 2010). Experiments in this tradition are often considered as seeds of change which should be supported to flourish in order to accelerate the transformation of incumbent socio-technical systems. Scholars interested in pedagogy, urban space and the 'learning city' have also provided valuable insights into how living laboratory projects help to build knowledge and capacity within and beyond institutions (Facer and Buchczyk, 2019a, 2019b; Hambleton, 2015; McFarlane, 2011). A more critical approach is adopted by researchers using theories of governmentality (Vanolo, 2014; Lovell, 2019; Levenda, 2019), political ecology and concepts from urban geography (Bulkeley and Castán Broto, 2013; Bulkeley et al., 2014; Castán Broto and Bulkeley, 2013). Amongst these diverse schools, various efforts have been made to characterise and categorise the heterogenous array of living laboratory projects, drawing on databases (ENoLL, n.d.; GUST, 2017; Bulkeley et al., 2018), literature reviews (Sengers et al., 2019), and case studies (Voytenko et al., 2016).

In their seminal paper, Voytenko and colleagues (2016) identify five characteristics shared by living laboratory projects. These are that projects tend to: (1) be geographically embedded; (2) foreground experimentation and learning; (3) promote user engagement and participation; (4) have clear – but often flexible – leadership and ownership arrangements; and (5) value and prioritise monitoring and evaluation. Conventionally, issues of justice have not been central features of sustainability-related living laboratory projects, although the focus on user engagement and participation often goes some way to incorporating these. Such issues have attracted increasing attention from researchers, policy makers and innovators in recent years however, and are becoming incorporated into living laboratory projects. The next section summarises recent literature addressing this emerging agenda.

Energy innovation and justice literature

The concerns of energy policy makers are often characterised by the 'energy trilemma', which posits that the competing forces of affordability, environmental sustainability, and security of supply must be balanced in every policy decision (World Energy Council, 2020). A valuable heuristic in many contexts, one limitation is that the multi-faceted issues of energy justice (equity, fairness and inclusivity) have been subsumed into discussions of affordability, and largely excluded from environmental or security concerns. In the last decade however, a burgeoning energy justice literature has served to challenge this model by demonstrating that justice concerns are implicated in all elements of the trilemma (Heffron et al., 2018), and there is growing pressure from citizens and civil society groups to ensure that the energy transition is just. This is exemplified by the call by the UK Climate Assembly for fairness, education and choice to underpin the UK's path to net-zero carbon emissions (Climate Assembly UK, 2020).

McCauley et al. (2013) propose their own triumvirate model as a conceptual framework for understanding the key elements of energy justice. They divide the concept into three 'tenets'. *Distributional* justice relates to the accessibility and allocation of energy resources, capital and capabilities. *Procedural* justice is concerned with how markets, institutions, policies and regulations are designed, implemented and experienced by different groups, highlighting the need for participation and transparency in all energy-system processes. Finally, *recognition* justice pertains to the ways in which different people and their interests are represented in the energy system. While the successful evaluation of any energy innovation will incorporate each component of energy justice, evaluators have particular influence over recognition justice, as their work can help to draw policy and research attention to diverse and under-represented groups.

