Loughborough University

Energy Strategy 2020-2050

July 2020
Version: Final

Contents

Note: COVID-19 is having a significant impact on the University's finances and will impact on capital project delivery. The intention is to reprioritise this programme when the full impact of the crisis is known.

Executive Summary

The purpose of this Energy Strategy is to set out a development framework covering a thirty year period from 2020-2050 to provide a sustainable energy future for the University.

This strategy supports delivery of the University's 'Building Excellence' Strategy and the Estates Strategy and has been developed with academic colleagues from the School of Architecture, Building and Civil Engineering (ABCE), the Centre for Renewable Energy Systems Technology (CREST) and the Climate and Environment Task Group (CETG).

Estates Management Committee (EMC) is the owner of the strategy and the Director of Estates and Facilities Management is accountable for its future development and operational delivery. As with the Estates Strategy, it is important to stress that this strategy is not a policy commitment endorsed by the University Council and EMC.

Student choice is increasingly influenced by climate and environmental issues. There is a body of evidence that student's are choosing their university based on its values and approach to carbon, fossil fuels and renewables. Loughborough might usefully project a progressive, environmentally conscious image enabled by this Energy Strategy.

The strategy covers both the Loughborough and London Campuses, but the majority of opportunities relate to the impact of the Loughborough Campus. It aims to set out the University's existing energy supply and consumption position and provide options for the future that balances the requirement of achieving net zero greenhouse gas emissions by 2050, whilst supporting the operational demands and financial sustainability of the Estate. Key Objectives are to:

- Support the delivery of the Estates Strategy 2020-2040.
- Align with the Government target of achieving net zero greenhouse gas emissions by 2050.
- Safeguard the University against escalating energy costs.
- Provide resilience and support business continuity.
- Support business development opportunities.

Energy Strategy Vision

A modern, integrated, clean energy system, delivering reliable energy supplies at an affordable price and meeting sustainability and net zero greenhouse gas emissions targets.

Estate Strategy 2020-2040

The Estate Strategy sets out a high-level capital plan road map covering the period from 2020 to 2040 focusing on providing the appropriate physical infrastructure to meet the University's "Building Excellence" strategy.

The strategy offers opportunities through new build projects, redevelopment projects, infrastructure development requirements and building demolitions to positively impact on the University's energy and carbon reduction aspirations.

The relationship between key initiatives in the Estates and Energy Strategies is set out in the high-level roadmap (See Appendix A). This will be updated as necessary to reflect the University's Capital Framework.

Strategic Objectives

Without an endorsed Energy Strategy the university will not be able to achieve net zero greenhouse gas emissions status by 2050. It should also be stressed that the University cannot achieve net zero status in isolation as it will be dependent on decarbonising of the national fuel supply to do this. The strategy should aim to identify what levels of de-carbonisation the University will need to deliver through local action to meet the 2050 target. This means that the Energy Strategy should position the University to capitalise on government, industry and regional de-carbonisation initiatives.

Significant risk to the University's ability to meet the net zero greenhouse emissions is old building stock and inability to spend on the scale needed to replace inefficient building's and infrastructure. This means that the University should be realistic in setting the scale of ambition. **Successful delivery of the strategy should facilitate: reduced energy costs, secure energy supply, reduced price volatility and reduced greenhouse gas emissions.**

Energy Use and Procurement

The University is a major user of energy consuming 100,000 MWh of gas and 28,000 MWh of electricity on an annual basis at a cost approaching £10m per annum. There is no significant on-site renewable energy generation, although 35% of the current electricity demand is produced by the on-site Combined Heat and Power (CHP) units.

The future energy requirements up to 2030 have been forecast to be 90,000 MWh, with electricity accounting for 34,000 MWh and gas 56,000 MWh respectively.

The energy supply market has historically been a volatile trading environment and the University will continue to work with appointed energy brokers and the LU procurement team to develop utility procurement strategies in a timely manner to ensure contracts can be secured at optimum rates to protect the University against escalating energy costs.

Even relatively modest reductions in energy use would generate substantial savings over the next 30 years, whilst also mitigating the impact of expected increases in future energy prices.

The costs of delivering this strategy are more difficult to quantify, as delivery is predominantly about integrating features throughout all areas of University business, rather than undertaking a series of separate activities. Where costs and benefits can be identified, they will be captured within other sub-strategies and plans and summarised in future versions of the strategy and supporting delivery plan.

Planning Horizons

The Energy Strategy addresses the future energy requirements across three time horizons: near-term (2020-2024), mid-term (2025-2030) and long-term (2030-2050). In the near-term the development needs of LUSEP phases 3 and 4 will need to be considered as well as the identification of options to replace the CHP's.

Net Zero Greenhouse Gas Emissions by 2050

The University's long-term ambition is to meet Government targets of achieving net zero greenhouse gas emissions by 2050, with significant progress by 2040. There are multiple benefits to achieving this target of net zero greenhouse gas emissions:

- Environmental.
- Financial.
- Comfort and Wellbeing.
- Reputational.

The University has adopted the UK Green Building Council's (UKGBC) Definition of zero carbon which sets out a five-stage hierarchy for achieving "net zero" carbon emissions: fabric efficiency, energy efficiency, on-site renewable, off-site renewables and offsets.

In 2018/19 the University emitted 25,384 tonnes of carbon; 18,280 (72%) from gas consumption and 7,104 (28%) from grid electricity consumption. The emissions associated with electricity consumption have seen a steady decline with the on-going decarbonisation of the National Grid and the increasing use of clean alternative energy sources.

With the decarbonisation of the National Grid the carbon benefits associated with the operation of the CHP's have demised over the years as electricity carbon emission factors approach parity with the gas carbon emission factors, as such CHP technology can no longer be considered a "low carbon" technology.

Leadership, Behaviours and Culture

Embedding an energy aware culture and a mindset of 'best for Loughborough' through the promotion of enhanced behaviours and culture will be vital. Communication will form a critical part of delivery of the strategy with behavioural change required at all levels within the organisation to achieve the reduction in the emissions target. Senior level support will need to be visible and embedded with clear targeted actions provided to enable implementation.

Academic Partnerships

Relationships with academic partners will be developed to utilise their expertise to inform and build on the energy strategy principles, as well as seeking to grow research expertise opportunities and valuable PhD student experience.

The University estate and infrastructure will be used to develop a "living laboratory" to implement and assess low carbon technology solutions and demonstrate the University's world class expertise in energy and the built environment.

High Level Roadmap -Capital Plan

This strategy must be enabled by a programme of energy projects that form part of the University's capital framework. The strategic programme could be based on a few major projects that would make the most impact in delivering the performance improvement needed to deliver the Energy strategy vision. The University will not have the capital to replace the current building stock within the next 30 years and so the main focus and drive will be to increase the use of clean energy sources, both on and off campus through a decarbonised National Grid.

Stage One: Decommission the gas fired CHP's by 2030 and identify alternative sources of clean energy - including the purchase of additional electricity from the grid.

Stage Two: Installation of a large PV array and battery storage on the campus land to deliver the University's base-load requirements. Successful delivery would make a significant contribution to meeting the 2050 net zero greenhouse gas emissions target.

Stage Three. Use low carbon energy from the National Grid to contribute to the target.

Smaller projects detailed in the schematic on page 05 and 'Living Laboratory' initiatives will be evaluated and developed when 'proven'.

High Level Roadmap

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1.0 Introduction

1.1 Aims

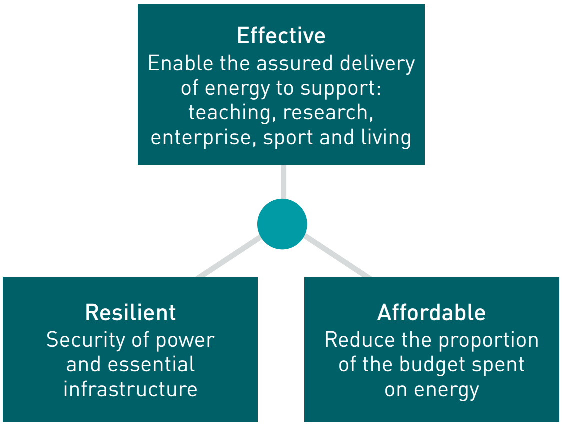
- Supports the delivery of the Estates Strategy 2020-2040.
- Aligns with the Government target of achieving "net zero" greenhouse gas emissions by 2050.
- Safeguards the University against escalating energy costs.
- Provides resilience and support business continuity.
- Supports business development opportunities.

1.2 Performance Ambition

ABCE Subject Matter Experts (SME's) advise that setting an energy target is unlikely to succeed, what is required is a performance standard.

The Energy Strategy performance ambition requires the University to balance three competing priorities: effectiveness, affordability and resilience. The University must define the quantifiable targets that it wishes to achieve in each of these in-tension performance dimensions. This would typically be summarised in a high-level statement and then be broken down into supporting detail.

The three components of the energy performance ambition are set out below:



Effective
Enable the assured delivery of energy to support: teaching, research, enterprise, sport and living

Resilient
Security of power and essential infrastructure

Affordable
Reduce the proportion of the budget spent on energy

Effectiveness Comprises:

- Meeting the energy needs of students, staff, tenants and visitors now and in the future.
- Complying with, or exceeding legislative and environmental standards.
- Meeting, or exceeding carbon reduction targets.

