Energy Superhub Oxford (ESO)

Oxford City Council
Thursday 1 October 2020

Summary

Oxford City Centre - like many cities in the UK - has illegally high levels of toxic nitrogen dioxide (NO2), alongside the daily noise pollution and gridlocks in a busy city. While the city has seen an overall 26% reduction in NO2 levels since 2013, air pollution levels have plateaued in the past four years. With its new Air Quality Action Plan, Oxford City Council has out plans to go significantly further than the current legal target for air pollution by setting out a city-wide air pollution reduction target, with a new local annual mean NO2 target of 30 µg/m3 by 2025. It had set out to reduce emissions by 40% by 2020 against a 2005 baseline and is now finalising its target for localised emissions reduction to net zero.

Energy Superhub Oxford (ESO) is pioneering an integrated approach to decarbonising power, transport and heat to accelerate Oxford's zero carbon journey. It will showcase a powerful network of rapid electric vehicle (EV) charging, hybrid battery storage, low carbon heating and smart energy management, providing a model for cities across the UK to cut carbon emissions and improve air quality.

Our problem

The UK government has committed to reducing the country's carbon emissions to Net Zero by 2050, which means that we'll be a lot more reliant on renewable energy, electric vehicles and cleaner ways of heating and lighting our homes. But how can the national electricity grid meet our demand for green energy when renewables such as wind and solar fluctuate in power from day-to-day, month-to-month? How will the grid be able to meet increasing electricity demand and balance supply for charging EVs and heating homes, while simultaneously reducing carbon emissions?

Our aim is to demonstrate how we can move towards a Net Zero country by 2050 by integrating different technologies to create a smart, local energy system.

Overview

In recent years, we've seen a much needed shift away from fossil fuel generated energy towards wind and solar and now we need to find ways of harnessing that power and controlling when it's available to use. ESO is building a massive battery which will help to store energy while the sun is shining and the wind is blowing. As well as storing green energy, the battery will help to balance electricity supply and demand and reduce the strain on the grid at peak times (evening), using machine learning technology to optimise its performance*. It will connect directly to the high voltage transmission network – where it can access large amounts of power - and share this connection on 8KM of private wire, which will deliver up to 25MW of power to rapidly charge lots of EVs at once.

Private wire systems are localised electricity grids connected to local distribution networks but which are privately-owned.

This innovative approach will help to alleviate strain on the low voltage distribution network, which is already supplying electricity to homes and businesses, and provide affordable, scalable power for rapid EV charging.

EV connections are usually low-voltage (LV) distribution networks. The distribution grid is constrained because it is supplying energy to homes and businesses. Of course, it has small substations in each area that supply energy locally, but every time additional energy is required in an area, a study is needed of available capacity. The private wire being installed in tandem with the battery can provide up to 25MW on *all* of its wire. The distribution network would need various upgrades to many different smaller substations to match this.

To reduce emissions and support low carbon methods of transport, Oxford is introducing a Zero Emission Zone (ZEZ) in the city centre in 2021. This means that only zero emissions vehicles (the majority of which will be electric vehicles) will be able to access the zone for free. The already increasing numbers of EV's around Oxford are likely to expand even faster, requiring accessible charge points, including new technologies such as the world's first pop-up on-street chargers, to 'refuel'. ESO will provide infrastructure (private wire, vehicles and charge points) to support Oxford's migration to electric vehicles, involving the creation of the UK's largest EV charging hub in Oxford and the acceleration of the City Council's fleet migration. The project's private wire will provide the electricity needed to charge thousands of EVs.

300 properties in and around the city will also be equipped with innovative low carbon heating solutions, combining ground source heat pumps with smart controls and a time of use tariff to optimise heat production for cost and carbon savings.

Timeline / project progress

This is a three year project running until March 2022, with a possible extension of 12 months. Year one (feasibility) has been completed, but due to Covid-19, we're running slightly behind on the battery and EV Hub installation although most of the City Council EV Fleet is operational and Ground Source Heat Pump installations are in progress. The ZEZ implementation was temporarily paused due to the impact of the pandemic on local businesses, but has now resumed with a final consultation on the Pilot ZEZ. We're treading a delicate balance between implementing these changes to slow climate change and supporting businesses through this difficult time and ultimately, that's meant adjusting a few lead times.

Next year, we hope to have completed all installation, be fully operational and evaluating the project for replication nationwide.

Stakeholders

Oxford City Council is working with a consortium led by Pivot Power (part of EDF Renewables), which consists of Habitat Energy (smart systems), Kensa Contracting Ltd (ground source heat pumps), Invinity Energy Systems (specialist batteries) and the University of Oxford (research). The £40 million ESO project is part-funded by UKRI, with the majority being financed by our partners.

