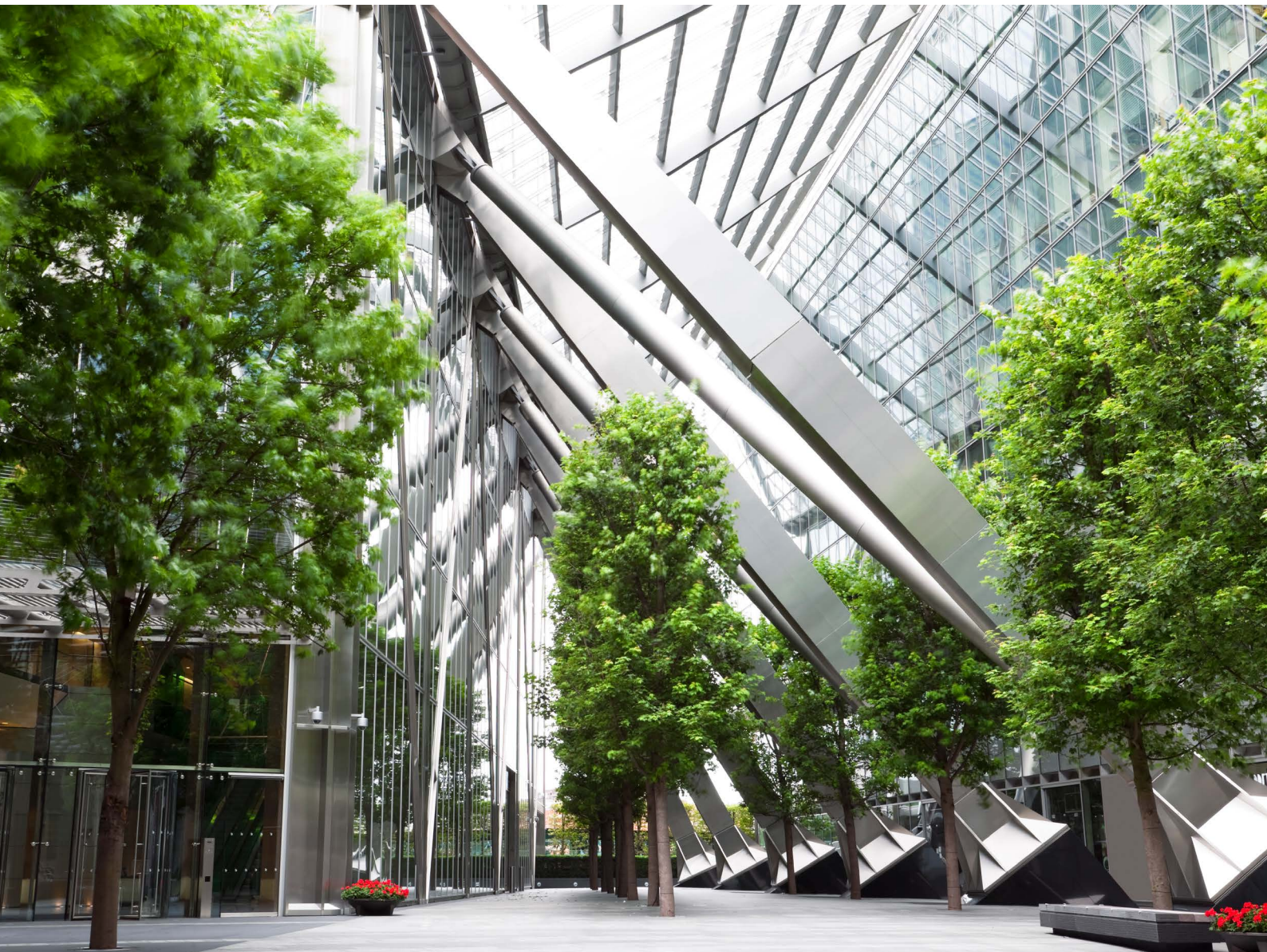
JLL

Life Sciences Sustainability Series

Achieving Environmental Sustainability

October 2022



Contents

Achieving sustainability in life sciences real estate is feasible if appropriate targets are set and a proactive approach is taken by both occupiers and owners.

Source: JLL

Solutions to achieving sustainability

In our last report, Embracing Sustainability[1] , we emphasised the challenges around high resource use in the life science industry. However, we also found that the benefits of embracing sustainability demonstrably outweigh the problems. Businesses that make moves early will see future success and stability, and many companies including JLL[2] are already taking clear steps to achieving environmental sustainability by setting net zero or Science-Based Targets (SBT)[3].

In this report we outline ways in which life science occupiers, developers, and landowners can begin to mitigate the climate impact of their assets by measuring and setting appropriate targets, reducing their operational and embodied carbon, curbing their waste and water usage, and preparing and managing for a sustainable future. We also outline the impact that these changes and a wider embracing of environmental sustainability can have on the value of real estate. Some life science companies, such as those in Digital Health and Pharmatech, only occupy offices and face different and well-documented challenges. This report primarily focuses on laboratory (lab) buildings.

