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D6.1.17 Summary report of the flexibility assessments undertaken on Oxford City Council leisure buildings

Ruth Harris– Oxford City Council

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Author(s):	Ruth Harris
Organisation(s):	Oxford City Council

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Context

The UK Government has legislated to reduce its carbon emissions to net zero by 2050. Meeting this target will require significant decarbonisation and an increased demand upon the electricity network. Traditionally an increase in demand on the network would require network reinforcement. However, technology and the ability to balance demand on the system at different periods provides opportunities for new markets to be created, and new demand to be accommodated through a smarter, secure and more flexible network.

The future energy market offers the opportunity to create a decentralised energy system, supporting local renewable energy sources, and new markets that everyone can benefit from through providing flexibility services. To accommodate this change, Distribution Network Operators (DNOs) are changing to become Distribution System Operators (DSOs).

Project Local Energy Oxfordshire (LEO) is an important step in understanding how new markets can work and improving customer engagement. Project LEO is part funded via the Industrial Strategy Challenge Fund (ISCF) who set up a fund in 2018 of £102.5m for UK industry and research to develop systems that can support the global move to renewable energy called: Prospering From the Energy Revolution (PFER).

Project LEO is one of the most ambitious, wide-ranging, innovative, and holistic smart grid trials ever conducted in the UK. LEO will improve our understanding of how opportunities can be maximised and unlocked from the transition to a smarter, flexible electricity system and how households, businesses and communities can realise the benefits. The increase in small-scale renewables and low-carbon technologies is creating opportunities for consumers to generate and sell electricity, store electricity using batteries, and even for electric vehicles (EVs) to alleviate demand on the electricity system. To ensure the benefits of this are realised, Distribution Network Operators (DNO) like Scottish and Southern Electricity Networks (SSEN) are becoming Distribution System Operators (DSO).

Project LEO seeks to create the conditions that replicate the electricity system of the future to better understand these relationships and grow an evidence base that can inform how we manage the transition to a smarter electricity system. It will inform how DSOs function in the future, show how markets can be unlocked and supported, create new investment models for community engagement, and support the development of a skilled community positioned to thrive and benefit from a smarter, responsive and flexible electricity network.

Project LEO brings together an exceptional group of stakeholders as Partners to deliver a common goal of creating a sustainable local energy system. This partnership represents the entire energy value chain in a compact and focused consortium and is further enhanced through global leading energy systems research brought by the University of Oxford and Oxford Brookes University consolidating multiple data sources and analysis tools to deliver a model for future local energy system mapping across all energy vectors.

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1 Introduction

1.1 Background

Project LEO's *"Barriers and Opportunities Report for LEO Trial Recruitment"* report[1] identified that assessing flexibility potential is a considerable barrier to participate in energy flexibility markets for most organisations where energy is not their core business purpose. Despite engaging with numerous organisations during the market trial recruitment phase (as shown in the barriers and opportunities report), many of these struggled to engage - there is not the resource, skills or knowledge currently available in house to assess flexibility and undertake the necessary steps to enable assets, which would allow organisations to participate directly. In order for local or national energy flexibility markets to recruit diverse assets and organisations, it needs to be recognised within the energy sector that further support is required in many cases on the initial steps of assessing energy flexibility and enabling participation.

Whilst Project LEO's Market Stimuli Packages (MSPs) were a welcome first step to support organisations to enter the project's flexibility markets, unfortunately they did not address the very first step of assessing and quantifying the flexibility available from an asset. Without this key piece of information it wasn't possible to sign up to, and therefore access the financial support from, the MSPs. This point is particularly important as many potential market actors where energy is not their core business activity (who may find support packages useful) are likely to have demand-side assets (i.e. buildings). These are especially complex to assess for flexibility because of the interaction of different components within the building; turning demand up or down at any given point has a knock on effect on the building's environment, operation and the building's users. This complexity has been previously demonstrated in Project LEO at Oxfordshire County Council's Westgate Library through the process of setting up the library to participate in Project LEO markets[2].

In order to investigate this very first step of assessing flexibility, Oxford City Council commissioned Consortio Ltd (a consultancy with expertise in energy assessments and energy flexibility) through Project LEO to assess the sources, quantity, controllability and potential value of energy flexibility of 5 of its leisure sites. At the start of this assessment process, the flexibility from these sites and the ability of BMS systems to control flexibility was not known, despite having half-hourly energy use data. This has provided valuable insights and evidence to Project LEO on the "lived experience" of trying to gather the information required to potentially access a local or national energy flexibility market, through a business as usual processes by an organisation which does not have energy as its core business purpose.