Affordability Comprises:

- Adherence to energy budgets and recognising the true life cycle cost of energy delivery and consumption.
- Driving efficiency by optimising output from current and future assets and resources.

Resilience Comprises:

- Risk taken against the security of power and essential infrastructure to sustain business continuity assets whilst enabling an environmentally compliant and sustainable estate and maintaining a trajectory to achieve "net zero" greenhouse gas emissions by 2050.

1.3 Assumptions

- COVID -19 is having a significant impact on the University's finances and will impact on capital project delivery. The intention is to reprioritise the programme when the full impact of the crisis is known;
- The energy budget will remain a significant element within the University budget;
- The unit energy costs for gas and electricity will continue to increase;
- The non-commodity costs associated with electricity supply will continue to increase;
- The capacity of the existing four main High Voltage networks are limited to the existing Authorised Supply Capacity Agreements. with Wester Power Distribution (WPD) who manage the electrical distribution network throughout the East Midlands. The de-carbonisation of the National Grid will continue in line with government targets;
- The target is net zero greenhouse gas emissions by 2050, with significant progress by 2040;
- Gas is high in carbon and government will gradually curb gas-heating in buildings;
- By 2030 it is forecast that gas consumption will account for 79% of the total University emissions, there must be a shift away from gas heating if the net zero greenhouse gas emissions target is to be met;
- Local generation and storage of power could make a significant contribution to reducing University energy costs;
- In the mid-term PV arrays and battery storage facilities and ground source heat pumps could meet base load requirements;
- Major projects will contribute to the realisation of the University's net zero greenhouse gas emissions;
- New build and refurbishment projects will offer opportunities to optimise energy performance;
- The CHP plants will be de-commissioned at the end of their economic life;
- Life cycle costing models will be developed to assess mid to long-term benefits and implementation priorities for energy related projects;
- Internal and external funding opportunities will be assessed to support the implementation of low-carbon technology;
- Energy performance data and Building Management System (BMS) data will be utilised to support academic research to develop smart building controls;
- There will be increased engagement with staff and students to increase the level of energy awareness and information dissemination;
- Hybrid/zero emission vehicles will have replaced most petrol/diesel vehicles by 2030 – a sufficient charging infrastructure will be required.

1.4 Principles

Energy Procurement

- The University Energy, Procurement and Finance teams will work with the appointed energy brokers to develop utility procurement strategies in a timely manner to ensure contracts can be secured at optimum rates.
- The University will adopt a low risk strategy towards future energy procurement strategies.

Building Standards

- The Building Research Establishment Environmental Assessment Method (BREEAM) 'excellent standard' should be applied to all new-build projects and the 'very good standard' to all refurbishment projects.
- Where possible Passivhaus, EnerPHIT to be the standard for new build and refurbishment projects.
- The University of Oxford Sustainability Design Guide will be used as the base guide for future new build and refurbishment projects.

Life Cycle Costs

- Life cycle cost assessments will be included as part of the project approval process in order to understand the full costs of a building across its life cycle, particularly the use of energy.
- The requirement for life cycle cost assessment will form part of the project design brief.

Net Zero Greenhouse Gas Emissions

- The University will adopt the UK Green Building Council's (UKGBC) hierarchy and definitions for net zero carbon building, covering net zero carbon - construction and net zero carbon – operational energy.
- With the on-going de-carbonisation of the National Grid electrical network, significant progress could be made in reducing the carbon emissions through the transition from gas fired heating to electric solutions utilising the latest technology developments.
- Opportunities to develop a range of renewable energy and low carbon technologies on the campus to support the existing infrastructure should be fully explored, including solar and battery storage, wind generation, ground source heat pumps, use of hydrogen fueled technology and de-carbonisation of the National Grid gas supply network.

Living Laboratory and Risk

- There will be a requirement to assess cost effective renewable energy opportunities and the estate and infrastructure will be offered as a living laboratory to develop and assess smart energy networks and low carbon technology opportunities. This will require trial projects to be funded.
- In the short-medium term if the University is going to be serious about innovation and using the campus as a living laboratory then leaders' should be prepared to accept a higher level of risk as we experiment and be prepared to fund projects and embrace a culture of succeeding or failing fast.

Energy

- Increase the Bulk Supply Point (BSP) supplying LUSEP from 2 MW to up to 7 MW to provide energy resilience for the LUSEP development.
- In the mid time frame, construction of a renewable solar PV array to supply 7-10 MW to the University and sell any excess capacity to the grid.
- Implement low energy/carbon project as part of the LTM programme.
- The planned review of the condition of the mechanical and electrical services will assist in strategically planning future infrastructure upgrades on a risk-based basis.
- The two main CHP units will operate until they are life-expired at which point the technical options for low carbon generation to support the de-carbonisation of the thermal infrastructure will be reviewed.
- On site renewable energy technology – consideration of renewable energy opportunities for both new and refurbishment projects across the existing estate.
- Energy consumption data will be utilised to identify energy and carbon hotspots, allowing mitigation plans to be developed.
- Increase the dissemination of energy performance data to staff, students and tenants.
- Incentivise schools and professional services to realise energy savings.
- Charging for electric/hybrid vehicles to meet projected demand.

Leadership, Behaviours and Culture

Alongside the infrastructure changes required and the high-level roadmap outlined in this strategy, a programme to encourage behaviourally based changes in individuals will be required to support a reduction in emissions on the scale envisaged.

Whilst infrastructure changes can and will take many years to implement, the benefits of behavioural change can be high impact and cost effective in the short-term, providing savings and benefits both directly and indirectly to the individual and the University.

People are generally influenced by social norms and influenced by what those around them are doing. Providing easily accessible information that is relevant and applicable to individuals and their areas or work will be important in any communications.

Senior level support for the delivery of a reduction in energy usage will need to be visible and embedded. The provision of area specific data and targets will encourage ownership across Schools and Departments. Governance will be required to monitor and check impacts from decision making at individual and department/school levels. Targeted actions will be provided along with succinct guidance on expectations for Deans, Heads of Professional Services and Operations Managers.

Key areas of impact will be established and plans of how to deliver change in policy created. Focus will initially be on Procurement, IT, Business Travel and Buildings.

COVID-19 has presented opportunities to review operational activity and methods of working and teaching in more flexible and efficient ways in the future.

Carbon Literacy Training will be explored as the overarching solution to getting all stakeholders on board and carbon literate. This would be delivered via the Organisational Staff Development team within HROD and tailored to the different stakeholder groups within the organisation. This type of training will provide an awareness of the carbon dioxide costs and impacts of everyday activities, and the ability and motivation to reduce emissions, on an individual, community and organisational basis.

Current media platforms and channels will be employed to communicate with all stakeholders and in partnership with the central Marketing Team. Re-engagement with environmental champions and enthusiasts will support wider buy in and localised communication.

Funding

- There are various funding models to support the implementation of low carbon projects utilising both internal and external funding.
- The Long Term Maintenance (LTM) programme will continue to be utilised as a funding route to implement carbon reduction projects.
- The University will adopt a low risk strategy to adopting new technology when it forms part of a project that entails major capital expenditure.
- The funding of 'Living Laboratory' energy projects should be included within the Capital Framework and considered on a case by case basis by Operations Committee and EMC.
- The potential for accessing external funding to implement research and technical projects should be maximised.

Academic Partnerships

- Relationships with key academic and tenant partners should be established to develop a "living laboratory" utilising the University estate and infrastructure to demonstrate LU's world class expertise in Energy and the Built Environment.
- Operational energy performance data and BMS data should be utilised to support academic research to develop smart building controls.

Carbon Offsetting

- Carbon offsets should represent the final step to achieving "net zero" greenhouse gas emissions.
- Any purchased offsets should be commensurate with any outstanding carbon to achieve a net zero carbon balance.

1.5 Governance

University committees are a core component of the University's governance structure and decision-making process. In addition to ensuring decisions are fully considered and formally recorded, they are used for consultation and communication. It will be important to work closely with the local planning authority and Charnwood Borough Council to prepare masterplans and development frameworks, particularily for options appraisals, feasibility studies and individual project implementation.

There are a number of University committees and project management boards (PMB's) that provide governance and policy direction for all estates matters.

Estates Management Committee: chaired by the COO, supported by lay members, provides expert estates advice relating to estate management strategy and long-term strategic plan.

Operations Committee: approves the relevant stages of major and minor projects and provides appropriate management and independent review.

Long-Term Maintenance Sub-Committee: chaired by the Deputy Finance Director, the LTM Sub-Committee approves the prioritised rolling 3-year maintenance programme and submits this to the Operations and EMC for approval.

1.6 Key Responsibilities

Estates and Facilities Management is responsible for the development and maintenance of the University categorised as :

- Capital Projects.
- Property Management.
- Statutory and Compliance Maintenance.
- Long Term Maintenance (LTM).
- Planned Preventative Maintenance.
- Reactive Maintenance.

All works will be carried out in accordance with standards set by the University which will be fully compliant with all statutory and regulatory requirements.