Fraser (2009) discusses three different ways in which groups can be *misrecognised. Cultural domination* refers to the under-representation of minority groups in public discourse; *non-recognition* is where their interests and voices fail to be heard; and *disrespect* relates to prejudicial, insulting representations. Jenkins et al (2016) illustrate the latter two forms of misrecognition in the energy domain by showing how local activists are often vilified and dismissed as short-sighted, self-interested NIMBYs in discourses about renewable energy development. The validity of emotional, place-based attachments, aesthetic qualities and cultural meanings associated with land can be obscured by these dominant representations. The ways in which the 'energy poor' are imagined and represented has also been the subject of academic critique, as researchers highlight the problematic depiction of those struggling to afford energy bills as suffering from insufficient knowledge and energy-literacy (Howell, 2018; Martins et al., 2019). This 'deficit model' has been shown to be embedded in energy system governance (Burningham et al., 2015). While there is evidence that the provision of feedback (for instance in the form of in-home displays linked to smart meters) can be effective in driving household behavioural change (Carroll et al., 2014; Darby, 2006), this form of intervention is warranted too much significance when compared with the effectiveness of building fabric efficiency and product standards in tackling energy poverty (Strengers, 2011; Hargreaves, 2018). Information and feedback too often stray into condescension, as demonstrated in January 2022 when Ovo Energy was forced to apologise for sending an email to customers advising them to do star-jumps and cuddle pets to stay warm, amidst unprecedented increases in fuel costs facing customers (BBC News, 2022). Moreover, there has been a tendency for energy literacy to be measured in predominantly technical ways (DeWaters and Powers, 2013; Sovacool and Blyth, 2015; Yeh et al., 2017), and for householder engagement with energy to be equated simply with the frequency with which they switch supplier in liberalised energy markets (Annala et al., 2013; BEIS, 2019; Deller et al., 2021).

When considering issues of inclusivity and justice, it is important that living laboratories adopt user-imaginaries and theories of change which go beyond the deficit model. If not, there is a danger user engagement is 'dumbed down', as projects resort to information provision and basic education. Calver and colleagues have recently examined these issues in their research on demand-side management (DSM). DSM is attracting increasing investment and policy attention, as it promises more efficient use of electricity networks, greater utilisation of renewable energy sources and cost savings throughout the energy value-chain (Calver and Simcock, 2021). Whilst for many commercial and industrial uses the business case for flexibility is already being demonstrated, the benefits are far from proven in the domestic setting, however. Flexibility capital is unevenly distributed along sociodemographic lines (Powells and Fell, 2019), and the greatest opportunities to realise cost savings from DSM are concentrated amongst owners of electric vehicles, solar panels, and available to those with advanced digital capabilities (Calver and Simcock, 2021). In a separate study, Calver and colleagues evaluated a trial of smart heat pumps deployed in 550 social housing properties in the north-west of England. The heating units were equipped with direct load control technology, meaning that they could be turned on and off remotely to match the price of electricity. While the trial successfully demonstrated network benefits and few disadvantages for most residents, the authors highlight how systems were designed according to a relatively narrow conceptualisation of users, with homogeneous comfort preferences, routines and needs. In fact, they found that users were more heterogeneous than imagined by the system designers, and the rigidity of contractual arrangements and constraints on control outweighed the benefits for some. The authors conclude that the provision of consent and opportunities for redress warrant more careful consideration as DSM is promoted as a way of delivering savings for the energy poor.

Energy justice is a topic of increasing importance and concern, and evaluators are key actors in helping to address issues of misrecognition in innovation and experimentation. In the case of the smart heat pump trial in north-west England, Calver and colleagues adopted a hybrid role as evaluators *within* the project consortium, helping to address issues of choice, consent, disruption, cost, comfort and control. The following section provides a summary of three living laboratory projects following the same model, in which university-based evaluators are embedded as partners.

Insights from living laboratory projects in Oxfordshire, UK

GO ULTRA LOW OXFORD (GULO)

GULO is a living laboratory trial of on-street electric vehicle (EV) charging infrastructure in the city of Oxford. Led by Oxford City Council, with funding from the Office for Low (later 'Zero') Emission Vehicles, Phase One of the project (2017–2019) involved installing different solutions to address the barrier to uptake of EVs where urban residents had no access to off-street parking. Technologies included three types of bollard-style charger (12 in total), retrofitted lampposts (29), and a 'gully' dug into the pavement outside trial-participants homes (5). This latter solution allows users to trail a charging cable from a charger installed on the front of their homes, to the vehicle parked on the road outside. Phase Two is now ongoing, in which a further 100 chargers are being rolled across the city.