[1] *"Barriers and Opportunities Report for LEO Trial Recruitment",* Oxford City Council - https://project-leo.co.uk/reports/barriers-and-opportunities-market-trials-recruitment/

[2] *"Minimum Viable System Trials: Compilation Report"*, Scot Wheeler, University of Oxford - https://project-leo.co.uk/reports/minimum-viable-systems-trials-compilation-report/

2 Approach

2.1 Purpose of this report

The work conducted by Consortio Ltd provided Oxford City Council with a commercial assessment specific to the Council's buildings. This informed the Council's decision that participation in Project LEO Trial Period 3 is not possible for the assets considered because they would require additional investment to enable them. There is currently not a business case for this nor would it be achievable within the remaining timescale of Project LEO. However it gave an opportunity to gather evidence and draw findings from the experience of assessing flexibility within a Business as Usual (BAU) context. This context is set because this assessment work was not undertaken by a project partner, but rather procured through standard procurement processes using Project LEO funding.

This report therefore draws out and interprets what was learned from the experience of assessing flexibility (rather than giving technical details and specific information about Council assets, except where relevant to the learning. The technical detail has been provided by Consortio Ltd to Oxford City Council). These interpretations are important because it adds to Project LEO's evidence base on the challenges to participating in energy markets (local or national) that are faced by organisations where energy is not their core business.

This report is expected to be of interest to other Local Authorities or public sector organisations as it provides insights which could be directly relevant and transferable to their own flexibility journey. However its primary audience is intended to be organisations who can support enablement of assets (e.g. Building Management System providers/installers, and assessment consultants), those who support participation in the markets (e.g. aggregators, or those providing services to support delivery of flexibility), and those who set standards (e.g. regulators or policy makers). It is hoped that the insights in this report will help provide information and evidence that prompts consideration in the energy sector of how to more effectively support public sector assets entering flexibility markets. In particular, its suggested these considerations extend to what types of commercial services that third parties could usefully offer to the public sector to overcome barriers to entry, and the need for common standards.

2.2 Scope of Consultant's Assessment

Oxford City Council commissioned Consortio Ltd to assess the sources, quantity, controllability and potential value of energy flexibility of 5 of its leisure sites:

- Hinksey Outdoor Pool – large heated outdoor pool.
- The Leys Leisure Centre – Gym, sports facility and indoor heated pool.
- Barton Leisure Centre – Gym, sports facility and indoor heated pool.
- Ferry Leisure Centre – Gym, sports facility and indoor heated pool.
- Oxford Ice Rink – Olympic standard ice rink.

These buildings were selected by Oxford City Council as heatpumps and batteries have been recently installed independently from Project LEO at four of the sites (excepting the Ice Rink), using Public

Sector Decarbonisation Scheme (PSDS) funding. It was thought that these might be good sources of flexibility to investigate for Project LEO, as well as the pools being potential thermal stores. Similarly the Ice Rink was also thought to be appropriate to investigate as a thermal store. As part of the PSDS programme work was done to update the building management systems (BMS) to allow installation of the heatpumps and batteries - however assessing flexibility was out of scope.

Therefore further work was still needed to identify and quantify flexibility potential of these buildings, and understand if the existing BMS controls are sufficient to dispatch flexibility to Project LEO and other markets. Consortio Ltd were appointed to do this and an excerpt of the procurement specification is shown in Appendix 1 to show the scope of the work. In summary, Consortio Ltd were asked to take a practical view on what energy flexibility could be easily realised now, using existing equipment, by answering the following key questions:

- What are the main sources of flexibility within the buildings?
- How much flexibility can be provided and when?
- What flexibility services can these buildings provide for Project LEO and what is the possible value to Oxford City Council?
- What flexibility services can these buildings provide for markets other than Project LEO and what is the possible value to Oxford City Council?
- Are the current building equipment/control and metering adequate to provide flexibility and what investment would be required to optimise assets?
- What are the "best" sources of flexibility?

The secondary focus of the assessment was to provide a recommendation about what sorts of upgrades might be required (with indicative typical costs) to maximise existing flexibility potential both in LEO markets and other markets. Consortio Ltd were not tasked with providing a fully specified and costed upgrade plan.