> *"One of the biggest obstacles facing the industry is around a global standardised definition and benchmark of net zero carbon including both operation and embodied carbon."*
>
> **Ali Ingram**, Head of Sustainability, International Capital Markets, EMEA, JLL

Measuring, monitoring, and setting appropriate targets

Measuring and monitoring

Benchmarks are a vital first step in the sustainability journey. Occupiers, investors, developers, operators and landlords cannot target net zero without being able to measure incremental improvements in the asset's carbon footprint or to identify the interventions needed to meet targets in areas such as energy efficiency. At present, this entails identifying the source of CO_2 emissions which can be controlled and reduced. Existing action plans such as the World Economic Forum Green Building Principles[4] provide indispensable, clear roadmaps and achievable targets.

Several tools already exist to assess existing assets and manage portfolios, but as many do not yet have a separate life sciences (lab) category. The performance of a given building needs to be measured against its own baseline, rather than other assets. This will change as tools such as the Carbon Risk Real Estate Monitor (CRREM), widely used in Europe to monitor energy efficiency and help understand risk in investments to avoid 'stranding'[5] , become standard.

[1] JLL, https://www.jll.co.uk/en/trends-and-insights/research/embracing-sustainability-in-life-sciences

[2] JLL, https://www.jll.co.uk/content/dam/jll-com/documents/pdf/research/jll-research-sustainability-transition-to-net-zero.pdf

[3] Science Based Targets, https://sciencebasedtargets.org

[4] WEF Green Building Principles, https://www3.weforum.org/docs/WEF_Green_Building_Principles_2021.pdf

[5] CRREM, https://www.crrem.eu/about-crrem/

Targets

Once systems for measurement and monitoring emissions are in place, sustainable, measurable and scalable targets that are relevant to occupiers, investors/developers, or owners can be set. Investors such as Alexandria Real Estate (ARE), British Land, AXA, and Landsec, and occupiers such as AstraZeneca, GSK, Sanofi, Novo Nordisk, and Takeda have all joined the Science Based Targets Initiative (SBTi) which provides companies with a pathway to reduce carbon emissions in line with the Paris Agreement goals[6]. Other businesses, governments and intergovernmental organisations have adopted net zero as their target.

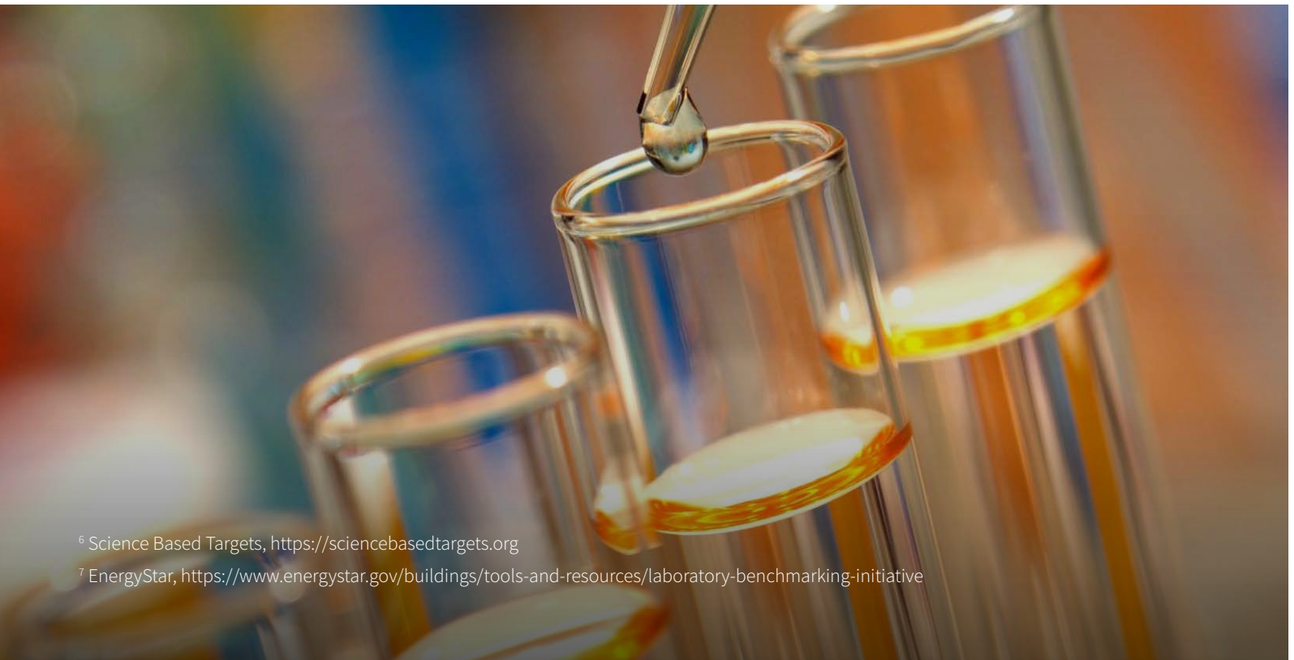
For water usage and waste output, there are no industry standard targets for life science assets, but the benchmarks for offices may be used as a proxy in the interim.