2.0 New Buildings and Energy Strategy

The opportunity to engage with academic schools, (ABCE and CREST) and research partners to deliver the long term aspirations of the Energy Strategy should be maximised allowing the estate to be used as a living laboratory to install and evaluate the effectiveness and resilience of new technology to support the drive to reduce greenhouse gas emissions associated with providing the electrical and thermal requirements for the campus.

This section has been provided by Professor Kevin Lomas (Professor of Building Simulation – School of ABCE) and sets the context for this strategy and how new and refurbished building projects will be approached in the future. Rather than grasp at an established design driver – Passivhaus, BREEAM etc, it tries to examine the problem based on the key factors of interest to Loughborough University and the outcomes, levers and constraints under which these objectives are to be achieved.

There may be six objectives:

- reduced energy costs.
- secure energy supply.
- reduced price volatility.
- reduce greenhouse gas emissions.
- high- quality built environment.
- projection of the University's values through 'flagship' buildings.

The University cannot achieve zero greenhouse gas in isolation. It will rely on the decarbonising of the national fuel supply to do this. Any energy strategy is thus about positioning the University to capitalise on such de-carbonisation.

Gas is high carbon so the country will gradually curb gas-heating in buildings. The proposed new building regulations (draft out for consultation) are driving in this direction. The University's emissions from burning gas are projected to be 79% of all University buildings' emissions by 2030. So, there must be **a shift away from gas heating if the zero-carbon aim is being taken seriously.**

This decrease in carbon intensity of the National Grid reflects the predicted increase in electricity generated from renewable sources and the switch away from burning coal in power stations.
In the future, zero-carbon hydrogen might materialise, but there is no realistic sign of this at present. If/when we have zero/low carbon gas available, the existing gas pipes will be used, and the University already has these. **A shift to electrical heating now doesn't preclude a drift to zero-carbon gas in the future (should it exist).**

Shifting to low carbon, centrally generated electricity, for heating is one possible route to achieve zero-carbon by 2050, but the whole country is likely to move in this direction putting pressure on the electricity network and on generating capacity. The consequence will be high electricity prices, especially at times of peak demand. Grid electricity needs to be utilised sparingly and not at times of peak demand. **This implies having low electrical heating energy demand, and an ability to store heat (and perhaps electricity) to avoid peak tariffs**.

Local generation of power can make a significant contribution to achieving the above objectives. As there is unlikely to be much incentive to export this to the grid, its distribution by private wire to the University is necessary. PV generation is at its maximum when the heat-load on the University buildings is at its lowest. One line of thought is thus to have **a PV capacity** and, possibly, any associated battery storage **to meet the base electrical load of the University** as it exists in e.g. in summer.

To reduce the amount of electricity used for heating, **it is necessary to move to electrically driven heat pumps**. The expertise in the delivery, installation and maintenance of these will increase significantly as the number of installations increases nationally.

The **University CHP system needs to be replaced by c2030, this is an excellent opportunity** to move to a low carbon, flexible and resilient heating system. But what do these terms mean in practice. Firstly, we use heat pumps, they have a Coefficient of Performance (COP) of 3.0 (one unit of electricity yields three units of heat), so they are 'ultra' efficient. To maximise the heat pump efficiency, the new campus wide system needs to be, at least, a (fourth generation) low temperature system. The proposed Building Regulation revision is pushing for a peak supply temperature of 55°C. Low temperature water also helps the overall system efficiency as there are far lower pipe-line losses. As with the current energy network, most of the critical plant is central where skilled operators and maintenance staff are based.

All new buildings should be capable of being heated by low temperature water. This implies, a well-insulated envelope, possibly large area heat sources (underfloor, or larger area emitters) and all mechanical ventilation must have very efficient heat recovery (we cannot heat large volumes of ambient air to comfort temperature with low temperature water). DHW is achieved by locally upgrading the district heat supply using a heat pump and storage and/or point of use electrical heating.

Similarly, all new and rufurbished buildings need to be cooled. With an increased awareness of the cost and environmental impacts of energy use, natural ventilation has become an increasingly important in reducing energy use and cost and for providing acceptable indoor environmental air quality and maintaining a healthy, comfortable, and productive indoor climate rather than the more prevailing approach of using mechanical ventilation. In favorable climates and buildings types, natural ventilation can be used as an alternative to air-conditioning plants, saving 10%–30% of total energy consumption.

The minimum design standard outlined here is thus framed around the technical minimum needed to make a low temperature building 'work'. This could set the building envelope efficiency (heat loss) that the energy systems require. Over and above this, it really depends on a **cost-benefit analysis** and in this context what the University is prepared to pay today to avoid energy high costs tomorrow. In the context of rising energy prices, short term thinking might be unwise. Energy system components typically last 20 years, buildings 60+ years. There are numerous built exemplars that could inspire aspirations to higher energy efficiency standard; various Passivhaus buildings, the Elizabeth Fry Building at UEA, etc.

Whatever the design standard set, expert advice, expert design and M&E solutions by specialists capable of delivering to the brief is essential. **Lowest cost contractors and officious 'value engineering' will kill** any hope of achieving high quality design ambitions, even mild innovation will fail. Adopting a **soft landings approach reduces risk**. The design team need to work with the University FM team post-handover to help ensure that the new building performs as well as possible.

Setting an energy target is tricky; what is needed is a performance standard; i.e. what will happen in practice, not what is predicted to happen. A target might be framed around, say, an in-use energy demand of A-rating as would be shown in the Energy Performance Certification (EPC). The benefit of this is that the achievement, or otherwise, is visible for all to see (EPCs must be displayed prominently in the University Buildings).

As context, an A rating is 80kWh/m^2 per annum total delivered (electrical) energy demand. If this was all electricity, used in heat pumps (COP=c2.5) it would cost the University roughly c£48k pa to heat light and power a new building of 10,000m^2. By 2030 this might rise to £69k pa. Striving for a B-rating would double these costs. A standard, D-rated, building would cost c£276k pa by 2030.

There are many non-cost, experiential factors that are considered when building. Visual appearance, indoor air quality and natural light are just some. Such matters improve learning and staff productivity, and **low energy buildings often have higher satisfaction ratings**.

Finally, **the design of buildings reflects the values of an organisation**. Loughborough might usefully project a forward looking, environmentally conscious image through its buildings. The **wider publicity of an ionic building and visionary energy strategy** could be invaluable. As at Keele and Nottingham, to name but two, such initiatives can **stimulate research investment** in energy-related research, and Loughborough University would be well placed to capitalise on this.

3.0 Energy Consumption and Expenditure

3.1 Current Consumption and Expenditure

The University is a major user of energy and currently spends around 3.5% of the budget on energy and utilities.

Figure 1 illustrates that whilst the consumption of gas and grid electricity has remained in a steady state over the past three years on a developing estate, the costs have increased significantly reflecting increases in the wholesale energy markets costs.

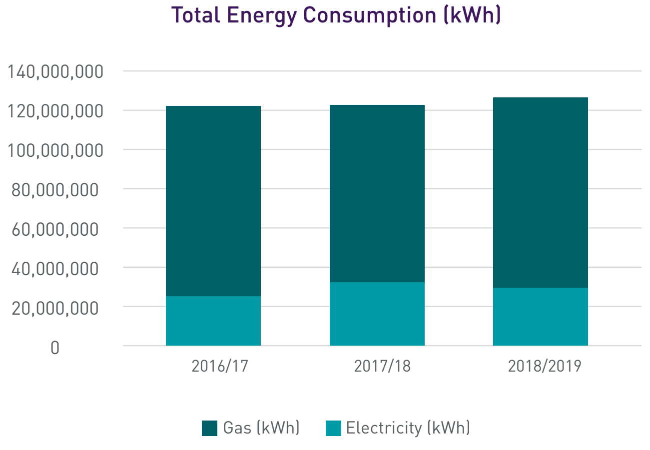
In the future the University must reduce its dependence on fossil fuels energy supplies and drive down energy costs and carbon emissions.

Figure 2 illustrates the current energy mix and the breakdown in energy expenditure.

The gas consumption represents 78% of the total annual energy consumption and the grid electricity represents 22% of the total annual energy consumption.

The gas consumption represents 40% of the total annual energy expenditure and the grid electricity represents 60% of the total annual energy expenditure.

