Project LEO Programme Update
March 2020 (Q3 & 4)

Overview

Welcome to the second Programme Update for Project LEO (Local Energy Oxfordshire), providing an update on activities undertaken within Q3 and Q4, year 1 of the project. All Programme Updates are posted on the Project LEO website providing insights into the activities, outputs and research being generated as part of the demonstrator project.

Project LEO is redesigning the energy system at a local level to facilitate the transition to a zero-carbon energy future and is a collaboration between 9 project partners, each operating within very different areas of the wider energy ecosystem.

The primary focus of Q3 and Q4, Year 1, of Project LEO has been the development of the initial Minimum Viable Systems to be tested within the project. This has comprised: identification of flexibility services within TRANSITION to be trialed as part of Project LEO; implementation of Phase 1 of the MVS process; development of key Plug in Projects and continued engagement with project stakeholders. This Programme Update provides details of these key activities.

Initial Learnings from Minimum Viable Systems Trialled in Q3

A significant output of the first quarter of Project LEO was the development of a generic Minimum Viable System (MVS) Flexibility Trial Procedure which allowed the implementation of an agile approach to developing and testing new flexibility services, business models and procedures required to operate a local flexibility market. These flexibility trials were conducted in Q3 of the project, between October 2019 - January 2020.

Through the MVS approach, new value can be identified at a small scale before significant investment is committed; it is intended as a way to manage the risks associated with innovation in an uncertain, changing environment.

A number of significant procedural issues, learnings and implemented changes have been gained from the MVS flexibility trials. Initially four different flexibility types have been identified based on currently available assets and include: 1) Electrical Storage, 2) Flexible Generation, 3) Demand Side Response (DSR) and 4) Aggregation. Over the course of these trials, a trial implementation framework evolved enabling learnings to be captured for each stage of the flexibility procedure. This included an assessment of process maturity, a useful metric for accessing the value added through the increased automation of each MVS procedural step.

Despite some of the trials resulting in a ‘failure to deliver”, trialing the procedure itself has been successful in providing some key learnings and modifications from issues that arose. Two key themes to highlight are: 1) the importance of bi-directional communication protocols between participants to notify changes in the operational status of assets; 2) a framework for setting out the consequences for failures and/or delays to deliver a flexibility service, including possible penalties for service providers and the resulting dispatch of secondary services where available.

Oxford Bus Company Battery: Export to Grid

The Oxford Bus Company (OBC) Battery: Export to Grid MVS was the first trial to be conducted within Project LEO. The aim of MVS was to test the suitability of the proposed MVS procedure.

The flexibility service and assets chosen for this MVS included a planned Distribution System Operator (DSO) constraint management service using electrical storage and was trialed for 1 hour between 13:00 and 14:00 on the 18th of November, 2019. The competition was registered on the Piclo LEO platform for the proxy flexibility service. The trial consisted of a 30 kVA (90 kWh) battery system, co-located with a 140 kWp solar array at the Oxford Bus Company depot in Cowley, which is connected at the 400 V low voltage (LV) distribution level. The Low Carbon Hub (LCH) owns the solar array, while OBC owns the battery storage system.

OBC Battery, Watlington Road - Cowley, Oxford

When initially commissioned, the battery was only configured to act as a buffer due to the import capacity limit of the site and it was unable to feed power back to the grid. This issue was fixed through a software update implemented by the battery manufacturer.

For the first iteration of the OBC MVS trial, temporary metering was installed at the secondary substation and at the site's common connection point as the standard half hourly metering does not allow for a high enough data resolution to complete the intended technical assessment of the trial. Later trial iterations will utilise permanent high-resolution metering that can be monitored remotely in near real-time. Other insights highlighted minor issues and ambiguity within the MVS procedure and the use of the Piclo platform which were quickly rectified for future trials..

The second iteration of the OBC battery MVS trial was undertaken with the aim to demonstrate remote activation of asset control following the dispatch signal sent from the DSO. Learnings from the trial are intended to assess the benefits of increased automation in service delivery and inform the design of automated control software being developed as part of Work Package 3. The remote asset control successfully delivered a 30 kVA service. Additional learnings from this trial highlighted a lack of clarity during constraint registration, (e.g. the meaning of certain terms like ‘deficit’ / ‘surplus’) and some troubleshooting with viewing and selecting winning bids were also experienced. These platforms are still under development but the issues were quickly amended and users were guided through the process. The OBC MVS trials highlighted the usefulness of the MVS approach, allowing for unforeseen issues to be flagged and quickly fixed in an agile, low-risk cycle of trial.