Certifications

Achieving or aiming for a certification is one route to future proofing an asset. However, as sustainability has only recently become a prominent issue to address in life sciences, there is no sector-specific certification in EMEA at the moment; indeed, the only such example internationally is Energy Star in the USA and Canada[7]. Nevertheless, several green certifications in the wider real estate industry, such as Building Research Establishment Environmental Assessment Method (BREEAM) and Leadership in Energy and Environmental Design (LEED), offer appropriate interim pathways.

Once targets are set or certifications pursued, measuring and monitoring must continue, so that the roadmap can be adapted and business operations can change.

> *"Given the many national sustainability targets and promising solutions now in place to address environmental sustainability, it is time for all players in the life science value chain to embrace environmental sustainability in their portfolios – future proofing their assets"*
>
> **Chris Walters**, Head of UK Life Sciences, JLL



[6] Science Based Targets, https://sciencebasedtargets.org

[7] EnergyStar, https://www.energystar.gov/buildings/tools-and-resources/laboratory-benchmarking-initiative

Solutions for life sciences

Once benchmarks have been established and targets set, life science occupiers, developers, and landowners can consider the most effective ways of mitigating the environmental impact of their assets. Whilst there are many possible routes, this report will focus on decarbonisation, waste and water usage, circular economy, and partnerships.

Climate impact	Investors/Developers/Landlords	Occupiers
Operational carbon	• More stringent management practices • Automated lighting and fume hood systems • Building features e.g. sun-shading, heat pumps • More efficient HVAC systems • Renewable energy generation • Carbon sequestration activities	• Monitor supply chain • Educate staff to reduce energy
Embodied carbon	• Computational models to optimise build efficiency • Alternative construction materials • Flexible and adaptive buildings for legislative or occupier changes	• Plan growth and fit-out changes to minimise impact
Water usage	• Efficient maintenance, management, and repairs • Automating water usage, monitoring and control	• Training and due diligence to change employee habits
Circular economy	• Provide shared equipment • Ensure effective infrastructure in place to manage waste	• Reduce single-use plastics • Use compostable materials • Sterilise and recycle where possible

Decarbonisation

Operational carbon

A distinction must be made between operational and embodied CO_2 emissions. As the name suggests, the former refers to the amount of CO_2 produced through the day-to-day operations of the asset, which can be reduced by increasing energy efficiency or reducing energy consumption.

Lab operations are often energy-intensive, requiring 550-1,000 kWh/m2/y compared with 175-300 kWh/m2/y for a typical office. The Royal Institute of British Architects (RIBA)'s 2030 challenge for lab buildings sets a goal of 147 kWh/m2/y[8]. Getting operational carbon to this level or below would be a significant step, but would still be double the target for new build grade A offices of 55-70 kWh/m2/y. It would also require drastic operational changes, underlining the importance of setting goals as a highly cost effective first step.

There are multiple routes to operational decarbonisation which many businesses are now focusing on given the increasing number of net zero commitments. A further consideration is whether the occupier or landlord is responsible for the required changes. This will vary dependent on the lease and the type of fit-out – a topic we will discuss later in the report.

Simply reducing carbon emissions – i.e. lowering energy usage – is unlikely to curb operational carbon completely. A combination is likely needed with offsetting ("negation") methods and/or methods to remove carbon from the atmosphere – i.e. reversion of historic CO_2 emissions.

[8] Pathway to Net zero Carbon Labs, https://www.hok.com/ideas/publications/pathway-to-net-zero-carbon-labs/