Figure 1:



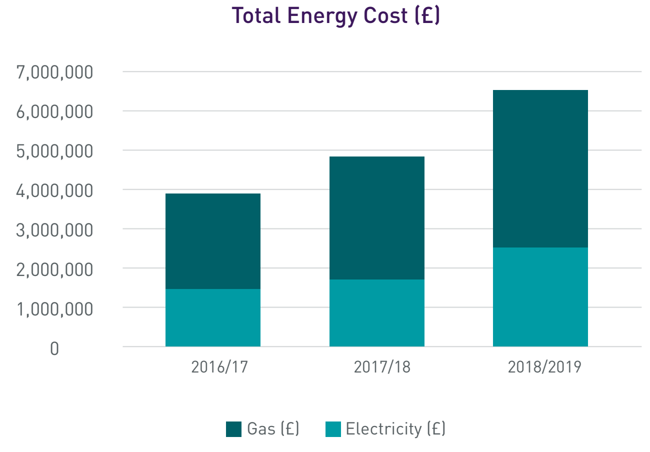
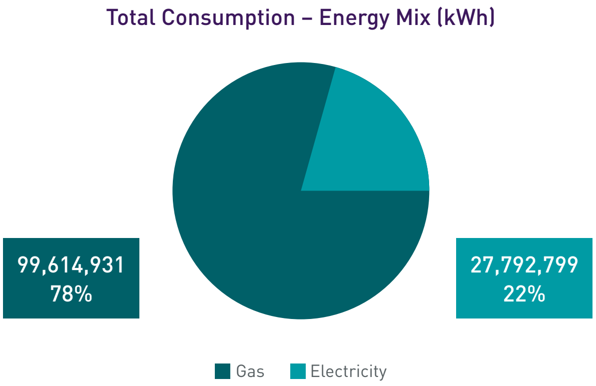
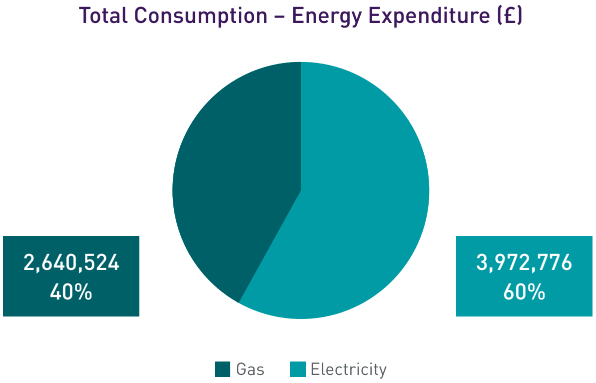


Figure 2:





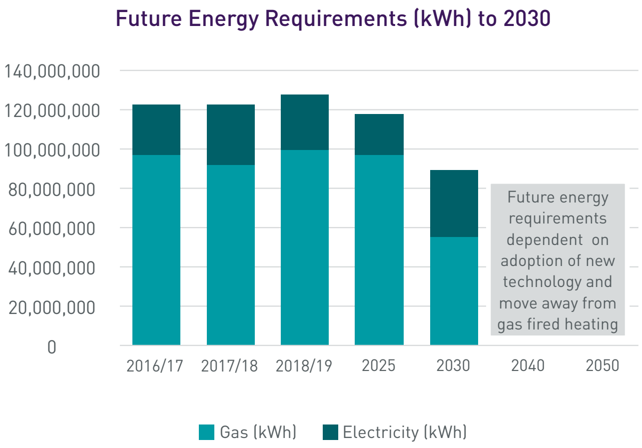
3.2 Future Energy Requirements

The future energy requirements for the University up to 2030 have been forecast based on the potential impact of projects within the current capital plan and LTM programme, incorporating some level of renewable energy technology on the campus and de-commissioning the CHP units.

Figure 3 illustrates the forecast energy consumption to 2030.

The total energy consumption is forecast to be 90,000 MWh, with electricity accounting for 34,000 MWh and Gas 56,000 MWh respectively.

Figure 3:



Future Energy Requirements (kWh) to 2030

Future energy requirements dependent on adoption of new technology and move away from gas fired heating

The energy requirements post 2030, will be largely dependent on the move away from gas fired heating technology to low carbon alternatives.

4.0 Utility Infrastructure

4.1 Existing Infrastructure

Electricity Infrastructure

The main University Campus and LUSEP are served by four dedicated High Voltage (HV) networks supplied by Western Power Distribution (WPD):

HV Network	Areas Served
Sir Richard Morris	Central Park, West Park and Village Park (excluding Falkner and Eggington)
Towers	East Park (excluding Swimming Pool, Security and Students Union)
Holywell Park	Holywell Park and Sports Park (excluding Michael Pearson East and West)
LUSEP	LUSEP Phase 2 (excluding New Access Development)

See Appendix B

Electricity Network – Operator Limitations

The development of the campus is making ever increasing demand on the utilities across the campus, of particular concern is the increasing demand for electricity.

The current loads in the Loughborough and wider Charnwood area are approaching the limits of the physical constraints of the WPD Infrastructure and significant upgrading of the wider WPD infrastructure will be required to meet known and future demand.

WPD have advised the trigger for a supply upgrade in the Loughborough area was activated in Autumn 2019 meaning the Loughborough Bulk Supply Point could potentially be upgraded within the next 2-3 years. This will allow the University to apply for additional supply capacity to support the wider development plans within the Estates Strategy.

The University has made an informal approach to WPD to ascertain the budget cost associated with increasing the existing LUSEP supply from 2MW to 3.8MW (existing switchgear capacity). The initial budget cost for the 2-3.8 MW upgrade is approximately £2.5 million and would be sufficient to meet short-term development needs; however, a new 7MW supply to serve mid-long term development projects on LUSEP phases 3 and 4 has not been scoped and is not included in the University's capital framework. This strategy must address this issue as without the additional power the mid to long-term resilience of LUSEP will be jeopardised.

The University have continued involvement in the wider group including Charnwood Borough Council, Leicestershire County Council, Leicester and Leicestershire Enterprise Partnership (LLEP), and WPD who are meeting on a regular basis to discuss the issues surrounding the power issues in the Loughborough and wider Charnwood Borough Council area.

The LLEP has shared its strategic document "Energy Infrastructure for Leicester and Leicestershire - November 2018" with the University and has requested that a cohesive approach is adopted to ensure common goals can be achieved.

Gas Infrastructure

The main University Campus gas network is supplied by Cadent. The campus is served by 68 individual metered accounts, of which six meters account for 81.5 % of the annual University gas consumption.

Conventional gas fired boiler plant supplemented by gas fired CHP's are the primary source for the provision of heating and hot water services across the campus.

The total installed thermal capacity is circa 50MW. The consumption and capacity data are summarised in the following table:

	Metered Supply	Boiler Thermal Capacity (MW)	Area Served	Consumption (%)
1	Main Boiler House	12 (+1.6 MWth CH)	Central Park Energy Centre and CHP	40.9
2	Holywell Park	7 (+1MWth CHP)	Holywell Park Energy Centre	25.4
3	Pilkington Library	1.4	Pilkington Library	5.6
4	S Building	6	S Building Energy Centre	5.3
5	Burleigh Court	1.5	Burleigh Court Hotel	2.2
6	Swimming Pool	1.6	Swimming Pool	2.1
remaining 62 meters		20	Various Building Across the Campus	18.5

4.2 Electrical Demand Short Term Requirements

The University has a Capital Framework programme that runs to 2024, several projects included within the programme will have a direct impact on the energy demand across the campus and LUSEP.

HV Supply	Project	Demand Impact
Sir Richard Morris	Student Village and Elite Athletes Centre	Increase
	F Building (chemistry) de-commissioning	Decrease
	Graham Oldham de-commissioning	Decrease
	School of Creative Arts	Increase
	Sir Richard Morris Business School Extension	Increase
Towers	John Hardie Demolition	Decrease
	LTA and Squash Courts Extension	Increase
	Rehabilitation Research Centre	Increase
Holywell Park	NCCAT	Increase
	Sports Park 4th Pavilion	Increase
LUSEP	Nemura Pharma	Increase
	New Projects	Increase
Students Union	New Student Union Building	Neutral

Current and Predicted Electrical Loads

The University have agreements in place with WPD for the supply of electricity to the University Campus and LUSEP.

The Authorised Supply Capacity (ASC) is the maximum load available from the WPD for each of the networks. The Maximum Demand (MD) is the maximum hourly load that has been recorded for each HV network over a 24-month period.

The following table summarises the demands and capacity following the completion of the projects within the Capital Framework Programme to 2024:

HV Supply	Capital Framework to 2019		
	Authorised Supply Capacity	Projected Maximum Demand	Spare Capacity
	kW	kW	kW
Sir Richard Morris	5,000	4,380	620
Towers	2,000	1,279	721
Holywell Park	4,400	4,335	65
LUSEP	2,000	77	1,923
Student Union	325	240	85

	Capital Framework to 2024		
Sir Richard Morris	5,000	4,740	260
Towers	2,000	1,499	501
Holywell Park	4,400	4,375	25
LUSEP	2,000	292	1,708
Student Union	325	240	85

See Appendix C

Summary of Projected Loads

There are several areas that present a risk in terms of having sufficient capacity to further develop the campus or attract tenants that require high power demands.

Sir Richard Morris

The Sir Richard Morris HV network will be nearing capacity with only limited spare capacity to accommodate any new developments. To give an order of magnitude to 260 kW, recently completed new build projects include STEM which has a maximum demand of 180 kW and Loughborough Design School which has a maximum demand of 160 kW. Therefore, only one more significant development can be accommodated on this network without any upgrades to the both the campus HV infrastructure and the wider Western Power infrastructure or the installation of 'local' on-site generation.

Towers

The Towers HV network has sufficient spare capacity to allow further developments to be implemented without the need for significant infrastructure upgrades.

