AECOM

WORKING SUSTAINABLY AND TACKLING THE CLIMATE EMERGENCY

NET ZERO: TIME TO THINK BEYOND SITE BOUNDARIES

The government's ambition of making the UK a zero emissions economy by 2050 sets a huge challenge to the construction sector. AECOM's Regional Sustainability Director **Dave Cheshire** argues that we should start thinking of buildings in terms of their carbon footprint, rather than their physical one.

Currently, those preparing for a low carbon future are urging targets for new construction based on the energy needs of individual buildings. The Committee on Climate Change proposes eradicating burning of fossil fuel in all new buildings by 2025, and the latest Intergovernmental Panel on Climate Change (IPCC) report[1] concludes that: "New construction [has] to be fossil-free and near-zero energy by 2020".

This approach, in isolation, is not enough. Policy makers should look instead to nudging developers to think beyond site boundaries to provide low carbon energy (as they are in London with the London Plan's energy hierarchy). New thinking is needed, including removing the red lines between construction and operation to provide designers with information on how buildings work in practice. Better information flows between the owners of buildings and their tenants could also improve energy efficiency.

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Site boundaries: a red line that needs to be crossed

Starting from scratch, it is possible to design and construct some new buildings that are truly net zero when it comes to carbon and energy emissions. It's a tough ask, but it has been done, albeit mainly for buildings that have relatively low energy intensity and plot density. Driving down energy demand, using on-site renewable generation and switching to electric solutions can all make a difference in carbon consumption.

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Buildings of one or two storeys that are not over-shadowed by other buildings can use photovoltaics to offset all their energy use, as long as the demands are at residential levels.

However, these things are not enough to achieve net zero in energy intensive buildings on constrained sites. Emerging technologies provide some of the answers. These are already improving the efficiency of chillers, lighting and IT infrastructure, and the emergence of smart energy systems is allowing better distribution of energy and the ability to store it for when it is needed. In the future, there will be transparent photovoltaic panels that can turn a window into a generator and new panels that use graphene to glean more energy from the sun.

The decarbonisation of the electricity grid in the UK also helps reduce carbon emissions and is leading to a switch to all-electric buildings. However, technology and a decarbonising grid are not going to be enough to create net zero energy-intensive buildings on constrained sites in the short term. Some red lines are going to have to be crossed.

The most important is the red line boundary around the site. To take a high-density city centre dwelling for example, it's simply not possible that sufficient energy can be generated on site to offset the energy demand of the building, so there will have to be some contribution from beyond the site boundary.

> THE NET ZERO AMBITION WILL DRIVE DEVELOPERS AND BUILDING OWNERS TO FIND PLACES WHERE THEY CAN INSTALL PHOTOVOLTAICS ON NEIGHBOURING BUILDINGS, FOR EXAMPLE, OR START TO PRODUCE ENERGY AS WELL AS CONSUMING IT.

Developers are understandably reluctant to look beyond their site as this has the potential to add costs, risks, delays and/or contractual issues to the project. This approach has already changed in London with the London Plan's energy hierarchy that requires developers to investigate sources of 'secondary heat', such as sewage heat recovery, canals, rivers, and district heating systems. The net zero ambition will drive developers and building owners to find places where they can install photovoltaics on neighbouring buildings, for example, or start to produce energy as well as consuming it. This would allow constrained, energy intensive buildings to glean renewable energy from lower intensity buildings with large roof areas (industrial buildings, stations, etc.) to help them towards net zero.

Crossing the red line between construction and operation

Unfortunately, design intent is often not being delivered in the operational performance of our buildings. This is in part because designers rarely get any feedback on their buildings after they've been delivered (unless something goes really wrong!). To ensure operational performance matches the ambitious targets set at the design stage, we need to monitor the performance of buildings in operation. Designers can then make suggestions to improve the actual operational efficiency — and it will also help them design better in future.

The differences between design intent and operational performance can be reconciled by using 'digital twins' to provide better estimates of operational performance at the design stage and help to understand how the building should be performing in operation. And there are lessons to be learned from the way that Passivhaus projects are delivering impressive performance by setting ambitious targets and applying a high level of scrutiny to every detail.