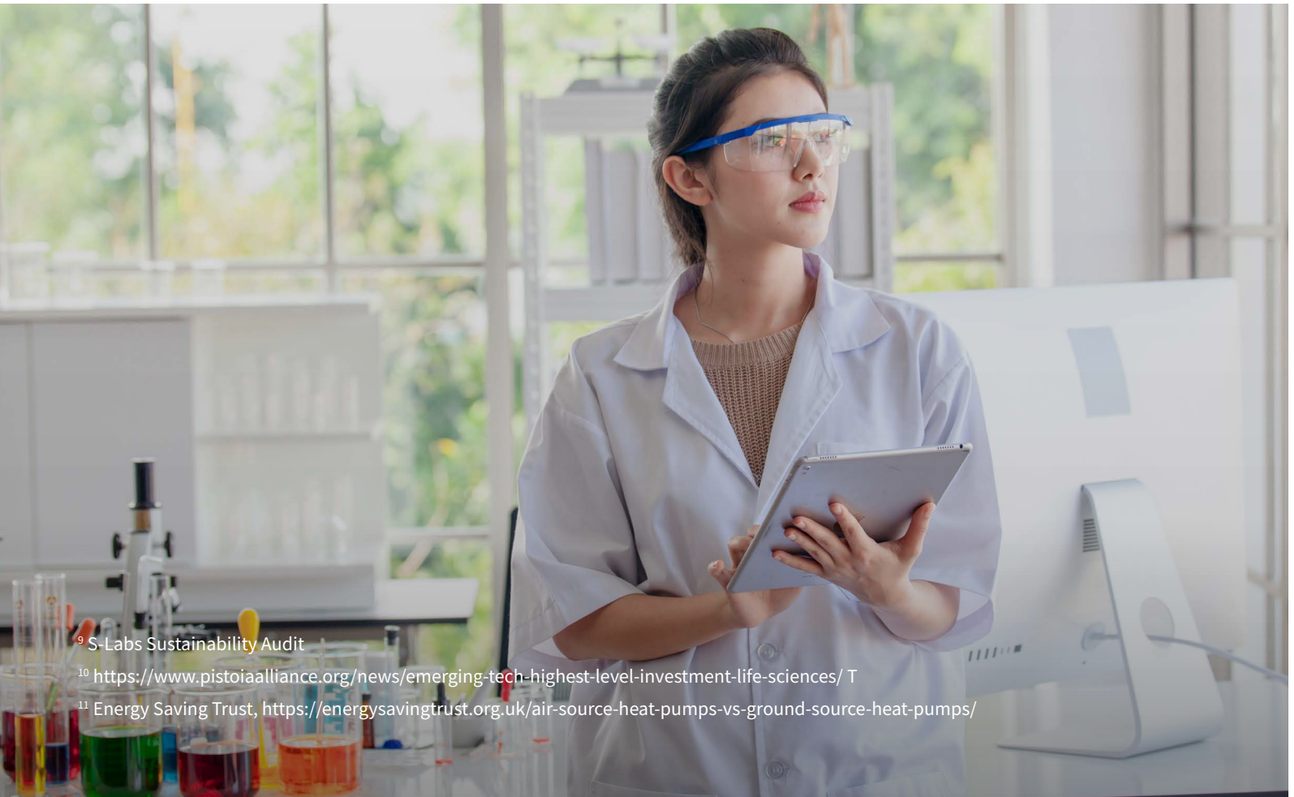
Decarbonisation

For operators/landlords

One of the easiest and most obvious ways of reducing operational carbon as an owner is through more stringent management practices. Up to 60% of energy use in chemistry labs and 45% in biology labs is related to ventilation[9], and so small changes such as ensuring HVAC (heating, ventilation, air conditioning) systems are turned off at night when the building is unused, can be instrumental.

These savings can be enhanced through automation, for example automatic lighting systems which turn off when areas are empty, or sensors that provide real time energy data that can automatically regulate operation. Similar sensors can be used on fume hoods or fridges to understand usage patterns. In fact, a survey by Lab of the Future found 72% of respondents believe labs will be 50% virtual by 2030[10] – and part of this can help on the road to sustainability.

A second route is through sustainable building features. Owners can reduce the strain on cooling systems by installing triple glazed windows or vertical sun-shading and on heating systems by providing winter gardens that store heat naturally. US life sciences specialist developer ARE's approach to several of their new lab buildings in Boston has embraced these solutions. Heating systems can be made more sustainable through using air or ground source heat pumps, with the benefits dependent on location and time of year in operation, as well as installation costs[11].



[9] S-Labs Sustainability Audit

[10] https://www.pistoiaalliance.org/news/emerging-tech-highest-level-investment-life-sciences/ T

[11] Energy Saving Trust, https://energysavingtrust.org.uk/air-source-heat-pumps-vs-ground-source-heat-pumps/

Finally, other items of equipment can be replaced with more efficient versions. Most of the responsibility will fall on the landlord here but this will vary by fit-out. If a shell and core or lab-enabled space is provided, this will mainly relate to the HVAC and Mechanical Engineering and Plumbing (MEP). If a fully fitted specification is provided, a review of the equipment and its energy usage by the operator/landlord will be needed, particularly in multi-let or incubator facilities with a lot of shared equipment.

There are two approaches to negating or reversing operational carbon emissions. Owners can pivot to energy produced from renewable resources such as through photovoltaics, wind turbines, or in some cases geothermal; or they can invest in activities such as tree planting or algae farms which extract CO_2 from the atmosphere. On the science parks where many life science occupiers are based, there are opportunities to do this at scale, installing solar farms to create a green alternative to grid power and planting trees to provide green space for health, well-being, biodiversity, and carbon capture.