Sandford Lock Hydro: Generation Increase

The flexibility service and assets chosen for the second type of MVS trials were a planned DSO constraint management service using a flexible generation resource. The Sandford Lock Hydro, a 440 kVA micro-hydro situated on the River Thames south of Oxford at Sandford Lock, was used for the trial. The Hydro is owned and operated by the LCH and consists of 3 Archimedes screws; 2 of which are either on/off, with a 3rd variable screw which when controlled as a set, allows a full range of power variability up to 440 kVA. The hydro is connected to the 11 kV network via a private substation, fed from the Kennington Primary substation. The site has an export connection capacity limit of 400 kVA.

Sandford Hydro is a key plug-in project for Project LEO. Generating 1.6 GWh annually for roughly 450 homes and offers an excellent opportunity to test how a local generation asset can operate in a flexible way for the direct benefit of local active system users. As generation from the hydro is seasonal, there is also an opportunity to look at complementary generation technologies which could make use of the export capacity when the hydro plant isn't generating; an example of 'Authorised Supply Capacity Trading' identified in Transition's 'Services in a facilitated market' report.[1]

This MVS allowed further refinements of the Piclo platform as a few technical issues were raised when registering the asset and delivering the subsequent service. These included the handling of power values and the definition of output/demand reduction tolerances at the competition stage to ensure that energy is reduced/delivered exactly as the Distribution Network Operator (DNO) requires over the service period.

The trial was for a 'DSO Constraint Managed Service' where 100 kWh increase in generation delivered over 1 hour was requested. The outcome of the MVS trial was a 'failure to deliver' due to a failure with one of the sluice gates which highlighted important questions on how the DSO deals with delivery failures. This has driven further development of protocols (within Work Package 5) guiding parties around penalties, notice periods and the secondary bid process associated with assets and services that fail to deliver.

Oxford Behind the Meter: Sackler Library DSR

The third type of MVS, Oxford Behind the Meter (OBM) concerns building DSR for flexibility services and initially, it will focus on University and Public Authority buildings within the City of Oxford. The Sackler Library (part of the Bodleian Libraries and situated in Oxford City Centre) was chosen as the first trial building for OBM. The demand response would come

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[1] *Services in a Facilitated Market; SSEN, Origami Energy; 2019; https://ssen-transition.com/library/ accessed: 10/01/2020.*

from changing the speed of HVAC (heating, ventilation, and air conditioning) fans on the air handling units which feed the central library rotunda. The aim of this MVS was to demonstrate DSR control within the University of Oxford estate in response to a DSO flexibility service request, and secondly, to assess the impact of such a response on the internal state of the building, to inform future building modelling and optimisation.

The key procedural learning which came from this MVS highlighted the need for an established two-way communication strategy between the DSO and service provider, particularly relating to failure or delay in service delivery. The trial saw a failure to deliver on the original scheduled date of December 12th, 2019. Key questions to answer as part of future trials include: what processes need to be in place for the DSO to be notified of any failure to deliver; and what is the mechanism to procure reserve services if a failure happens after bid acceptance but before dispatch requests. The second MVS trial attempt saw a delay of 10 minutes in delivering the service as a result of human error during manual control of the HVAC system raising the question of how strict should the windows for dispatch be, and what penalties, if any, should apply.

Manual HVAC control in Sackler Library as part of the OBM MVS trial.

TRANSITION Update

SSEN's Ofgem-funded TRANSITION project is an integral element of LEO. The work within Work Package 5 (WP5) aims to demonstrate the integration of a local energy system in the wider national system, through the use of distributed energy resources (DER) in an efficient and effective way to reduce the cost of any reinforcement.

A key activity undertaken within Q3 and Q4 of the project has been to develop a trial philosophy and flexibility services, along with basic market rules that will be tested within the Project LEO trial environment. These services include: Peak Management, Constraint Management, Short Term Operating Reserve (STOR), Authorised Capacity (MIC/MEC) Trading, and Offsetting. Further details can be found in the 'Services in a Facilitated Market' document, available on the TRANSITION website.[2] The second phase of MVS trials will be developed to be aligned with these services, along with consideration of operational and near-term plug in projects in the Project LEO pipeline.

A Site Selection/Trial Planning workshop was hosted by SSEN TRANSITION / WP5 team on the 30th and the 31st of January (2020) in Cumbernauld. The purpose of the meeting was to:

- Provide LEO partners with an understanding of the DSO services to be trialled by TRANSITION,
- understand the current landscape of flexibility assets from LEO partners and their approach to recruiting new assets,
- and establish the suitability of the assets to fulfil service trial requirements.