2.3 Consultant's method

Consortio Ltd collated a variety of information to undertake their assessments, including building energy use data, grid connection and metering information, schematics, building management system details, operational information and anecdotal evidence for each of the sites, as well as conducting site visits at each location. They also utilised CIBSE weather data[3] to understand what impact seasonality has on both the available flexibility and building environmental conditions, and PWTAG[4] codes of practice and technical notes on the operation of pools, where needed.

This information was used to assess each site and identify where there were sources of flexibility, how large they were and when they were available (e.g. times of day, times of year). This involved

[3] Chartered Institution of Building Services Engineers. https://www.cibse.org/weatherdata
[4] Pool Water Treatment Advisory Group. https://www.pwtag.org/

complex demand profile modelling (using IES-VE[5] software for internal spaces, TMSYS for pools[6] and AutoCAD CFD 2022[7] software for the ice rink) to inform realistic assumptions around flexible loads, and to understand the impact that altering energy flows in the building would have on the building environment (e.g changes in humidity in the pool room, temperature drops, ice melting etc). As noted in Section 2.1, this report does not set this process or findings out in detail (except where directly relevant to a learning point).

Having undertaken this modelling to identify and quantify the main sources of flexibility, Consortio Ltd then used the outputs to understand the value to Oxford City Council, by undertaking their Revenue Potential Assessment process. This shows the theoretical value to the Council of bringing these leisure sites in to the Project LEO trials as well as other national markets. This included setting out a suggested approach to controlling assets to provide flexibility to trade in the markets, in terms of which assets and services to prioritise. This control philosophy aimed to maximise the return from the markets in different trading scenarios.

3 Discussion of key learnings

3.1 Key learnings

The following sections sets out the key learnings from the experience of undergoing a flexibility assessment and highlights their relevance to the evidence base being developed by Project LEO about energy flexibility. The key learnings are set out using the broad themes of flexibility quantification, asset enablement, market insights, financial considerations, and, organisational and communication considerations. These interpretations are important to add to Project LEO's evidence base on the challenges to participating in energy markets (local or national) that are faced by organisations where energy is not their core business.

3.2 Flexibility sources and quantification

Learning 1: The main sources of flexibility identified are the batteries, air handling units and heat pumps, but further investment is required to enable dispatch of this flexibility (Section 3.3. below). However, contrary to expectations the Ice Rink site isn't a good source of flexibility. It wasn't recommended to dispatch flexibility for longer than 30 minutes, a very short duration. Modelling indicates that ice temperature would change very rapidly because it is a thin layer with a large surface area, and has a long (2hr or more) recovery time. This means flexibility dispatch would quickly impact the Ice Rink's primary business purpose (i.e. ice skating), potentially reducing business income. Secondly the Ice Rink it has exceptionally long opening hours (typically 06.15am to 01.30 the following morning). To avoid impacting operational use, the opening hours limit flexibility dispatch to a very short window early in the morning. As only one ice rink was assessed, it's not a robust conclusion to say all ice rinks are either unsuitable or limited in their flexibility potential,

[5] Integrated Environmental Solutions software. https://www.iesve.com/software/virtual-environment
[6] TMSYS Building Information modelling software.
[7] Computational Fluid Dynamics software. https://www.autodesk.co.uk/products/cfd/overview

however other organisations may find the insight about the rate of ice melt useful context when assessing their own facilities.

Learning 2: Sites with swimming pools appear to be more consistently able to provide flexibility than the ice rink. Maximum possible flexibility was estimated between 28kw and 161kw for various air handling units and heatpumps. Batteries were estimated between 120kw to 300kw. Flexibility would vary from site to site and by time of year, and seasonal conditions may not be optimum to realistically reach these maximum values. Flexibility from air conditioning units was negligible. Theoretically all four pool sites could provide a minimum of 1hr of flexibility without adversely impacting building operation. Two sites could provide up to 3 hours by operating heatpumps, batteries and/or air pumps in a specific sequence over the 3 hours. This learning suggests that markets requiring shorter duration flexibility (1 hr) for small quantities of flexibility may be more suitable / attractive for leisure sites in general.