For occupiers

Solutions for the occupier similarly centre around good management practices, using energy-efficient equipment, and monitoring their products' supply chain to reduce and negate their operational emissions, but there are some occupier-specific solutions as well.

Much can be done through educating workforces in behaviours that promote sustainability – such as turning lights or equipment off when not needed – while adapting work schedules to optimise operational efficiency. Nottingham University significantly reduced operational emissions at the Carbon Neutral Laboratory by ensuring staff and students only used it during certain hours.

For tenant-driven fit-out space, choosing energy-efficient equipment with automated features will mitigate climate impact while helping to drive further investment in such technologies.

Overall, strategies on both sides are likely to feature a combination of the measures outlined above. Where feasible gains can be made in the short term is focusing these physical changes on already low energy labs such as teaching or dry labs that are less time intensive to adapt to sustainable changes, as well as encouraging sustainable research behavioural practices.

Embodied carbon

Embodied carbon refers to the emissions produced through the lifecycle of the building fabric: the extraction of raw materials, the manufacture of components, their transport to site, the subsequent fit-out, maintenance and refurbishment, and finally the disposal of the building[12], all of which can be assessed through the Whole-Life Approach. Embodied carbon is higher for new builds, leading to a preference for retrofitting existing buildings over demolition and rebuilding. As 80% of buildings that will exist in 2050 are already built, this also means many buildings will need to be retrofitted to low carbon standards. It is estimated that most current buildings have an embodied carbon of between 600-1,400 KgCO_2e/sqm, with the best-in-class Carbon Neutral Laboratory (see below) using <200 KgCO_2e/sqm. The London Energy Transformation Initiative (LETI) has set embodied carbon goals for labs at 315 KgCO_2e/sqm[13], which is more realistic.

For developers/landlords

Embodied carbon can be reduced by using computational models to optimise the size of a building, eliminating excess materials and/or ensuring sustainable sourcing. 3D 'digital twins of buildings' can be created, together with models of supply chains, allowing efficiency gains and opportunities to reduce embodied carbon to be identified prior to any physical construction[14].

Alternative construction materials, such as sustainably-sourced wood rather than carbon-intensive steel or concrete, are gaining ground; this could reduce embodied carbon by up to 90%[15]. Architects BDP have proposed timber for lab construction at Norwich Research Park[16], while The Carbon Neutral Laboratory's frame, walls and floors were designed by Fairhursts Design Group using vibration-resistant cross laminated timber[17]. The latter had an embodied carbon of <200 kgCO_2 e/sqm, compared to the 650 kgCO_2e/sqm[18] typical for most new labs today. Even where floor loading means fully timber solutions are not viable, a hybrid of materials can reduce embodied carbon considerably.

A final route for developers to reduce embodied carbon links back to the planning and design stage. Ensuring buildings can be adapted as legislative requirements change will preclude the need for deep retrofits and reduce future increases in embodied carbon. This is especially relevant to labs with high turnover of tenants – for example, in incubator facilities there is a consistent churn of companies, so investors, operators, or developers that design for flexibility will reduce the building's lifecycle embodied carbon.

[12] JLL, https://www.us.jll.com/en/trends-and-insights/research/2021-global-proptech-report/sustainable-buildings-and-places

[13] LETI Whole Life Carbon Primer, https://www.leti.london/_files/ugd/252d09_c4aa3410d7614e8d8b524e87b1b8fd2a.pdf

[14] JLL, https://www.us.jll.com/en/trends-and-insights/research/2021-global-proptech-report/sustainable-buildings-and-places

[15] Pathway to Net Zero Carbon Labs, https://www.hok.com/ideas/publications/pathway-to-net-zero-carbon-labs/

[16] BDP, https://www.bdp.com/en/projects/research/net-zero-lab/

[17] https://www.nottingham.ac.uk/chemistry/research/centre-for-sustainable-chemistry/the-carbon-neutral-laboratory.aspx

[18] LETI Embodied Carbon Primer, https://www.leti.uk/_files/ugd/252d09_8ceffcbcafdb43cf8a19ab9af5073b92.pdf

For occupiers

The responsibility for reducing embodied carbon will fall on the party providing the lab fit-out. In this sector this can be borne by the landlord/investor or the occupier dependent on the location, asset, and targeted end user. Open communication between occupier and landlord is therefore key – a topic further discussed below.

More generally, occupiers need to plan for growth, anticipate their space requirements and ensure the fit-out is adaptable, avoiding unnecessary carbon-intensive refurbishments.