At the start of the project, efforts were made to recruit participants across a range of socio-demographic groups and different neighbourhoods within the city, which includes some of the most and least deprived areas in the UK. One decision that the project team had to make at an early stage was whether to require that participants already owned or leased EVs prior to charger installation, or whether a commitment to procure one was sufficient to warrant the infrastructure investment. In most cases, sites were chosen where participants already had possession of EVs, however in some cases where residents claimed that the principal barrier to ownership was access to a local charger, the Council went ahead with the installation before an EV was procured. These decisions can be seen as addressing distributional and procedural justice, as the Council chose to take on risk in certain instances where potential EV adopters were seen to be at a disadvantage due to urban design and infrastructure. Their efforts to ensure that chargers were installed across a range of neighbourhoods demonstrate a further concern for distributive justice. These were successful to a certain extent, and those participating in the trial were distributed around the city across a variety of housing and street-types (see Figure 1). A local car club was also included in the trial, enabling access to EVs for those unable or choosing not to own a private vehicle. 10 on-street chargers were installed alongside dedicated parking bays for the car club in residential neighbourhoods across the city. Despite the Council's efforts for equitable distribution of infrastructure, the sociodemographic makeup of private EV-driving participants was less evenly distributed. While a variety of ages were represented in the trial, 77 % of participants were male, and while data on household income was not gathered, most participants owned homes in one of the UK's most expensive cities. These patterns reflect the socio-demographic characteristics of 'early adopters' of EVs (Westin et al., 2018; Lee et al., 2019).

A team of university-based social scientists specialising in sustainable transport and qualitative methods were given the task of evaluating Phase One of the trial. Their remit included a specific focus on user experiences, and they conducted up to four rounds of interviews and surveys between 2017 and 2019 with private and car club users (Hampton et al., 2019). This was a deliberate choice made by the project consortium, which was concerned that decisions about which technologies to install in which locations should account for the needs of all citizens and the city's wider sustainability transition, as well as the commercial interests of charge-point operators. User priorities were established from empirical evidence and codified into a set of eight criteria for evaluating the performance of on-street chargers. These are summarised in Table 1.

As well as documenting the experiences of trial participants, the evaluators paid attention to the impact of the charging installations on non-EV users (Pawson and Tilley, 2004). Where dedicated parking bays are allocated (for car club chargers and bollard chargers), the council is required to issue a public consultation, and the evaluators summarised the responses provided by the local community. While the balance of comments was roughly even in terms of objections and support, the most cited concerns were of increased pressure on local parking availability, and access to services. Users also reported on interactions with neighbours and others throughout the trial, citing interest from passers-by in the technologies, as well as more negative responses such as charger vandalism and parking violations prevent access to chargers.

In summary, justice concerns were prominent on Go Ultra Low Oxford, reflecting the institutional priorities and concerns of consortium members, led by Oxford City Council. The university-based evaluators played a key role in representing the needs and interests of charge-point users and the local community.