Learning 3: The assessment highlighted that buildings are complex assets to model, understand and quantify because they are an ecosystem comprising of the building fabric, functioning equipment and building occupants. This complexity is compounded by data and information not being always easily available to conduct assessments. Some new equipment at the sites were either not yet operational and/or did not have much baseline data - raising a question on how to consistently assess flexibility potential for building demand side response assets where new components have been recently installed. Similarly, it's difficult to create a business case for upgrades that unlock future flexibility, where existing systems lack key information to assess and quantify the potential for flexibility. This learning makes a recommendation to the flexibility sector to establish common and clear industry recognised guidance, standards and methodologies on assessing building-based demand side response assets, especially for organisations where energy flexibility is not their core business.

Learning 4: Tracing grid connection agreement information to check and confirm capacity of existing connections can be challenging, especially at older sites which have undergone development with multiple amendments to grid connections. It is also difficult where sites may be sufficiently old that connection agreements may not have been explicitly documented in the past. Whilst organisations generally keep these records accessible as part of good practice, developing a way for commercial customers to rapidly check and confirm with the DNO existing connection capacities at sites would be helpful.

3.3 Asset enablement

Learning 5: Although the BMS had recently been updated in 4 of the 5 buildings, this had not been done with flexibility in mind. Further work and investment would be needed to re-programme the battery controls so they can dispatch on demand. Reprogramming would also be needed for the BMS that manages the building equipment to ensure that e.g. altering heatpump or chiller energy consumption doesn't create an unintended reaction in the BMS. For example, turning down key items of equipment (e.g. chillers, heatpumps) to provide flexibility could result in changes to the building conditions (e.g. building temperatures, humidity). If this causes a change outside of the

BMS's pre-programmed tolerances then this could set off an alarm, or result in the BMS switching on other equipment to compensate – potentially cancelling out the delivery of flexibility. The buildings are essentially a system of interconnected equipment controlled by a BMS, but just because the BMS exists, doesn't mean that the building will be capable of delivering flexibility. This finding is consistent with Oxfordshire County Council's experience of needing to reprogramme their BMS to enable the Westgate Library in Project LEO to deliver flexibility[8], and adds to the body of evidence on the challenges to flexibility faced by public sector buildings. A recommendation based on this learning is that having a publicly available standard on flexibility-enabled BMS would be helpful in future to ensure where BMS upgrades are carried out, that they are done in a "flex-ready" way, including being able to remotely access the BMS.

Learning 6: The total potential flexibility identified in the buildings is equivalent to at least 10% of the energy usually consumed. In theory, this means that e.g. the delivery of a demand turn down across all equipment identified should be sufficiently large to show up against background "noise" on the main electricity utility meter for each building. This means that it could be used to evidence flexibility dispatched without investing in new metering. However, this would need testing in a real world scenario and if this is not the case, additional revenue-grade sub meters would need to be installed to provide better and more granular data, at the time of writing at a cost of approximately £800/meter – adding to the cost of asset enablement.

Learning 7: It was a challenging timeline for Consortio Ltd to assess 5 leisure sites in 3 months. This, coupled with the need for upgrades and real world tests to verify expected flexibility, indicates there is a long lead in time to enable assets. Overall, assessing and quantifying flexibility is a time consuming process which requires considerable technical expertise, which must be brought in if not available in-house. Local Authorities and the public sector will need more resource to quantify flexibility and enable their assets if they are to participate in a market directly. Alternatively, third parties need to provide a suitable and commercially viable full end-to-end contractual service that removes these challenges by quantifying, enabling and operating their client's assets.

Learning 8: There is an opportunity to integrate different low carbon technologies in the buildings to provide more flexibility. For example, whether the new batteries could be charged from the solar PV, or whether they could export electricity via the grid export connection associated with the solar panels. However, these low carbon technologies were installed at different points in the building's lifetime, and therefore they may not be physically connected with each other. Unfortunately in the case of the leisure sites assessed the wiring schematics showed that the batteries couldn't be charged by the existing solar PV installations, and further investigation would be needed to understand if the batteries can use the solar PV's export connections. In some cases there is no existing export connection anyway and one would have to be applied for – potentially increasing the cost of asset enablement. This learning highlights that DSR sites are complex – just because they have multiple energy assets doesn't mean that they are integrated, and investigating these adds to potential asset assessment and enablement costs.