Case study: The Carbon Neutral Laboratory[19,20]

The Carbon Neutral Laboratory

- Despite energy usage in most labs being high compared to offices, there are labs that are achieving net zero carbon targets by adopting many of the operational approaches above – a prime example is The Carbon Neutral Laboratory for Sustainable Chemistry at the University of Nottingham, designed by Fairhursts Design Group.
- The 48,000 sq ft, £15.8m project, opened in February 2017 and was backed by a £12m fund from GSK. The idea was to develop a proof-of-concept design that could feasibly be used to ensure future labs could be carbon neutral by 2050.
- The two-floor building contains lab space for up to 120 FTE researchers, instrument rooms, a teaching lab, and space for a range of outreach activities.
- The labs use 37% of the benchmark energy consumption for chemistry labs by generating renewable energy on site through photovoltaic panels on the roof and through an innovative design to utilise natural ventilation systems that cool and provide air handling. Excess energy created by the building and sold back to the grid provides enough carbon credits over 25 years to pay back the carbon used in its construction.
- Training of students and staff was needed to change lab usage behaviour to ensure labs were only used during certain hours. Chemicals at the facility are held in special storage units, meaning individual labs can shut down operations at night, leading to substantial energy reductions in ventilation and cooling requirements.
- Ventilated cabinets were also installed to allow users to carry out work that couldn't be done on an open bench but didn't need a full fume cupboard – limiting fume cupboard use to absolute necessity.
- Overall, the building was built on passive house principles, with airtight walls and installation, a winter garden to generate heat, and constructed mostly of sustainable cross laminated timber, which is vibration proof. This has resulted in a 70% reduction in the embodied carbon, with < 200 $kgCO_2$ e/m2.
- BREEAM calculations suggest that the building's water consumption is 5.47 cu m per person annually, a 63% improvement in water efficiency from standard labs.

> *"For us the success of this building will not only be measured by consumption, but by how over time it will influence people to think about how they can lessen their own impact on our environment."*
>
> **Mark Adey**, Managing Director, Fairhursts Design Group

[19] University of Nottingham, https://tinyurl.com/yc2h6w6n

[20] Fairhursts Design Group, http://fairhursts.com/project/the-glaxosmithkline-centre-for-sustainable-chemistry/

Image Source: Martine Hamilton Knight, Fairhursts Design Group

Water usage

Although carbon tends to take priority when addressing environmental sustainability, water usage also plays a key role, with labs using up to four times more water than offices[21]. There is no standard target in the industry for water usage, but The Carbon Neutral Laboratory uses c. 5.5 cu m per person per year, which is lower than the good practice for office water usage by the BBP of 8 cu m per person per year[22]. As such, a benchmarking water usage should be a priority for occupiers, operators, and landlords, before any solutions are put in place. This will often include cooling and heating systems, which consume a lot of water, as well as taps.