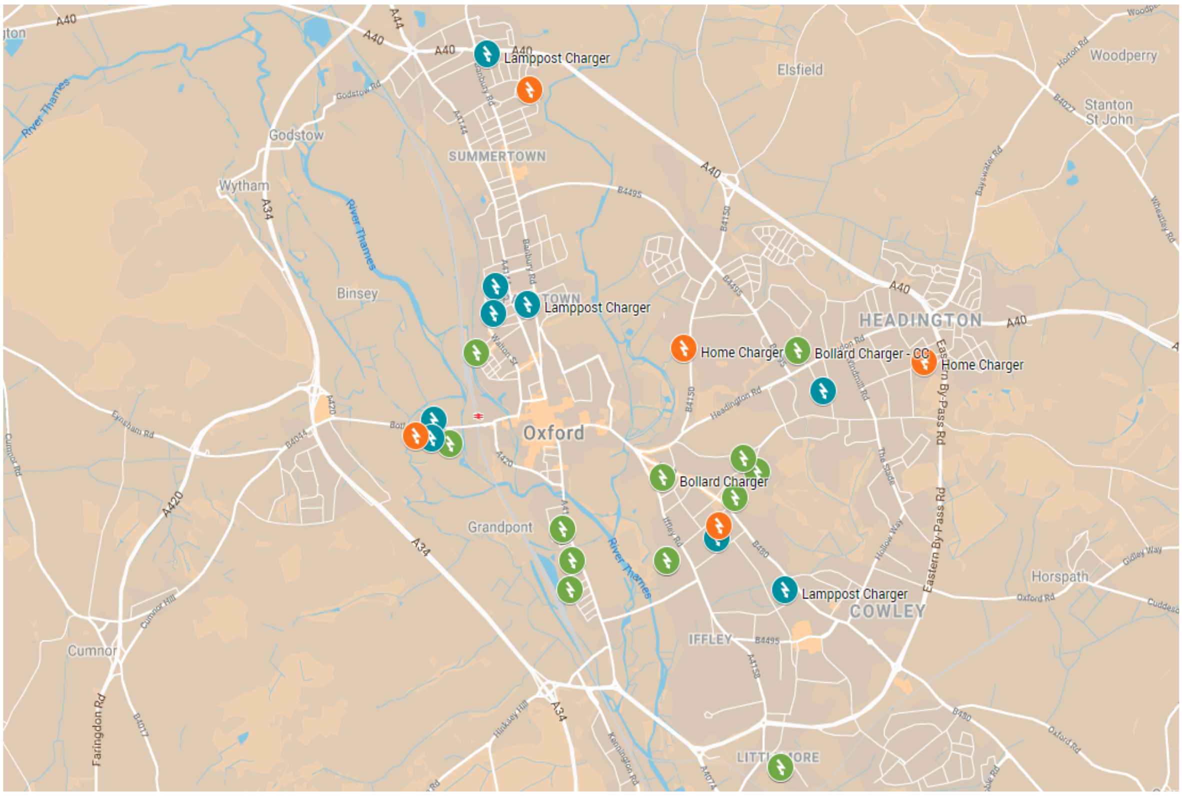

Figure 1. Map of chargers featured in the GULO trial. Icon colours: Lamppost chargers (blue); home chargers (orange); bollard chargers (green).

Table 1. Criteria for the evaluation of electric vehicle chargers from the user's perspective.

Evaluation criteria	Description
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).
Installation footprint	Integration into the 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).
Data and billing	Accuracy and accessibility of usage and billing data
Maintenance and repair	Measured by (1) the ease and speed with which technologies are repaired; (2) how easy it is for users to report faults and (3) the ability to see which (alternative) chargers are operational.
Price	Cost of charging in absolute terms (£/kWh plus connection fee), and relative to other charging options, fossil fuels and electricity in one's home.
Speed of charging	Compares reported power outputs with actual charging data.

ENERGY SUPERHUB OXFORD

Energy Superhub Oxford is one of three national energy system demonstrator projects, funded by Innovate UK as part of the Prospering From the Energy Revolution (PFER) programme. Running from 2019 to 2023, the project budget is substantial (£42m). It features the UK's first transmission grid-connected battery (50MW/55MWh), EV charging infrastructure using a transmission-connected private wire, the electrification of City Council vehicles and licenced taxicabs, and smart-controlled ground source heat pumps installed in social housing.