Holywell Park

It is predicted that on completion of the current Capital Framework projects the Holywell Park HV network will be operating at full capacity and without any upgrades to the wider Western Power infrastructure or the installation of 'local' on-site generation there will be no capacity to add additional loads to this network at peak consumption periods(i.e. 07:00 to 19:00 Mon-Fri)

LUSEP Phase 2

The LUSEP HV network has sufficient capacity to meet the current aspirations of the LUSEP phase 2 developments. The potential spare capacity would allow the development 22 (67,000 m2) ATIC style buildings or 9 (47,000 m2) STEM style buildings.

Student Union

The projected demand of the new Student Union development will need to be established as the design project progresses to assess if an application for additional demand will need to be submitted.

4.3 Electrical Demand Mid-Long Term Requirements

There are plans to develop phase 3 and phase 4 of LUSEP over the mid to long-term.

See Appendix D

To ascertain an initial order of magnitude for potential future power demands associated with LUSEP phase 3 and 4 the types and size of the building plots that may be developed have been identified and benchmarked against a range of current buildings on the campus to establish indicative power demands.

The "desk-top" assessments indicate an initial projected power demand in the range of 4.5 MW to 6 MW. Accurate assessments of future power requirements can only be established once detailed plans for the the development of LUSEP are known.

The University has approached WPD to ascertain the budget cost associated with increasing the existing LUSEP supply from 2MW to 3.8MW (existing switchgear capacity) and a speculative application for a new 7MW supply to serve the future LUSEP phase 3 and 4 developments.

The initial budget cost for this is £2.5-£3 million and would provide long term resilience for the future LUSEP development opportunities.

These are only budget costs and detailed costs can only be developed once a formal application is submitted to WPD for the future power requirements and the lead time for having the power available is 2-3 years.

4.4 Meeting Mid-Long Term Demand Requirements

Renewable energy technology could play an important role in meeting future demand requirements. Installing solar PV technology and battery storage on University owned land could support demands for future development whilst reducing energy costs, improving resilience and contributing towards the University's net zero carbon aspirations.

This could be implemented using University funding or utilising 3rd party funding under a Power Purchase Agreement (PPA).

To give an order of magnitude a high level desk-top study has been undertaken to assess the land requirements and potential financial savings associated with installing a solar farm on University land under a private wire PPA.

Solar Farm Size (Acres)	Capacity (MW)	Annual Savings (£)	20 Year Life-Time Savings (£)
35-40	7	£400,000	£8 million
70-80	14	£800,000	£16 million

To fully assess the potential benefits and funding models available to support the implementation of the technology a detailed technical and financial feasibility study would need to be undertaken by a suitably qualified professional.

4.5 Electrical Infrastructure Resilience

The University Infrastructure has been developed on a "project by project" basis over time to meet the continued development of the estate.

There is a continued risk of the failure of aging underground mechanical and electrical services with the associated disruption to students, staff and University tenants.
A detailed site infrastructure report was produced in 2012 by Axis Consulting Engineers which covered a review of the campus wide electrical, mechanical and IT infrastructure.

This survey has been utilised to prioritise on a risk-based basis projects for implementation under the LTM programme to minimise as far as is practically possible the risk of infrastructure failure.

It is recommended that a full review of the original report is undertaken. This will provide an up to date set of reports and record drawings for the infrastructure across campus that will assist the University in strategically planning infrastructure upgrade works over forthcoming years.

Sir Richard Morris and Towers HV Rings

The Sir Richard Morris Ring (SRM) has been developed and continually expanded over time to meet the development of the estate and currently feeds twenty-seven substations.

The size of the ring is significant in terms of the buildings and areas of the campus served and considerable disruption results in the event of unplanned power outages.

To improve reliability and minimise disruption, downtime and areas of the campus affected when a power failure occurs there are several viable engineering options that could be explored:

- Split the SRM ring main into two smaller HV ring mains.
- Increase the size of the Towers HV ring main to include Central Park buildings that are currently served by the SRM ring main.

The options would need to be fully evaluated in conjunction with WPD and may result in the requirement to increase the availability of the existing Towers HV supply capacity.

4.6 Thermal Infrastructure

The majority of the heating and hot water services across the campus are provided by three main district heating networks, with a number of buildings supplied by individual boiler plants.

- Central Park Energy Centre: Central Park and East Park
- S Building Energy Centre: West Park
- Holywell Park Energy Centre: Holywell Park Complex

In the short term the gas fired plant will remain the primary method of providing heating and hot water services across the campus.

Combined Heat and Power

The University has installed four CHP Units:

- Central Park Energy Centre.
- Holywell Park Energy Centre.
- Holywell Fitness Centre.
- Claudia Parsons/ EAC Energy Centre.

The CHP units continue to form an integral part of the University thermal and electrical infrastructure providing 3MW of electrical capacity and producing approximately 35% of the annual University electrical demand in 2018/19.

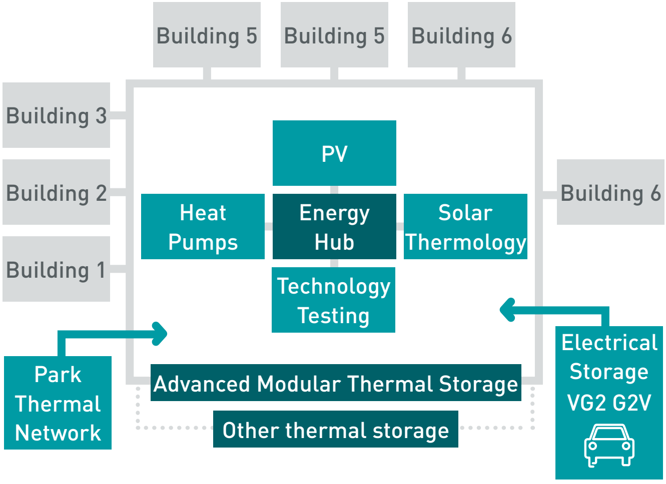
The investment in CHP technology has historically produced both carbon and financial benefits for the University and the units continue to provide significant financial savings due the difference in the unit cost of electricity to gas (currently 5:1) and in 2018/19, the financial saving were £840k.

With the de-carbonisation of the National Grid the carbon benefits associated with CHP operation have demised over the years as the electricity carbon emission factors approach parity with the gas carbon emission factors and as such CHP technology can no longer be considered a "low Carbon" technology.

The CHP plant will continue to operate to support the University infrastructure until the units are life expired (2.6 MWe of plant has a max 10 year life expectancy), at which point the available options for low carbon energy generation to support the University thermal and electrical infrastructure will be reviewed and the most appropriate technology to produce a resilient and low carbon infrastructure will be developed.

Future Low Carbon Thermal Infrastructure and Academic Engagement

By 2030 it is forecast that gas consumption will account for 79% (10.672 tonnes) of the total University emissions.The long term use of gas for heating the campus will therefore be the main challenge post 2030 in moving towards the target "net zero" emissions by 2050 and it is here that support and relationships with key academic and research partners (ABCE and CREST) will need to be developed to ascertain the types of "low carbon" technology that could be utilised to support the existing infrastructure and development of smart energy networks.



Due to the nature and layout of the campus the opportunity exists to introduce new technology in a phased "low risk" approach to allow full evaluation of the resilience and long- term benefits of the specific technologies whilst ensuring the estate continues to function and business continuity is not compromised.

5.0 Estate Strategy 2020-2040

The Estate Strategy sets out a development framework for Loughborough University covering a twenty-year period from 2020 to 2040 focusing on providing the appropriate physical infrastructure to meet the University's 'Building Excellence' strategy.

It includes a high-level capital plan roadmap for the development of the estate and offers opportunities through new build projects, redevelopment projects, infrastructure development requirements and building demolitions to positively impact on the energy and carbon reduction aspirations of the University.

Key aspects of the high-level Estates Strategy roadmap and opportunities to influence the future energy strategy are summarised in Appendix A.

The first two tranches of the Estates Strategy set out the high-level road map to 2030, areas of the strategy that could support the aspirations within the Energy Strategy include:

New Build – School of Design and Creative Arts and Student Union

Opportunities to minimise the life cycle carbon impact of the new build projects through the application of Passivhaus/BREEAM/ Low Energy/Low Carbon design techniques at the design stage and throughout the construction phase of the project.

Redevelopment of Student Village

Opportunities to reduce the impact of the Student village redevelopment thorough the application of Low Energy/ Low Carbon and renewable energy opportunities through redevelopment phases.

LUSEP Infrastructure and Phased Development

There is a requirement to secure power availability to facilitate the long-term development aspirations of the LUSEP.

Opportunities to minimise the life cycle impact of the new build projects through the projects through the application of Passivhaus/BREEAM/Low Energy/Carbon design techniques at the design stage and throughout the construction phase of the project.

Demolition Projects/Space Management

Planned demolitions and associated reduction in carbon emissions.

5.1 Building Standards

The construction of new buildings and the refurbishment of the existing buildings offer opportunities to support the aspiration to achieve net zero carbon emissions by 2050.

All modern building refurbishments should consider adopting retrofit technologies during project evaluation and must aim to achieve a relevant and appropriate level of certification, this could be: BREEAM, Passivhaus, EnerPHIT or a bespoke standard.

Where this is not possible, it must be demonstrated that this approach has been considered, explain why it is not possible and incorporate the best standard possible.