[8] *"Minimum Viable System Trials: Compilation Report"*, Scot Wheeler, University of Oxford - https://project-leo.co.uk/reports/minimum-viable-systems-trials-compilation-report/

3.4 Market insights

Learning 9: The aggregated portfolio of leisure sites does not have enough flexibility to meet entry criteria (min 1MW) for national markets (see Learning 2). In reality the sites cannot all be aggregated together as they are not all in the same Bulk Supply Point on the electricity network. To be able to access national markets, Oxford City Council would either need new dedicated flexibility assets, or to assess its other buildings to build up a larger portfolio - either way requiring significant investment without confidence in the potential financial return provided by flexibility markets. The flexibility that is available is most reliably available for 1 hour (and up to 3 hours in some cases). This learning highlights that public sector organisations are likely to have smaller, dispersed, short duration DSR assets. If local and national markets want to utilise these types of assets, they need to design a route in and service requirements that are appropriate for small dispersed flexibility. Alternatively, third party aggregators need a variety of viable commercial offerings suitable for public sector DSR assets that can support all or some of assessment, enablement and delivery of flexibility, depending on the DSR asset and organisation's individual needs.

Learning 10: The business case doesn't currently exist for Oxford City Council to participate directly in a local flexibility market because the assessment indicated significant further investment in assets would be required, and specialist staff would be needed to support participation. Project LEO's Market Stimuli Packages were intended to provide financial support for minor asset enablement, but the funding provided would not have been sufficient in the case of the leisure sites. The market return to justify this investment is uncertain as it was hard to determine the expected number of successful flexibility events and revenue in a year if the Project LEO markets entered in to business as usual situation. The conclusion is that direct participation in this market would currently be very difficult outside of an innovation funded project. This is likely to be the same for many Local Authorities, whose fundamental business purpose is not the provision of flexibility services to the grid. If local and national markets want to attract public sector demand side response assets, they need to find a viable way to facilitate asset enablement. Alternatively, third party aggregators need a variety of viable commercial offerings suitable for public sector DSR assets that can support all or some of assessment, enablement and delivery of flexibility, depending on the DSR asset and organisation's individual needs.

Learning 11: Simple price arbitrage from charging the leisure sites' batteries at cheap times and discharging to the site at expensive times was noted by the consultants as an option for flexibility not explicitly connected with the Project LEO markets. Theoretically this is more attractive to Oxford City Council than participating in the flexibility markets because it is a simpler process, needs minimal staff time (largely a passive approach once the battery is programmed), and sufficient data exists to calculate a business case outside of an innovation environment. Price arbitrage across all sites with a battery was projected to create nearly as much in cost savings over 1 year (based on 10p/kwh arbitrage), as would be gained in revenue from 4 sites delivering 150 hours each of flexibility (after reasonable staff costs were deducted). At least 1 FTE of skilled staff resource is considered appropriate to manage a more involved manual full end to end process (such as that needed in the Project LEO trials) for 4 DSR assets (the Ice Rink was not included – see Learning 1).

The recommendation from this is that the market process needs to be simpler and/or support is needed with enabling automation.

Learning 12: Assuming the building controls could be made capable of delivering flexibility, the leisure sites were thought predominantly suitable for the Sustain Peak Management, Sustain Export Peak Management, and Secure DSO Constraint Management (pre-fault) Project LEO flexibility services. This is because these services have longer dispatch notice periods which can accommodate manual rather than automated dispatch. The leisure sites were not considered suitable for Dynamic DSO Constraint Management (post-fault) service as the response time was too short to react using existing systems and processes. A more automated process would be required.

Learning 13: Theoretically the pool sites are ideal for Sustain Export Peak Management because the pool could be used as a heat sink to take excess energy from the grid. Although this would provide a grid service on one hand, it could be very wasteful on the other if this was done when the pool isn't in use (in particular, Hinksey Pool out of season). The marketplace payment would need to be more than the electricity cost of heating the pool to make this a financially attractive option. However from an ethical and environmental standpoint it would not be appropriate to deliver if the additional pool heating didn't give benefit to the pool users (i.e. service delivered when pool is out of use).

Learning 14: There could be considerable potential at certain times of year for the leisure sites to undertake peer to peer trading[9] of temporarily spare capacity within the Project LEO markets. This is especially true for Hinksey Pool during the winter (the pool is not open) when there is limited load on the grid connection. Given the expected shift to electrified heating which will place a bigger strain on the network in in the winter months, having "spare" winter capacity should be a useful to the DNO and also as a trading opportunity. Other seasonal outdoor heated lidos may have similar opportunities. However, a key barrier to participation in the peer to peer markets is finding a suitable trading partner in the same part of the electricity network.