Evaluation is a central component of the PFER programme, and there are several organisations with a remit to monitor and assess different processes and impacts from the demonstrator projects (Hampton and Fawcett, 2020). Consultancies Ipsos

Mori and Technopolis are collaborating to evaluate the entire PFER programme, while a consortium of 60 energy researchers spanning 22 universities, called EnergyRev, are conducting research alongside projects. The Energy Systems Catapult, a government-funded think tank, is developing additional evaluative insights, with a focus on an audience of private sector innovators and local authorities. Their work includes developing a toolkit for municipalities to foster the conditions for smart, local energy systems to thrive. Finally, the Energy Superhub Oxford project consortium includes a small team of university-based researchers, some of whom specialise in battery degradation modelling, and others who have expertise in energy innovation policy and the role of user practices in energy systems change. Having such a wide array of evaluators focused on the same living laboratory project has generated its own challenges, with risks of duplicating effort, wasted resources, confusion, and consultation fatigue on behalf of project participants (Hampton and Fawcett, 2020). However, the combination of different perspectives, expertise and skillsets offers benefits and synergies too, as evaluators scrutinise each other's work, seek depth rather than breadth, and appeal to a wider range of audiences.

These advantages are illustrated with respect to Energy Superhub Oxford, where the university team internal to the project has been able to keep abreast of the various challenges and obstacles faced by the project in a turbulent period affected by Brexit and COVID-19. Knowing that other evaluators are analysing the implications of the PFER programme for energy policy and regulation; and addressing the question of how to replicate and scale-up local, multi-vector energy system innovation, the internal evaluators have focused their efforts on one key aspect of the project: monitoring user experiences associated with heat pumps. Compared with other project activities such as the operation of the grid-connected battery, this work-stream most directly impacts vulnerable energy users, and the innovation being trialled has the potential to address energy poverty.

57 social housing properties were provided with ground source heat pumps during winter 2020–21. 55 of these replaced electric storage heaters which residents reported as being exorbitantly expensive to operate, and many under-heating their home as a result. Two others replaced gas central heating. 73 % of those surveyed (n=32) reported strong *dissatisfaction* with their previous heating system, while the same proportion of respondents said they were highly *satisfied* with their heat pumps, when asked six to nine months after installation. 15 tenants were asked if they had saved money on energy since receiving a heat pump, and while eight said it was too early to tell, six reported significant savings. Four tenants estimated that their bills had more than halved. As well as drawing attention to these benefits, the internal evaluators' close relationship with project partners and users has allowed them to assist with project delivery by providing formative insights. For instance, conducting in-depth qualitative research with social housing tenants has revealed instances of system malfunction, users' confusion about controls and hot-water schedules, and injustices relating to over-charging by utilities. The university team has been able to work with other stakeholders to resolve some of these issues.

Gathering quantitative evidence relating to this cohort of social housing tenants has been challenging. Temperature sensors were installed in nine dwellings prior to heat pump installation, with a larger sample size inhibited by pandemic-related lockdown restrictions. Analysis of *before* and *after* data showed less diurnal variation and higher average temperatures in some properties (see Zahiri et al., 2021 for full analysis). Unfortunately, energy consumption data has been elusive. 69 % of those taking part in the research study (n=32) pay for their energy on a pay-as-you-go basis, using pre-payment meters. Very few respondents keep records of energy consumption or bills, and most are only able to provide a rough estimate of weekly or monthly expenditure on energy. However, more than half of the properties have smart meters installed, meaning that high-resolution consumption data should – *in theory* – be available for analysis. Unfortunately, gaining access to smart meter data in the UK is far from easy, even with the full consent of householders. The university team have been pursuing different solutions and encountering a range of legal and bureaucratic obstacles, which are discussed elsewhere in these conference proceedings (Grunewald et al., *in press*).