Passivhaus Standard

The definition of Passivhaus is driven by air quality and comfort: "A Passivhaus building is a building in which thermal comfort can be achieved solely by post-heating or post-cooling the fresh air flow required for a good indoor air quality, without the need for additional recirculation of air" – Passivhaus EnerPHit is a slightly relaxed standard for retrofit projects, where the existing architecture and conservation issues means that meeting the Passivhaus standard is not feasible.

Where the Passivhaus standard is not possible, each project must show that the possibility of taking the Passivhaus approach has been robustly explored and prove why it is not achievable

Passivhaus and EnerPHit Performance Targets

	Passivhaus	EnerPHit
Primary Energy Demand	⩽ 120 kWh/m2.yr	⩽ 120 kWh/m2.yr + heat load factor
Space Heating Demand	⩽ 15 kWh/m2.yr	⩽ 25 kWh/m2.yr
Space Cooling Demand	⩽ 15 kWh/m2.yr	⩽ 25 kWh/m2.yr
Specific Cooling Load	⩽ 10 W/m2	⩽ 10 W/m2
Airtightness	⩽ 0.6 air changes/ hr@n50	⩽ 1.0 air changes/ hr@n50

To achieve the Passivhaus standard in the UK typically involves:

- Accurate design modelling using the Passivhaus House Planning Package.
- Very high levels of insulation.
- Extremely high performance windows with insulated frames.
- Airtight building fabric.
- "thermal bridge free" construction.
- A mechanical ventilation system with highly efficient heat recovery.

University of Oxford – Estates Services Sustainability Design Guide

In February 2017 Oxford University elected to move from its BREEAM Excellent requirements to using the Passivhaus methodology to guide its projects and to support this change the University produced a design guide that supported the delivery of sustainable buildings that compliment and support the University's education and research objectives.

This design guide has been adopted and will now be used by Loughborough University as the standard in delivering new build and refurbishment projects.

Life Cycle Costing

The University's project approval process for major capital projects greater than £1m have been changed from consideration of acquisition/build costs only to include life cycle costs, in order to understand the full costs of a building across its life cycle, particularly its use of energy.

Whole Life Carbon Assessment

A whole life carbon assessment addresses a building's entire carbon impact throughout its lifecycle. Moving towards a net zero carbon built environment will require measurement and mitigation of carbon impacts across all stages of the building's lifecycle.

The reporting of in-use embodied carbon impacts in a building's lifecycle is currently challenging, however a modelled assessment of impacts should still be carried out. This assessment is valuable to inform early design decisions which aim to minimise the building's life cycle carbon impacts.

The whole life carbon assessment should be undertaken in line with the RICS Professional Statement "Whole Life Carbon Assessment for the Built Environment".

Governance

The capital approval process requires a business case for each project including a section on carbon impact/reduction benefits. The amount of energy/carbon consumed/saved will be a primary driver in considering whether a project can proceed. All future approvals should seek climate modelling and risk assessments and zero carbon projects/proposals as these will have a critical impact on the University's ability to meet the 2050 zero greenhouse gas emissions target.

Commitment and support from senior management and senior project sponsors is essential in delivering the low carbon aspirations and a low carbon champion should be appointed to each PMB.

5.2 Information Dissemination/ Building Management Systems

Energy Monitoring

The University has an energy monitoring system that provides high level energy consumption data at an operational level, the data is typically used for:

- Establishing annual consumption and energy trend for individual buildings.
- Establishing league tables of consumption.
- Identifying anomalies is consumption.
- Provision of data for tenant billing.
- Provision of data for monthly LU financial management reporting.
- Provision of data for periodic reporting of school energy performance.
- Provision of data for statutory energy and carbon reporting requirements.

The opportunity exists to utilise existing media platforms to increase the dissemination of the performance data to a wider audience to increase awareness relating to both global campus performance and performance at individual building level.

The data should be utilised to identify energy and carbon hot-spots which should be targeted to identify mitigation plans through a combination of technical and people solutions.

The data is not generally used for school or professional services billing, but the potential exists to use the data as a basis to set energy reduction targets for incentivise the schools and professional services that realise energy savings.

The data is used at an operational level but the opportunity exists to open up the data access to a wider academic audience to assist with more detailed and granular modelling of building operation and energy performance.

Building Management System

The University has a site wide BMS that controls the operation of the primary building services on a day to day basis across the campus.

The opportunity exists to upgrade and expand the current BMS systems to provide a greater degree of smart building control through additional monitoring and intelligence.

Academic partners within ABCE are embarking on a project to increase the level of monitoring and control within the BMS system to assess the real time energy and carbon benefits that could potentially be realised across the campus.

The Loughborough University Estates Strategy 2020-2040 states that the ambition is to use the estate as a living laboratory. One of the goals is that "By 2030, a decision support centre should be established, fed by predictive analytics, drawing on the data from the University's 'Living Laboratory', to enable evidence-based decision making to manage and improve the performance of the estate". To develop predictive analytics significant amounts of data is required to inform the underlying models, therefore the first step in creating a living laboratory is collecting data about the current state of the campus, aligning the data collection with the long-term estate ambition. Understanding the current energy demands and what is driving them can aid in better energy management.

Staff within Estates and Facilities Management with responsibility for the operation of the BMS will work closely with the academic partners to assess the potential benefits whilst also ensuring that existing systems are still controlling the building services effectively to ensure satisfactory environmental conditions for building users and university tenants.

6.0 Carbon Reduction Opportunities

6.1 Carbon Reduction Projects

The annual energy performance data for individual buildings will be used to identify and target the areas to implement cost effective energy and carbon reduction projects.

The energy data for the top energy consuming buildings per m2 are presented in the following table.

Combined these buildings consume 49% of the total energy consumption on the Loughborough campus. None of these buildings are scheduled to be refurbished or replaced; therefore, the deduction must be that other options must be identified to contribute to the plan to meet net zero green house gas emissions.

Building	Total Energy kWh/m2	ELEC kWh/m2	GAS kWh/m2	% of Total Energy
Swimming Pool	939	280	659	2.3
Holywell Park	624	228	422	32.7
Haslegrave Building	550	166	396	1.8
James France	440	128	377	1.9
Edward Herbert Building	422	114	357	2.0
Stewart Mason Building	418	112	345	0.8
Burleigh Court	402	106	326	3.5
Stewart Miller Building	319	99	254	1.3
Pilkington Library	312	93	252	2.5
Summary				48.8

Note: The consumption for the S building and W building are not included within the data as they have recently undergone major refurbishment programmes and there is insufficient energy data to assess current performance levels.

The implementation of energy and carbon reduction projects will continue to be included within the funding submissions to the LTM Sub Committee.

Projects will be considered for implementation that are proven technology, provide a payback in terms of energy and maintenance savings and reduce carbon emissions and could include:

- LED lighting Improvements – Replacing the aging lighting with LED luminaires will reduce lighting loads by 50-60% whilst improving the lighting quality.
- BMS – Upgrade of BMS systems and installation of new smart campus technologies to optimise existing systems.
- Air Handling Plant Controls – Replacement of aging plant with high efficiency units.
- Fabric Improvements – Upgrade of building fabric to current standards.
- District Heating Controls – Upgrade of pumps and 2-port control valves.
- District Cooling Controls (Holywell Park) – Optimise district cooling opportunities at Holywell Park.

6.2 Refurbishment Projects

Refurbishment projects within the capital development plan will offer opportunities to reduce the current level of energy consumption, the phased re-development of the student village will offer opportunities to replace life expired infrastructure and technology and could include:

- New district heating system.
- New heating and hot water generation and distribution.
- Heat Pump and Low Carbon Technology.
- Fabric insulation upgrades.
- Double/triple glazing.
- Renewable Energy opportunities.
- LED lighting.
- BMS upgrades.

6.3 The University’s Reduction Target

Loughborough University aims to achieve Net Zero Greenhouse Gas Emissions by 2050, with significant progress being made by 2040.

The University will need to establish what levels of decarbonisation will be achieved through the decarbonisationof the National Grid and what levels will be needed through local action.

Net Zero Carbon Definitions

Loughborough University has adopted the UK Green Building Council’s (UKGBC) definitions for net zero carbon buildings:

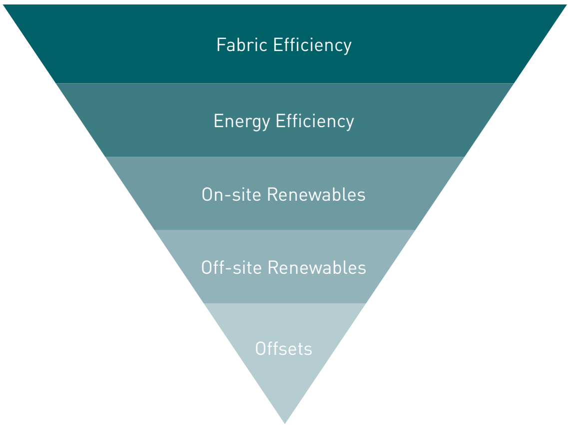
Net Zero Carbon-Construction (for new buildings and major renovations)

“When the amount of carbon emissions associated with a building’s product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy”

Net Zero Carbon – Operational Energy (for all buildings in operation)

“When the amount of carbon emission associated with the building’s operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with the remaining carbon balance offset”

Carbon Reduction Hierarchy (UKGBC)



This means that by 2050, all the University buildings should create zero greenhouse gas emissions on an annual basis from their lighting, ventilation, hot water, appliances, heating and cooling. This should be achieved in line with the hierarchy shown, promoting fabric and energy efficiency and only minimal offsets once all means on-site and off-site renewable energy production have been exhausted.