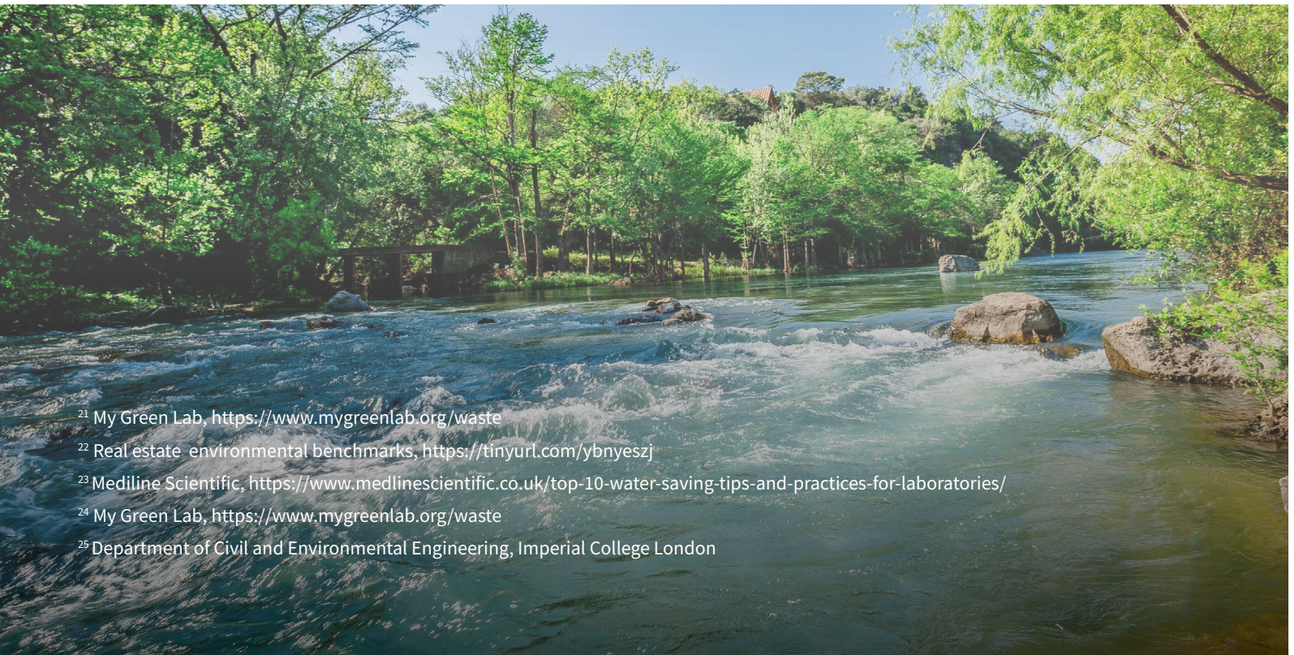
For occupiers

There are some simple yet effective approaches for occupiers to reduce water consumption. Training and due diligence to change employee habits is perhaps the most obvious. For example, ensuring glasswashers are fully and efficiently loaded, using the correct water (distilled or deionised water for relevant procedures), and turning off taps when not in use all reduce excess water usage[23]. As a second step, occupiers should focus on equipment changes. For water cooling, these include using closed loop systems that recirculate water or alternatives to water baths such as beads. For water reduction, the use of steam-jacketed autoclaves, low-flow aerators, vacuum aspirators[24], and waterless condensers[25], can all save on water usage.

For operaters/landlords

For landlords and operators, ensuring all leaks are fixed quickly and installing more efficient equipment or automated systems that reduce excess water usage will help. Alternatively, the source of water can be made more sustainable with on-site rainwater harvesting.

Overall, there are numerous approaches to water efficiency and as with operational carbon, incorporating as many as possible will improve both operational efficiency and environmental sustainability.



[21] My Green Lab, https://www.mygreenlab.org/waste

[22] Real estate environmental benchmarks, https://tinyurl.com/ybnyeszj

[23] Mediline Scientific, https://www.medlinescientific.co.uk/top-10-water-saving-tips-and-practices-for-laboratories/

[24] My Green Lab, https://www.mygreenlab.org/waste

[25] Department of Civil and Environmental Engineering, Imperial College London

Circular economy

The circular economy refers to the concept of keeping all materials and products in use, recycling all waste, and investing in regenerating natural systems. For life sciences this translates to a focus on the management practices around waste disposal and recycling.

For occupiers

One of the most significant lab waste products is plastic from single-use items such as pipette tips. My Green Lab estimates that US labs produce enough to cover approximately 138,000 ha each year, equivalent to 193 football pitches. Most of this waste can be recycled and reused if properly sterilised. A more efficient approach, however, is eliminating the use of these products from the outset. A research lab in the US managed to reduce its non-chemical waste by more than 95% through compostable alternatives and its consumption of single-use plastics by 69% by using glassware, saving $16,000 in the process[26]. Training employees and automating lab work – including running virtual simulations rather than physical experiments – can help reduce excess waste.

Another method is using shared resources. At early stages, life science companies often share the cost of equipment such as mass spectrometers or high throughput sequencers given the expense. Wider shared use of equipment beyond that which is expensive can instil more sustainable practices, reducing waste potential. The disposal of chemical and biomedical waste can be more challenging but there are still methods which reduce, substitute or neutralise hazardous effects before potentially recycling. A study by Pfiedler – a healthcare training company – found almost 23% of surgical waste could be recycled if sterilised[27].

For operaters/landlords

For operators and landlords, the infrastructure for handling this waste and avoiding leakage or pollution into natural systems is essential. Optimising construction through computational models can help reduce both embodied and operational carbon. For example, selecting the right building materials can reduce waste at the end of the building lifecycle. Investors/developers that provide space in multi-occupancy facilities can rent out shared equipment to generate additional income while also promoting sustainable usage.

[26] https://www.nature.com/articles/d41586-022-02092-1

[27] https://www.medprodisposal.com/blog/does-medical-waste-get-recycled/

Case study: 325 Binney Street[28]

325 Binney Street

- Another example of a laboratory building aiming to address many of the solutions mentioned in this report is the 325 Binney Street development by Alexandria Real Estate, a 375,100 sq ft development project at One Kendall Square mega campus, selected by Moderna for its new HQ and R&D operations.
- Due for completion in 2023, the building's high-performance design is expected to eliminate most of the operational carbon for building heating with a major geothermal heating source as well as solar photovoltaics, exhaust source heat pumps and fan coil units to heat/cool zones and filter air locally.
- The building will also have a large skylight to increase daylight usage over lighting and a high-performance façade with triple glazing to reduce pressure on temperature systems.
- To reduce embodied carbon, they are using an improved concrete mix, which will also improve thermal bridging and help reduce operational carbon.
- To reduce water usage, there will be multiple storm water capturing stations.
- It is LEED Gold and Fitwel certified.
- Overall, the development is expected to achieve a 50% reduction in energy consumption and an 80% reduction in fossil fuel usage compared to their other developments.