3.5 Financial considerations

Learning 15: Flexibility assessments were commissioned because there was no mechanism within Project LEO market processes to support the quantification of flexibility and Oxford City Council did not have the resource to do this in house. The Market Stimuli Packages (MSPs) were intended to provide some level of financial certainty to support participation and enable assets, but required organisations to have quantified their flexibility potential to be able to sign up to them. Without this key piece of information the MSPs, as designed, were not actually accessible. The recommendation is that future versions of an MSP need to consider how to support the initial step of quantification, in order to make market access easier for organisations where energy is not their core business.

[9] Definition of peer to peer trading in Project LEO is when an organisation trades (temporarily) some of their grid export or import capacity for an agreed period of time with another organisation. The DNO needs to agree to this trade, to ensure it doesn't negatively affect the network. See; https://project-leo.co.uk/the-context/flexibility-services/

Learning 16: There is a significant up front cost of assessing flexibility and making assets ready. At the procurement stage, costs quoted from potential suppliers for undertaking the flexibility assessments of the 5 leisure sites ranged significantly (c.£37,000 difference between the lowest and highest costs quoted), indicating there may not be much standardisation in approach for assessment of demand side response assets. It is also clear after assessment that further investment in e.g. controls, grid connections and real world testing is needed before potential flexibility could be delivered. In one case, the cost of adding a small standalone air conditioning unit to the BMS far outweighed the financial benefit of the flexibility it could give (7kw). There also needs to be consideration of staff time costs, energy costs, increased maintenance costs and legal costs to enter in to market agreements directly – outside of an innovation project, the return from the markets would need to sustain these. It is recommended that there would need to be a larger and more predictable financial return from the markets, to improve the cost-benefit analysis of making assets ready and the overall business case.

Learning 17: It was difficult to quantify the value the Oxford City Council could gain from Project LEO markets because it was hard to know how many flexibility events might run per year if the LEO markets transitioned to business as usual, and how the price caps might change. This was overcome by assessing theoretical scenarios of successfully delivering 30, 90 or 150 hours of flexibility per year by the leisure sites. Oxford City Council then added some additional calculations on the cost of staff time to administer the full end to end administration of the trading and settlement process (see Learning 11), and concluded that currently with a manual process that the staffing cost to administer flexibility trading and dispatch flexibility is a very large part of the market transaction costs.

Learning 18: New or additional export connections were recommended in the assessment. Export connections are a very difficult cost to factor in to flexibility assessments as there is limited upfront information available, as it depends on the DSO's assessment of the network. The batteries were installed without being configured for export, as their original business case was for behind the meter optimisation. However an export connection in theory would unlock further flexibility potential (especially in national markets) - but it comes at a cost. This learning highlights that it would be helpful if the DSO could in future make information more readily available on possible connection costs.

3.6 Organisational and communication considerations

Learning 19: The cost range of quotations received for the work (see Learning 16) and the value that flexibility would need to have over the long term to be attractive, suggests that both consultancy support or "aggregation" contracts providing an end to end service would be of sufficient value that they could trigger thresholds for public sector procurement rules requiring competitive tender, and/or internal institutional procurement policy thresholds. This potentially adds to the complexity of direct engagement with the market, as the expected cumulative value of the contract over a period of time with the market would need to be determined prior to commencement to ensure the correct level of procurement process had been followed. A recommendation would be for more information being made easily available from the DNO on likely returns from example categories of

different buildings over set periods of time in the market to assist with determining contract values for direct participation – but this would likely require further work to establish.

Learning 20: Providing flexibility services is not the core purpose of a Local Authority. A common assumption is generally that direct market participation would come under an existing Energy Manager role, however each step in the process requires different skills and activities including assessing assets, market trader activities, controlling the building to dispatch flexibility and undertaking financial settlements. It's likely therefore that for Local Authorities and the public sector there are resource, knowledge and skills gaps, and that more support would be needed to address these. This learning highlights the need either for Local Authorities to develop new skills and staff roles, or more likely, for third party organisations to provide suitable commercial services so this can be outsourced (see Learning 10).