Elsewhere on Energy Superhub Oxford, obtaining quantitative data has been challenging for a different set of reasons. The project has provided funding for 40 vehicles owned by Oxford City Council to be converted to EVs, and for a range of chargers installed in depots across the city. Each charger and vehicle is able to produce myriad information relating to usage and performance, collectively representing a rich dataset for analysing and optimising fleet operation. However, coordinating and corralling these data to be consistent, comparable and accessible to analysts has proven difficult. The electric fleet includes a range of vehicle types, including a digger, a street sweeper, two 3.95t tippers and a refuse collection vehicle. Extracting data from each vehicle-type involves a different process, and larger units have been provided with dedicated, rapid charge-points for which data are available separately from other chargers. The City Council is provided with telematics data from three different suppliers, and three further companies operate and extract data from charge-points. The result is an overwhelming quantity of data, provided in different formats, at different intervals. Requiring a complex software solution, the City Council, facing unprecedented budgetary constraints as a result of COVID-19 (Oxford City Council, 2021), is struggling to resolve the problem to make data available for evaluation.

In summary, substantial resources and diverse expertise have been made available to evaluate Energy Superhub Oxford. The multi-actor model for evaluation chosen by the broader PFER programme has enabled evaluators such as the university team internal to the project and the Energy Systems Catapult to focus their efforts where their strengths lie. This arrangement has provided justice recognition to vulnerable, energy-poor users of heat pumps. However, practical, external factors have made it difficult to gather quantitative data relating to their energy consumption, and vast quantities of heterogenous data on the City Council's EV fleet has led to the paradoxical outcome of *knowing very little* about its operation.

LOCAL ENERGY OXFORDSHIRE (PROJECT LEO)

Project LEO another energy demonstrator project funded by the PFER programme. It is led by the Distribution Network Operator, SSEN and aims to maximise the usage and efficiency of the county's constrained electricity network, bringing the benefits of a smarter, flexible energy system to households, businesses, and communities. Justice and inclusivity are core tenets of the project, which has a strong focus on activities 'behind the meter', including temporal flexibility to enable the optimisation of low-voltage networks, mitigating the need for costly infrastructure upgrades.

A key impetus for the project is the opacity of electricity demand at the neighbourhood scale. Whereas the flows of electricity through high-voltage networks are available to network operators at high-resolution, the low-voltage network in the UK lacks adequate monitoring devices to enable detailed analysis of demand. Project LEO is rolling out sensors to shed light on local demand dynamics; and using a range of public, private and crowd-sourced datasets alongside community engagement and co-design activities to conduct local area energy planning. A key tool for this is the is the creation of 'local area energy maps'. These maps display information on energy use, local generation assets, building attributes, socio-demographics, fuel poverty and electricity networks. They are intended to highlight opportunities for co-development of neighbourhood scale "net zero" projects such as the creation of virtual micro-grids, peer-to-peer trading, and other targeted interventions such as installing building efficiency upgrades. These tools help to make visible the various material and social elements of the energy system in neighbourhoods across Oxfordshire. The effect is to give greater prominence to users and local communities in the discourses and governance of the energy system: delivering recognition justice. The meaning of the phrase 'behind the meter' reveals how the dominant perspective is that held by institutions, rather than users. As discussed by Smith and MacGill (2020), this phrase constructs a problematic conception of users, as unknown and unknowable. Project LEO is attempting to correct this narrative by generating data to reveal not only patterns of usage, but to demonstrate that if supported and included, the users of electricity can play a pivotal role in balancing the demands on the grid. It operates according to the belief that entire communities, if technically equipped, motivated and incentivised can coordinate their activities to create multiple benefits – for the system, community and householders. Whereas the energy system tends to consider the activities and behaviours at the level of the household (or single Meter Point Administration Numbers (MPANs)), Project LEO is shifting the unit of focus to the community as a whole, creating 'communities of MPANs'.