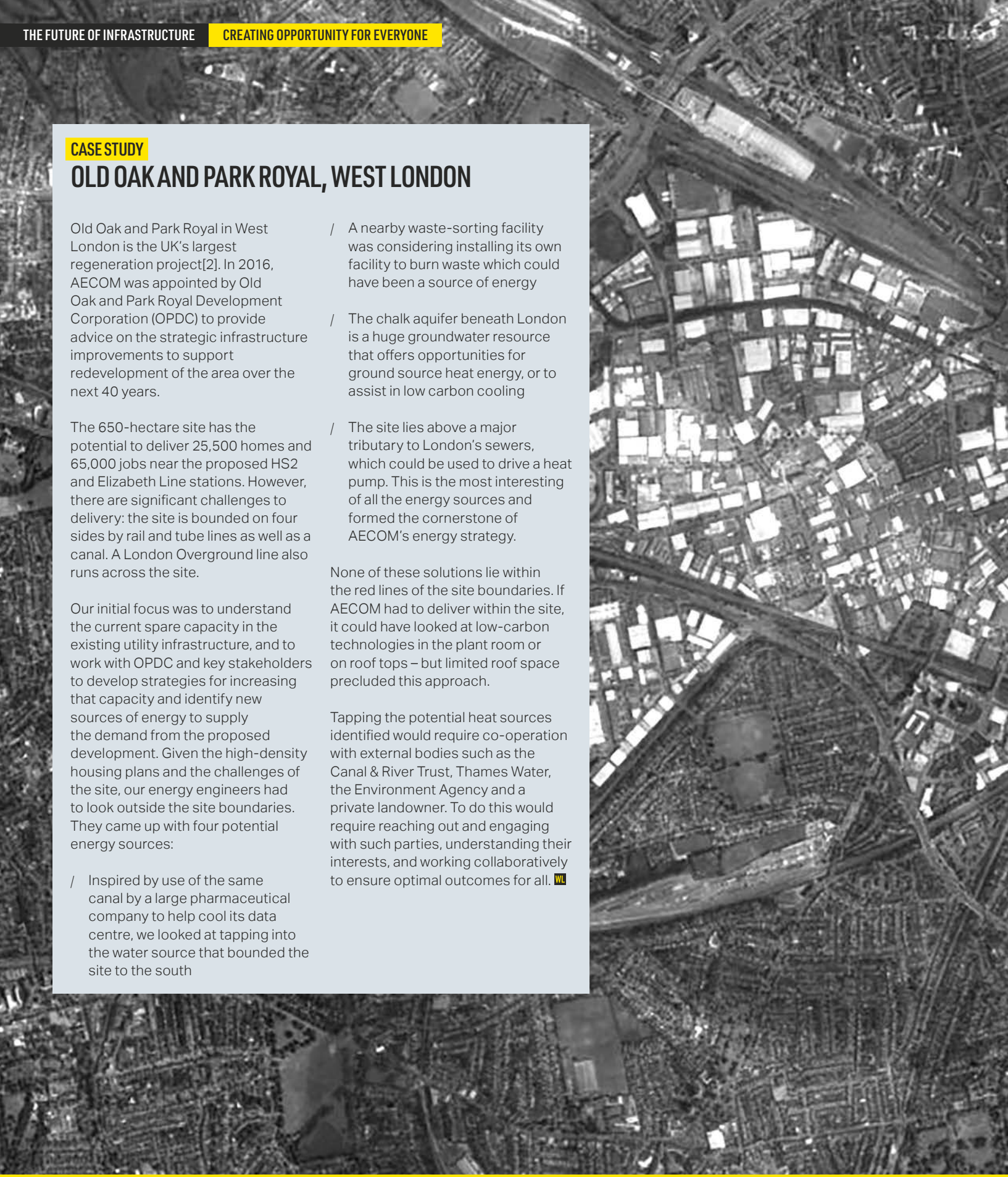
Speaking to the users of buildings: the third red line

Finally, red lines between landlords and tenants should be addressed. The occupants drive the energy demand of the building, while the landlord owns and operates the central plant. This divide could be bridged with co-operation and enabled with technology. Smart meters and intelligent building management systems (BMS) can help by providing data to both landlord and tenant to inform behaviour change. It can also enable demand management to turn off equipment when it is not needed.

New thinking required

Tackling climate change isn't something that can be done in isolation. This is true for buildings as much as it is for people: reducing our impact on this planet requires thinking about ourselves and our buildings collectively.

The road to net zero buildings requires us to cross both physical and contractual boundaries that have long hampered our ability to deliver low energy, low carbon building. We can only achieve net zero in our densely populated buildings on constrained sites by breaking down these boundaries and using disruptive technologies to dissolve the lines we have drawn. →



CASE STUDY

OLD OAK AND PARK ROYAL, WEST LONDON

Old Oak and Park Royal in West London is the UK's largest regeneration project[2]. In 2016, AECOM was appointed by Old Oak and Park Royal Development Corporation (OPDC) to provide advice on the strategic infrastructure improvements to support redevelopment of the area over the next 40 years.

The 650-hectare site has the potential to deliver 25,500 homes and 65,000 jobs near the proposed HS2 and Elizabeth Line stations. However, there are significant challenges to delivery: the site is bounded on four sides by rail and tube lines as well as a canal. A London Overground line also runs across the site.

Our initial focus was to understand the current spare capacity in the existing utility infrastructure, and to work with OPDC and key stakeholders to develop strategies for increasing that capacity and identify new sources of energy to supply the demand from the proposed development. Given the high-density housing plans and the challenges of the site, our energy engineers had to look outside the site boundaries. They came up with four potential energy sources:

- Inspired by use of the same canal by a large pharmaceutical company to help cool its data centre, we looked at tapping into the water source that bounded the site to the south
- A nearby waste-sorting facility was considering installing its own facility to burn waste which could have been a source of energy
- The chalk aquifer beneath London is a huge groundwater resource that offers opportunities for ground source heat energy, or to assist in low carbon cooling
- The site lies above a major tributary to London's sewers, which could be used to drive a heat pump. This is the most interesting of all the energy sources and formed the cornerstone of AECOM's energy strategy.

None of these solutions lie within the red lines of the site boundaries. If AECOM had to deliver within the site, it could have looked at low-carbon technologies in the plant room or on roof tops – but limited roof space precluded this approach.

Tapping the potential heat sources identified would require co-operation with external bodies such as the Canal & River Trust, Thames Water, the Environment Agency and a private landowner. To do this would require reaching out and engaging with such parties, understanding their interests, and working collaboratively to ensure optimal outcomes for all. WL