6.4 Emissions Scope

This strategy focuses solely on the University’s scope one and two carbon emissions.

Scope 1: are the direct emission that occur from sources that are owned or controlled by the University, for example emissions from combustion in boilers.

Scope 2: are emissions from the generation of grid electricity consumed by the University.

Scope 3: are other indirect emissions that occur upstream and downstream, associated with the university’s activities and include: waste, water consumption, staff/student commuting, business travel and procurement.

At this stage, the University have not included scope three emissions within this strategy. However, as scope three emissions are generally recognised to be considerably larger than the organisation’s scope one and two emissions, the University recognises the importance of reducing them. Therefore, the University will firstly work to quantify their scope three emissions and work with the Higher Education sector to create a mutually agreed definition of which emissions are and are not included in scope three. The University will adopt best practice in reporting, recognising the need to move beyond merely operational carbon reporting to quantify broader benefits from our activities.

Drivers for Reducing Greenhouse Gas Emissions

Whilst the environmental benefits of achieving net zero greenhouse gas emissions are clear, there are multiple co-benefits to achieving this target. The University’s key drivers in setting this ambitious aim are as follows:

Environmental: By reducing greenhouse gas emissions, the University will play its part in averting or reducing the worst effects of climate change.

Comfort and Wellbeing: If approached correctly, low carbon buildings achieve very high comfort levels, which have been proven to improve the wellbeing of their occupants. The benefit of this can be assessed using the Design Quality Indicator (DQI) - a toolkit to measure, evaluate and improve the design quality of buildings, including consideration of the operating and energy costs throughout a building’s life .

Financial: The reduction in greenhouse gas emissions will be achieved through reducing the University’s energy consumption. This reduction in consumption will in turn reduce the University’s annual gas and electricity expenditure.

Reputational: With students becoming increasingly guided by their environmental principals and many other Universities working to reduce their emissions, the reputational risk of not reducing carbon emissions at the University is great. Conversely, the potential reputational benefit of leading the way and sharing best practice on achieving net zero greenhouse gas emissions in the HE sector is immense.

6.5 Baseline Emissions

The Loughborough Campus baseline emissions are from the 2010/11 academic year.

The Loughborough London Campus baseline emissions are from the 2016/17 academic year, this was selected as it was the first year that reliable accurate energy consumption data was available.

The consumption data for both campuses is collated on a monthly basis from actual metered energy consumption data that in managed by the energy team in Loughborough and the LU Facility Manager at the London Campus.

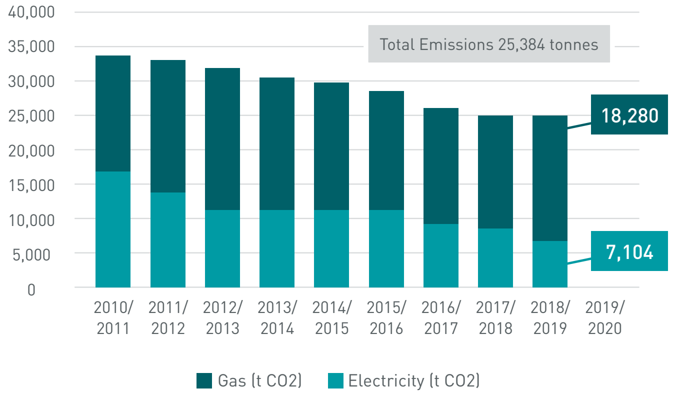
The decarbonisation of the National Grid has had a significant impact on reducing the emissions associated with electricity consumption. The Department for Business, Energy and Industrial Strategy (DBEIS) published carbon emission factors for electricity in 2018/19 are 51% lower than those published in 2010/11 .

The installation of low energy lighting and controls, installation of new high efficiency boilers and BMS upgrades together with behavioural change through staff and student awareness campaigns have contributed towards reducing the energy consumption and associated carbon emissions.

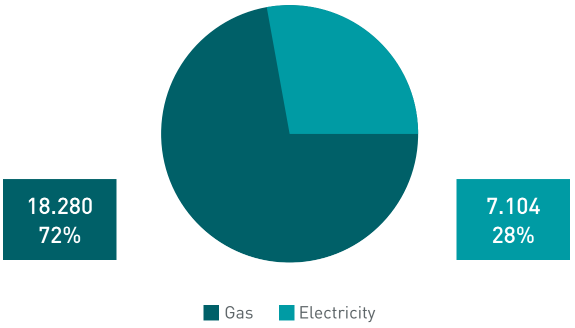
6.6 The University's Progress to Date

Loughborough Campus

Absolute Scope 1 and 2 Carbon Emissions – 2010 Baseline



Main Campus Breakdown of Carbon Emissions



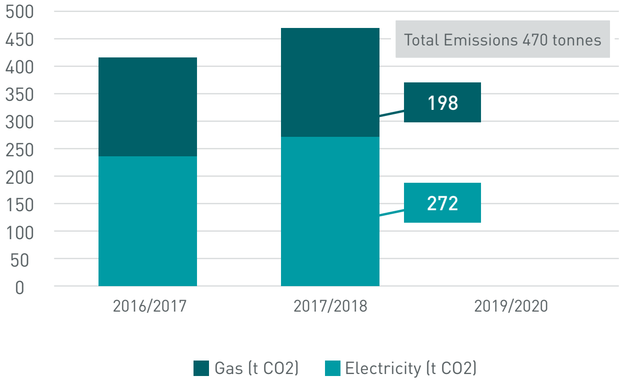
The Loughborough Campus has achieved a 25% reduction in absolute emissions against the 2010/11 baseline, this has reduced the annual CO2 emissions to 25,384 tonnes.

This has been achieved on a developing estate and an 8% increase in student numbers.

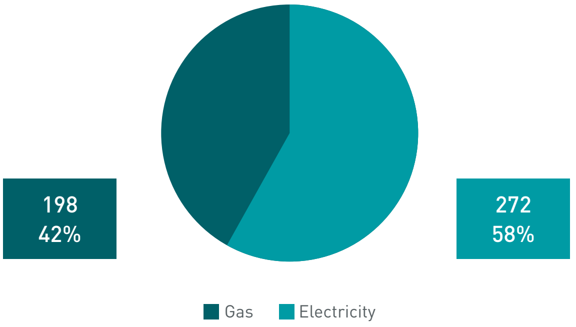
The gas consumption represents 72% and the electricity consumption represents 28% of the current emissions respectively. (In 2010/11 electricity represented 49% of the emissions and gas represented 51% of the emissions).

London Campus

Absolute Scope 1 and 2 Carbon Emissions – 2017 Baseline



London Campus Breakdown of Carbon Emissions



The London Campus emission have increased by 11% compared to the 2016/17 baseline. The annual CO2 emissions are 470 tonnes.

The increase is a combination of the University taking over additional areas within the building and a 23% increase in student numbers compared to 2016/17.

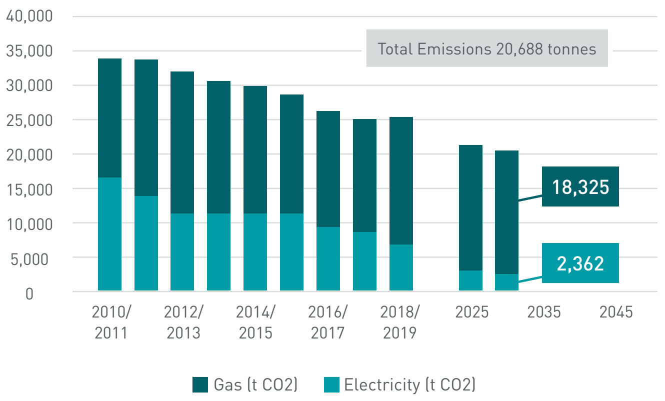
The gas consumption (heating and cooling supplied by the Olympic Park District Heat network) represents 42% and the electricity consumption represents 58% of the current emissions respectively.

6.7 Emissions Projections – Business as Usual

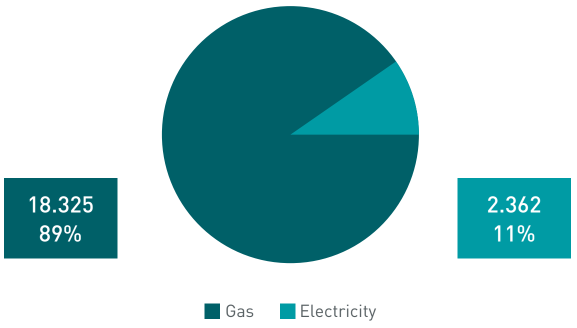
Loughborough Campus

This scenario assumes a static consumption for both electricity and gas consumption, with the reduction in carbon emission being achieved through the decarbonisation of the national grid.