Like Energy Superhub Oxford, Project LEO benefits from having multiple evaluators with different responsibilities and expertise. This includes a university-based team of social scientists and power-system engineers who are internal to the project consortium. Other partners with a strong interest in community energy, inclusivity and justice include Oxford City Council and the Low Carbon Hub, a Community Interest Company which has led the deployment of community-owned renewable energy assets across Oxfordshire. Working with local community groups, Project LEO initiated five 'Smart and Fair Neighbourhoods' in the county. These draw on the intelligence provided by low-voltage network monitoring and local area energy mapping to demonstrate the value of local action in balancing the energy system at the grid edge. The creation of Smart and Fair Neighbourhoods is guided by an ethical framework which highlights the need for collaboration, respect, informed consent, risk minimisation and transparency (Huggins, 2020). The trials are investigating the conditions needed for mobilising local communities in support of rapid, equitable sustainable energy transitions. The need to prioritise equity and justice is at the heart of the theory of change: the deliberative consideration of ethical considerations means that success is more likely when translating learnings into action.

This careful, inclusive approach to engaging and mobilising local communities requires substantial resource from project partners, including those social scientists with an evaluation remit. While the neighbourhoods chosen benefit from substantial social capital made up of volunteer resource, local knowledge and motivated citizenry, Project LEO partners are instrumental in driving momentum, bringing energy expertise and linking local efforts with networks, activities and resources at the regional and national level.

In summary, recognition justice is a central feature of Project LEO, which aims to make visible patterns of energy consumption, generation assets, socio-demographics and social capital at the neighbourhood scale. Like Energy Superhub Oxford, the team of social-scientists internal to the project consortium are playing a crucial, hybrid role: evaluating impacts, articulating user experiences, and supporting project delivery.

Evaluators as agents of justice: factors influencing success

At first sight, the three living laboratory projects described above appear to be focused on trialling key technological innovations to help accelerate the development of smart, decarbonised energy systems at a local level. As the findings illustrated however, issues of justice are embedded in each of these projects, but the visibility and prominence of these issues depend crucially on the ways in which user experiences and interests are represented. Evaluation is perhaps the principal route through which justice is recognised in energy innovation projects, and this recognition is influenced by factors which may be said to be internal and external to the institutions conducting evaluations.

While it can be convenient to think of evaluators as external and objective, they are in fact imbued with institutional and personal motivations, pressures, and positionalities. The examples above show how the approach taken, and audiences reached, varies significantly according to which institutions are leading the work. On Energy Superhub Oxford, for example, the team of social scientists specialising in qualitative methods have been able to give prominent voice to energy poor social housing tenants, while the Energy Systems Catapult also evaluating the project have focused their efforts at higher levels of governance: developing insights for policy and regulation, and a toolkit for local authorities. In GULO and Project LEO, the prominence of justice reflects the priorities of the partners leading the project, as well as the evaluators involved. In the former project, Oxford City Council sought to distribute the benefits of EV charging infrastructure across a variety of neighbourhoods, and the university evaluators were tasked with evaluating charger performance from the user perspective: offering a counterbalance to the dominant voices of commercial interests in this burgeoning market. The vision of a community led energy transition is foundational to the project partners involved in Project LEO, where significant resources are dedicated to engaging local groups, guided by an ethical framework. These findings illustrate the important ways in which the 'ownership' of living laboratory projects influences the balance of attention paid to issues of justice (Voytenko et al., 2016).

The ability of evaluators to address justice also depends on practical, external factors. In GULO, the sociodemographic make-up of EV early-adopters constrained the ability of the project to distribute benefits evenly. In 2017–2019, the total cost of ownership of EVs remained higher than fossil fuelled vehicles, excluding many low-income households, while the majority of participants were male. Difficulties obtaining quantitative data on electricity consumption by social housing tenants in Energy Superhub Oxford has also hindered the evaluators' ability to represent user behaviours. While qualitative data have provided insights into user experiences and preferences, quantitative data are widely considered to have greater sway with key audiences such as housing associations, developers, investors and other landlords. As well as limiting recognition justice, the difficulties of accessing smart meter data for participants is a form of procedural injustice. It is likely that the barriers to access are unintended, given that data protection is the principal rationale behind the complex and bureaucratic processes created by the organisations responsible for governing smart meter data in the UK. Nonetheless, these hinder the ability of Energy Superhub Oxford's evaluators to represent the interests of vulnerable energy users. Besides practical obstacles, data which are important for evaluating issues of social justice can often be highly sensitive, requiring careful justification and handling. On GULO, income data was not collected for instance, perhaps due to it being considered too peripheral to the main objectives of the project. Finally, Project LEO partners have high ambitions for a community-led, inclusive and equitable transition and are providing significant and sustained input. Besides this, it is becoming clear that the ability of Smart and Fair Neighbourhoods to deliver system benefits using demand-side flexibility, local renewables and energy-trading is highly dependent on social capital in the form of volunteer time, local knowledge and the strength of community networks. Ultimately, it will be important to understand and quantify the dynamics of these community capabilities, to better understand which elements of successful Smart and Fair Neighbourhoods can be attributed to socio-economic circumstances, and which can be supported by policy, private investment, or action-research. At present, such insights elude the project evaluators, given the novel nature of the activities and small sample sizes available.