Learning 21: Developing a shared language and understanding between Oxford City Council and Consortio Ltd about the assessment task at hand was challenging in places - some terminology was assumed to be understood on both sides, and some terminology was interpreted differently (e.g. the meaning of "peer to peer" or "aggregator"). For example, "flexibility management as a service", where a third party can be brought in to manage the full process of interacting and dispatching a client's assets is not necessarily the same as "aggregation" (although ultimately a 3rd party may do both). Clarity of shared language about this is important because the word "aggregation" gets used interchangeably. This learning about communication reinforces Project LEO's previous findings that clarity of language is key, if diverse actors are to be brought in to flexibility activities.

4 Conclusion and recommendations

Commissioning Consortio Ltd to undertake an assessment of the flexibility potential of 5 of Oxford City Council's leisure facilities was very valuable. Although the assets are not currently capable of participating in Project LEO's flexibility markets because further investment would be required, it has provided clear learnings on flexibility quantification, asset enablement, market insights, financial considerations, and organisational & communication considerations.

In summary demand side response (DSR) assets, such as the leisure sites, are complex to assess and quantify the potential flexibility they could offer. It requires specialist skills, knowledge and resource to do, which have to be procured or resourced in house for organisations where energy flexibility is not their core business. This would only be supported if the business case to do so was very clear.

In terms of project replication, there is potentially a vast pool of untapped, small and dispersed flexibility (i.e. buildings) in the UK owned by public sector organisations who are unlikely to be fully equipped with the skills, knowledge and resource to access and benefit from it directly, and to provide public benefits through reduced need for grid reinforcements and to support net zero goals. It is also clear that for Local Authorities to build a business case (outside of an innovation project environment) to tap in to this flexibility, the following needs to be addressed:

- **Quantify assets** – it is recommended that the flexibility sector establish common and clear industry recognised guidance, standards and methodologies on assessing building-based demand side response assets, especially for organisations where energy flexibility is not their core business.
- **Enable assets** – It is recommended that further support is provided with costs to upgrade DSR assets so they are made capable (including automation) to participate in flexibility markets, through further grant funding, market mechanisms and commercial offerings. The Market Stimuli Packages were a step in the right direction but were not sufficient as they didn't address assessment and quantification of flexibility. Also required is clear guidance on how to install BMS that is "flex ready".
- **Provide appropriate market opportunities** – It is recommended that the markets design tailored routes in to attract small scale and dispersed DSR flexibility that have manual and slower dispatch processes. This would recognise that this is the type of asset (buildings) that are common within the public sector.
- **Quantify the value back to the flexibility provider from both Project LEO (DSO markets and national markets** – it is recommended that more certainty is needed at present to build a robust business case with pay back times for investment, that will be viable outside of an innovation environment.
- **Clearly communicate** – It is recommended a clear process tailored to Local Authorities and public sector is created by third party organisations and the DSO, to enable the public sector to more easily engage with flexibility.

If third party organisations in the flexibility sector had commercially viable "flexibility as a service" contract offerings that manage as much of the end to end process as possible (including initial flexibility quantification and incorporating all commercial, technical and operational elements of market participation), as well as overcoming the issue of asset size through aggregation, this would likely be a more appealing route for Local Authorities to enter the markets. Designed well, these end to end services could cover all the bullet points above and open up access for the DNOs to a potentially vast pool of buildings-based flexibility across the country. However, it may require further support from central government and policy makers/ regulators to stimulate the development of offers tailored and appropriate to the public sector.

Otherwise, with the need to build a viable business case it ultimately could come down to Local Authorities participating in a market via a commercial contract with an "aggregator", or not at all. "Flexibility as a service" commercial offerings could completely change the situation from Local Authorities having no assets in flexibility markets and receiving no revenue (because they haven't currently got the means to overcome barriers to direct participation), to Local Authorities receiving at least some market revenue which could be used to support local public services by participating indirectly via an "aggregator". Alternatively, Local Authorities need to be appropriately resourced and directed to participate directly. Ultimately, this would benefit both the electricity grid and markets (more flexibility assets with a wide geographic spread, that can help support the transition to a net zero energy system) and local authorities (who generate some income which supports their

local services, and their net zero goals). This provides a clear market opportunity for the sector, arising from the learnings from Project LEO.

5 Appendix

5.1 Appendix 1: Excerpt from bid specification

Approach to be taken for the assessment and report for each building

This assessment and report should take a practical view on what flexibility can be easily realised now, rather than theoretical view detailing all small sources of flexibility that cannot be efficiently tapped in to. We want to identify the "quick wins" – where are the best sources of flexibility that Oxford City Council can control now using existing equipment? When is the flexibility available, how much of it is there and how valuable is it (in LEO markets as well as other markets)? This should be the primary focus of the assessment and report.