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[2] *Services in a Facilitated Market; SSEN, Origami; 2019; https://ssen-transition.com/library/; Accessed: 13/02/2020*

The workshop enabled WP5 to provide all LEO partners with a clear understanding of the five DSO services to be trialled by WP5 as part of Project LEO. In addition, an understanding was gained of the available flexible assets provided by each of the LEO partners (technology / geography / generation or demand-led) and provided an initial opportunity to identify the preferred primary substations for running service trials.

Site Selection Workshop held in SSEN's HVDC, Cumbernauld (30th January 2020)

Plug in Projects

The LCH, lead of Work Package 3, is working towards the objective of demonstrating how the electricity system can be optimised and balanced from the bottom up: the hypothesis is that optimised and balanced low-voltage branches of the network will deliver optimal and balanced high-voltage branches.

Significant work has been undertaken throughout Q3 and Q4, Year 1 of Project LEO on the OBM Plug-in Project, which intends to look at the flexibility of loads within Oxford City and how assets can be balanced locally as a sub-system behind a virtual meter, in order to manage peaks in demand. Oxford City Council, in conjunction with the University of Oxford, held a workshop in November 2019 to create a shared understanding between key project stakeholders of the OBM concept and which defined the OBM MVS trial, discussed above.

From this workshop, a vision for the OBM Plug in Project developed and is to explore the art of the possible in balancing energy generation and energy demand locally in and around Oxford, to help meet net zero carbon goals. By the end of Project LEO, OBM will have tangibly demonstrated how local energy assets and infrastructure belonging to our community can be coordinated in such a way as to allow local energy trading and services for the mutual benefit of our local community and the environment. Success will be when this is achieved in a way which is easily understood by our community and helps us to meet our net zero carbon goals. A report providing the modelling and specification of how a detailed trial of OBM will run and plug into Project LEO is currently being drafted by the project team and will be available in the coming months.

Stakeholder Interview Analysis

In September 2019, a number of internal Project LEO stakeholders were interviewed by WP6 Lead, Dr Sarah Darby, to explore their views on a number of LEO focus points , mainly:

- What respondents see as the 'Big Idea' behind LEO: its ethos;
- How they interpret the terms 'smart', 'local' and 'energy system';
- How they see change coming about during a transition to smart local and low/zero-carbon energy systems;
- What they see as the main challenges facing the project; and,
- The potential for replicating the LEO approach to transition, in terms of geography, resources and processes.

The main aim is to contribute to a Theory of Change that can guide LEO in association with the work of EnergyRev and fellow demonstrator projects. This theory will attempt to explain how the project will achieve its aims: what people, equipment and rules will be needed, and how they will influence outcomes. It will shape the choice of metrics and indicators for assessing project outcomes and processes. The interviews will be repeated at yearly intervals and the theory will be revised as necessary, as the project proceeds.

The LEO internal stakeholders are: the Low Carbon Hub, the local anchor for the project; SSEN, who operate the electricity network for most of Oxfordshire, aim to evolve into a DSO and have national reach; industry and market-enabling partners; the County and City Councils; and Oxford and Oxford Brookes Universities. Between them, these bring expertise and experience in many aspects of setting up a viable smart local energy system (SLES) and deriving social and environmental benefit from it. The interviews showed a shared commitment to what the 15 respondents saw as a significant demonstrator project that can bring social, environmental and economic value to people in Oxfordshire and beyond.

Stakeholder objectives, concerns and priorities are inevitably shaped to some extent by their organisational remits and the scale on which they operate. There was a striking level of agreement on the combined organisational, social and technical nature of the project, even if emphases varied. The MVS approach was seen as a key concept, something modular that can be tested relatively quickly as part of agile processes. Without this, replicating LEO's processes was seen as unlikely; a great deal depends on the mix of people, skills, built environment and network characteristics in a given locality. Oxfordshire was seen as especially fortunate in terms of social capital, engagement, skills and knowledge.

Partners shared the view that a timescale in the region of 10 years is realistic for the LEO vision, given the scale and complexity of what needs to be done. There is an open question about the relationship between reliance on markets and the extent to which LEO achieves equity in access to energy services and assets, and people having a voice in their governance.

All these points are worth bearing in mind when setting or revising KPIs and evaluating the project as a whole. The equity and inclusion issues, in particular, need careful thought as they are not the easiest to capture in KPI terms. They will be revisited in the autumn of 2020 when this exercise is undertaken again for WP6.