The project involves many Council departments, including planning, property etc, ODS (fleet operator), chargepoint companies (contracts with these are integral to the financing of the private wire) and commercial fleet operators locally, including bus companies, logistics companies and taxi firms.

Whole systems approach

Poor air quality contributes to around 40,000 deaths in the UK every year. Oxford is therefore seeking to further reduce its NO2 levels and improve the health of those living, working, and visiting Oxford. To support this reduction, Oxford has recently set out plans to go significantly further than the current legal target for air pollution. It is seeking to introduce a new draft Air Quality Action Plan, which will mean a city-wide local annual mean NO2

target of 30 µg/m3 by 2025 - the existing legal annual mean limit value for NO2 is 40 µg/m3.

The Zero Emission Zone (ZEZ) in Oxford city centre in 2021 will reduce emissions as well as support low carbon methods of transport to meet local and national Net Zero targets. The ZEZ is designed to take polluting vehicles out of the affected areas and to ensure that only zero emissions vehicles and low emissions public transport are able to access the zone for free. The complimentary Connecting Oxford programme will seek to reduce congestion and car use in the city through the introduction of traffic filters and a workplace parking levy.

Oxford City Council is also a member of Zero Carbon Oxford, a network of 40 private and public organisations that aim to reduce citywide emissions by 40% of 2005 levels by 2020. This project is a huge part of that plan and, in spite of delays caused by Covid, we have the partners, funding and plans already underway to achieve carbon neutrality in the near future.

Impact

For the UK to meet our 2050 net zero targets, we urgently need to decarbonise our power, heat and transport systems. This means we must generate 70-80% of our electricity from wind and solar, build over 25GW of energy storage and electrify our heat and transport systems. ESO provides an infrastructure blueprint to do this.

ESO demonstrates how connecting to the high voltage transmission network rather than the low voltage distribution network can provide essential capacity for rapid EV charging infrastructure throughout the UK, delivering power where and when it’s needed. By coupling this with large-scale energy storage it offers an efficient, clean and reliable way to integrate and store renewable energy and accelerate the UK’s transition to a clean, electric future.

For Oxford City Council, ESO is a direct response to the climate emergency and is helping to deliver a step change in our drive towards zero carbon. The project’s unique approach aims to save 10,000 tonnes of CO2 per year by 2021 – the equivalent of taking over 2,000 cars off the road – rising to 25,000 tonnes per year by 2032.

Part of the ESO project involves heat pump innovation. That means that 56 properties are currently scheduled to be retro-fitted from night-storage heaters to individual ground source heat pumps and shared ground loop arrays (which is where heat pumps are connected to communal ground loops which provide thermal energy). This produces lifetime bill savings of £19,225 per property (based on a recent ECO3 submission). Larger savings can be made, when combined with a smart thermostat and a new cloud-based smart controls platform (from Kensa heat), which takes advantage of the Octopus Energy Agile tariff. This new platform combines property information with time-of-use tariffs to produce an optimised heating schedule. When those options are added on, predicted lifetime bill savings per property increase to £31,575. This also benefits from consistent energy supply, as it reduces the amount of electricity used on the grid during peak times. It does this by running the ground source heat pump when the electricity is cheapest, and there’s less pressure on the grid, but enables a comfortable temperature to be retained in the property for the customer.

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We know that this project is replicable because other cities have already signed up to replicate the transmission connected hybrid battery/private wire innovation. Pivot Power has a network of 40 sites UK-wide where it aims to replicate the transmission-connected battery storage and private wire model to accelerate the decarbonisation of power and transport, and help Britain achieve net zero.

Kensa Contracting is already installing heat pumps around the UK; what makes the Oxford project so unique is that they're using smart technology to implement an agile flexible tariff. The idea is that we'll be able to demonstrate that these heat pumps are as cost effective as gas - and if we can do that, no doubt the company will be able to roll this service out further afield.

During the course of the past year, we've come to realise certain things:

Resource: Innovation projects like these always need double or triple the staff resource that you think.

Costs: Large electric vehicles are more costly than fossil-fuelled equivalents. Government financial backing and policy needs to be targeted to achieve decarbonisation targets. Either by subsidy until costs of decarbonisation technologies reduce or by increasing charges to those producing CO2.

Speed: Private businesses and local authorities have different approval processes, it is important to take this into account when working through programmes.

Development: The electric vehicle market is developing very quickly, which means that the number of models coming on the market is increasing - allowing for more competition.

Cross-working: Resilience and legacy are built by excellent team working, shared goals and deliverables.

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