The information provided should also give detail to inform Oxford City Council's decisions on how any future investment in these buildings could be strategically managed in a way which enables flexibility. Therefore, the secondary focus of the assessment and report should be to provide a recommendation on what upgrades (with indicative typical costs) would maximise the existing flexibility potential (both in LEO markets as well as other markets).

The assessment and report must also give due regard to the market requirements for Project LEO (see Appendix 1) and responses to the key questions should be set primarily in this context. However, Oxford City Council is also interested to understand the potential value of its flexibility to any other relevant markets and how these can be accessed, and will expect to see commentary included to this effect.

Key Questions to answer within the assessment and report for each building

Question 1: What are the main sources of flexibility within the buildings?

- There is a separate attachment which provides some basic background information about the buildings.
- The buildings variously have chillers, heat pumps and/or batteries and we expect at a minimum these will be considered in the assessment, as well as confirmation of any other sources of flexibility.
- Please ensure you also consider import and export capacity (refer to Project LEO's market information on Peer-to-Peer trading) in your review of flexibility sources.

Question 2: How much flexibility can be provided and when?

- You must quantify the flexibility: in kW for equipment/buildings, and kVA for import and export capacity.
- You must ensure that it is clear how much flexibility can be delivered now, with existing equipment and controls, and how much additional flexibility could be delivered if upgrades could be carried out.

- You must provide a clear breakdown of what amount of flexibility is provided by which equipment system, or individual piece of equipment (i.e. do not just provide a "black box" figure for flexibility for the whole building).
- You must identify how long flexibility can be provided for (e.g. number of hours).
- You must identify when this flexibility can be provided (e.g. times of day, days of week, months of year OR define specific criteria such as - when outdoor temperature reaches specific point, facilities timetable indicates pool is not in use etc.)
- What is the likely impact from delivering flexibility on the building environment (e.g. indoor temperature, humidity, air circulation - would cause a drop of 2 degrees in temperature of the pool, would cause a drop in 1 degree in space heating)
- You must account for the recovery time of the building or equipment (e.g. if ice temperature rises by 1 degree during a flexibility event, how long would ice temperature take to recover a 1 degree decrease?)
- You must provide a commentary explaining your method, as well as any assumptions made or proxies used.

Question 3: what flexibility services can these buildings provide for Project LEO and what is the possible value to Oxford City Council?

- Details on the flexibility services that Project LEO is testing can be found here, with further definitions found here.
- Equipment must be able to turn its demand and/or generation up or down when requested, with up to 12 hours notice, and it must have half hourly monitoring with the appropriate meters (see requirements on SSEN Transition website).
- There are some indicative price ceilings on the SSEN Transition website and value calculators which can be used to help with assessing value. Please ensure it is clear what value can be derived now from flexibility services (i.e. from assets which do not require any investment in upgrades), and what value could be derived if future investment allowed for flexibility assets to be optimised.
- If it would be likely that a 3rd party "aggregator" would be the best route to gain entry to these markets, please provide a commentary.

Question 4: what flexibility services can these buildings provide for markets other than Project LEO and what is the possible value to Oxford City Council?

- Please provide information on any flexibility markets you feel are relevant.
- Please ensure it is clear what value can be derived now from flexibility services (i.e. from assets which do not require any investment in upgrades), and what value could be derived if future investment allowed for flexibility assets to be optimised.
- If it would be likely that a 3rd party "aggregator" would be the best route to gain entry to these markets, please provide a commentary.

Question 5: are the current building/equipment controls and metering adequate to provide flexibility and what investment would be required to optimise assets?

- What are the current equipment/ building controls and metering?
- Which flexibility services are they adequate to respond to?
- Is there a function for an on-site manual override in case of system faults?
- Are the flexibility assets controllable remotely? If not:
    - What control systems would be required to enable this and why (including a function for on-site manual override in case of system faults)?

- What might be the likely cost of retrofitting controls?

Question 6: what are the “best” sources of flexibility?

- Taking in to account all of the above: please clearly rank from best to worst the assets you have considered (prioritising those which can be controlled now, without further upgrades).
- Are there any common themes emerging between buildings or equipment type on the types of flexibility services they can provide, requirements for control systems, or upgrades needed etc?

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