[28] Alexandria Real Estate: https://www.325binneystreet.com

Image Source: Alexandria Real Estate, coUrbanize

Landlord and occupier engagement

A common thread running through all these measures is the need for a change in behaviour to ensure the asset continues to operate in the most sustainable way. Open communication, collaboration, and engagement, as well as training at every step are key.

It is also important to ensure both landlords and tenants share responsibility and accountability for achieving sustainable targets. One way to encourage this partnership is through green or ‘responsible’ leases, particularly responsibilities and obligations regarding the building’s environmental impact to each party.

> *“Responsible leasing can unlock both short and long-term benefits for occupiers and owners, creating a framework for collaboration that can drive sustainable value creation and help both parties achieve mutual goals.”*
>
> **Quentin Drewell**, Director, Sustainability Consulting, JLL

Capital markets, green financing, and the impact on value of ESG

Capital markets and green financing

For investors

A key point to consider before investing in a life science asset is that as a result of ESG, the acquisition process is changing. For real estate investors in Europe, this largely means adhering to mandatory disclosures and regulations such as the EU Taxonomy and SFDR. The EU Taxonomy is a classification system, establishing a list of environmentally sustainable economic activities, to fundamentally define what is 'sustainable'[29]. Investors will therefore need to consider any acquisitions or assets in their portfolio in relation to the EU Taxonomy.

A second consideration is climate risk, which assesses the physical risk of an asset in the context of likely environmental change, i.e. rising sea levels or increased weather phenomena. Alexandria Real Estate is one of the leading investor/developers in the life science real estate sector addressing climate risk in their portfolio, with several new developments built with risk from flooding or extreme weather in mind.

From a financing perspective, with the increasing reliance on ESG credentials becoming an integral part of the real estate investment landscape, access to green financing in the life sciences sector can aid in accelerating decarbonisation in the asset class. Unfortunately, as the life sciences industry is still in its infancy as an asset class, with historical hurdles to achieving environmental sustainability, there is no 'one size fits all' approach to green financing. It is still too early to say whether demonstrating certain 'green' credentials would be beneficial to the asset; however, for lenders it is has become the standard to at least show intent to gain ESG credentials when applying for financing.

Despite this, there is also no consolidated view on which credentials to demonstrate or which certification to use. Some recent life science investments and developments have included BREEAM credentials to meet the ESG criteria for some lenders, but this is by no means the standard. In terms of specific financing, 'green bonds' can offer more liquidity than 'green loans' but much of the marketing of these bonds is to meet ESG credentials for a specific project or lender rather than a consensus approach. Overall, there is a clear need for consensus in certification standard to ensure effective and sustainable investments in life sciences can be made.

[29] EU Taxonomy, https://tinyurl.com/5xwprtm2

Impact on value

Sustainability factors are becoming increasingly important in real estate investment and are beginning to affect pricing. Pressures from occupiers, landlords, lenders, and legislators will increasingly lead to significant “brown discounts” for underperforming buildings.

For occupiers

Value drivers from an occupier perspective are threefold. Firstly, the high energy intensity of life science buildings coupled with rising energy prices means that utility bills for occupiers can be significantly higher than other real estate users. Therefore, occupying energy-efficient lab space is particularly attractive as the reduction in operating costs will have a much more significant impact on businesses’ bottom lines.

Secondly staff increasingly express a desire to work for sustainable and purpose-driven businesses. Attracting and retaining talent is a major priority for life science occupiers and occupying best-in-class sustainable buildings can be a key differentiator. Finally, life science companies are setting Science-Based Targets which require them to reduce energy use over coming years in line with the Paris Agreement. Real estate decisions will have a major impact on occupiers’ ability to achieve these goals. Rental levels and leasing velocity for speculative developments are likely to be increasingly impacted by a building’s sustainability credentials.

For operators/landlords

JLL has witnessed a substantial increase in investor due diligence related to sustainable features of buildings over the past 12-18 months. Certification, energy intensity, wellbeing features and social impacts are all under increasing scrutiny. Liquidity and yields appear to have been impacted in some sectors as a result. Additionally, preferential margins on green loans as well as stronger rental and lower void prospects have the potential to produce superior returns. Evidence is emerging slowly and the timing and scale of impact on life sciences investments are unclear. However, the direction of travel in other sectors is clearer and it is only a matter of time before the impact of sustainability on value is apparent in life sciences real estate.

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About JLL Life Sciences

JLL Life Sciences provides specialist advice to real estate owners, occupiers, investors and developers in the science sector. The dedicated team utilises a deep industry knowledge and extensive experience to provide clients with the best possible advice in connection with acquiring, developing or disposing of sites, creating portfolio strategy, connecting with occupiers or finding the optimal space to locate. For further information, visit **https://www.jll.co.uk/en/industries/life-sciences**.