Conclusions and implications

In recent years, living laboratory projects have become popular ways to experiment with and demonstrate various forms of energy system innovation. While issues of equity and inclusion are not typically central to living laboratories, they are being increasingly incorporated into project design. This reflects a broader shift in energy discourse and governance towards concern for a just transition. User participation, evaluation, and learning *are* however core features of living laboratories, and evaluators are becoming key actors in assessing the justice implications of energy innovations. Whereas conventionally, evaluators' work may have been consumed by project partners and funders alone, it is becoming ever-more important in shaping the governance of the energy transition, with implications for a much wider set of stakeholders, including the public.

Evaluators increasingly find themselves in hybrid roles, and the three living laboratory projects discussed in this article included teams of university-based social scientists with a range of responsibilities. These not only included providing assessments of impact and process, but also supporting project delivery, and giving voice to the experiences and interests of users and citizens. In a changing context, evaluators are key agents of justice, with an ability to provide recognise and represent marginalised groups and vulnerable users of energy. These developments have implications for this community of practitioners, who have a responsibility to critically reflect on factors largely internal to their organisations, including their positionality, motivations, capabilities and limitations. The social scientists working on GULO, Energy Superhub and Project LEO are theoretically and methodologically inclined towards addressing issues of justice and equity in innovation. However, immersed in the academic community, it is possible that their reach and impact amongst policy makers and private sector innovators may be more limited than other evaluators such as the government-sponsored think-tank the Energy Systems Catapult, or large consultancies. In the case of the PFER programme (of which Energy Superhub Oxford and Project LEO are part), multiple evaluators have been appointed in an unusual deviation from the conventional model of having a single, external organisation evaluate projects with an emphasis on ex-post analysis. While problematic in several ways which are discussed elsewhere (Hampton and Fawcett, 2020), this approach goes some way in overcoming the limitations imposed by individual organisational characteristics. There is a need for further analysis on the effectiveness of this model.

External factors discussed in this article include the fact that evaluators are often inhibited by lack of access to key data. In such cases, it might be tempting for evaluators to focus their efforts on analysing information that *is* readily available. However, as this article has demonstrated, data availability is often skewed, and can itself contribute to inequality and misrecognition. Evaluators can use their influence to highlight barriers and obstacles to obtaining information, such as in the case of accessing energy consumption data for social housing tenants. In so doing, they might also highlight procedural injustices such as those associated with smart energy data protocols.

The climate emergency is not only increasing the urgency of energy innovation, but widening the expectations placed on innovators, to ensure that the transition to zero carbon energy systems is inclusive and equitable. There have been calls in recent years for more social (Creutzig et al., 2018), psychological (Nielsen et al., 2021) and interdisciplinary (Rineau et al., 2019) science alongside technical specialisms in efforts to address climate change. Yet the role of evaluation, as an essential component of rapid innovation and effective policy making, remains under-acknowledged. It is hoped that this article goes some way in articulating the potential for evaluation to help achieve a just transition.

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