Absolute Scope 1 and 2 Carbon Emissions – 2010 Baseline



Main Campus Projected Carbon Emissions – 2030

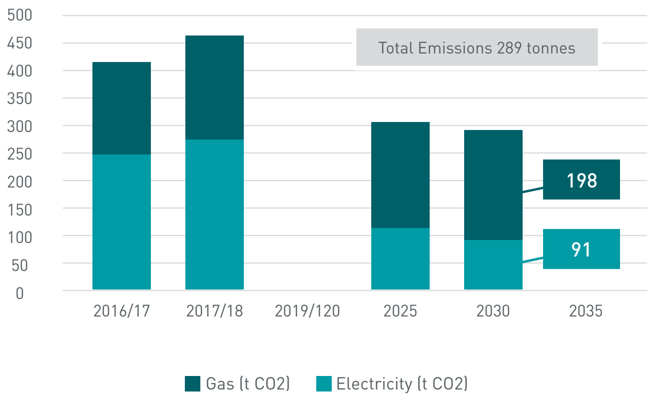


Under this scenario, the predicted CO2 emissions in 2030 are 20,688 tonnes, this represents a 38% reduction compared to the baseline year with the gas consumption accounting for 89% and grid electricity consumption accounting for 11% of the emissions.

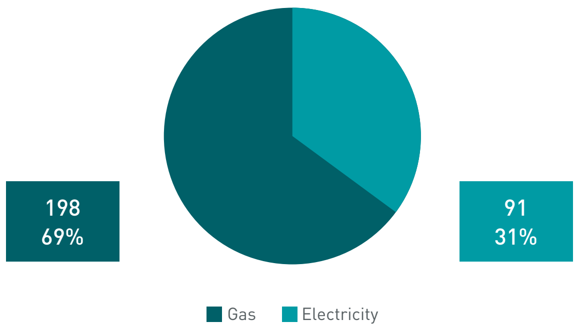
London Campus

This scenario assumes a static consumption for both electricity and gas consumption, with the reduction in carbon emission being achieved through the decarbonisation of the national grid.

Absolute Scope 1 and 2 Carbon Emissions – 2017 Baseline



London Campus Projected Carbon Emissions – 2030



Under this scenario, the predicted CO2 emissions in 2030 are 289 tonnes, this represents a 38% reduction compared to the baseline year with the gas consumption accounting for 69% and grid electricity consumption accounting for 31% of the emissions.

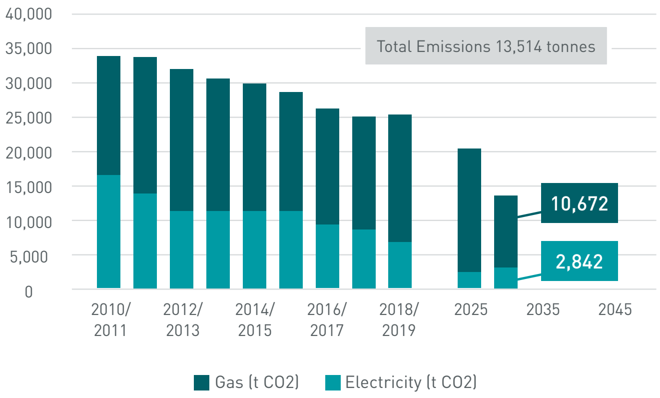
6.8 Emissions Projections – Zero/Low Carbon Approach to the Estates Strategy

Loughborough Campus

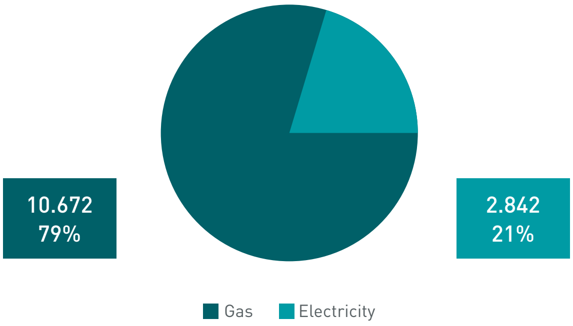
This scenario assumes the following will be adopted as part of the delivery of the Estates Strategy masterplan:

- a zero/low carbon approach will be adopted for the new build projects.
- a zero/low carbon approach will be adopted for refurbishment projects.
- continued de-carbonisation of the National Grid in line with DBEIS forecasts.
- Building demolitions in line with the Estates Strategy.
- Implementation of Renewable energy technology.
- Implementation of carbon energy/ carbon reduction projects within the LTM plan.
- De-commissioning of the Central Park and Holywell Park CHP units.

Absolute Scope 1 and 2 Carbon Emissions – 2010 Baseline



Main Campus Projected Carbon Emissions – 2030



Under this scenario, the predicted CO2 emissions in 2030 are 13,514 tonnes, this represents a 60% reduction compared to the baseline year with the gas consumption accounting for 79% and grid electricity consumption accounting for 21% of the emissions.

London Campus

The London Campus occupies a relatively small area of the 2012 broadcasting centre building and is the heating and cooling services are provided under contract by the Olympic Park District Heat network.

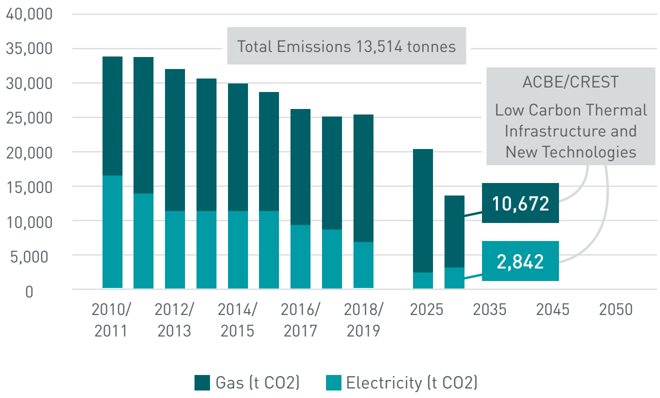
Other than implementing LTM improvements to lighting, heating and ventilation services and behavioural change improvements in areas under the direct control of the University there is limited scope for any significant improvement in the energy performance of the London Campus.

6.9 Emissions Projections – Towards 2050

The de-carbonisation of the heating network will be the main challenge in moving towards "net zero" greenhouse gas emissions by 2050 and it is here that support and relationships with key academic and research partners will need to be developed to ascertain the next generation of "low carbon" technology that could be utilised to meet the thermal demands of an operational estate.

The opportunity exists to offer the estate as a living laboratory and allow the development of a smart energy network through the introduction of new technology in a phased "low risk" approach to allow full evaluation of the resilience and long-term benefits of the specific technologies whilst ensuring the estate continues to function and business continuity is not compromised.

Absolute Scope 1 and 2 Carbon Emissions – 2010 Baseline



7.0 Renewable Energy Opportunities

The opportunity to develop a range of renewable energy technologies including solar and battery storage, wind generation, ground source heat pumps, hydrogen fueled technology and de-carbonisation of the National Grid gas supply network to support the existing infrastructure low carbon aspirations and protect against exposure to escalating energy costs should be fully explored in conjunction with our academic and tenant partners.

Car Parking and Electric Vehicle (EV) Charging

The development of additional car parking facilities offers the opportunity to incorporate multifunctional solar car parks in line with the BRE National Solar Centre – Multifunctional Solar Car Parks – a good practice guide for owner and developers.

There are currently around 230,000 registered EV's in the UK and this is estimated to rise to between 1-1.2 million by 2023 and it is predicted there could be as many as 32 million EV's on the road by 2038.

There will be a requirement to incorporate additional charging capacity to meet future demand, placing increased demand on existing infrastructure, but offering the opportunity to utilise renewable energy technology to support the transition to EV's.

Solar Farm – University Land

To support the University electrical infrastructure, the possibility exists for the University to develop a solar farm on existing University land. There are several potential opportunities in terms of technology, location of solar farm and funding opportunities that would require fully investigating to assess the technical and economic feasibility of the project.

This maybe a standalone system away from campus or connected if located locally. (Approx. area required would be 50 acres for 10MW).

The primary benefits could include:
- On site renewable energy generation.
- On site generation capacity to support the University demand requirements.
- Safeguard against escalating energy costs and volatile energy markets.
- Clear demonstration of the University's environmental commitments.
- Possibility to link to battery storage/smart energy networks.
- Potential links to future electric vehicle charging network.
- Provide a "live" research and teaching facility for academic departments.

There are several funding models to support the implementation of the solar technology:
- Full University Funding.
- 3rd Party Funding – Power Purchase Agreements (PPA).
- Joint Venture between the University and 3rd Party Funding.
- Joint Venture between the University, 3rd Party Funding with community co-op investment scheme.

A "desk-top" analysis was carried out in 2019, based on a 7MWp (electricity generation 7,000 MWh) solar farm on University land with a direct wire PPA agreement.

The average electricity cost savings of the PPA agreement compared to grid electricity is in the order of £400k per annum, with additional rental income opportunities if the scheme is located on the University land.

The savings over the lifetime of the PPA agreement is calculated at £8m.

8.0 Funding Opportunities

There are several current funding models that could potentially support the implementation of low carbon technology across the campus.

Internal Opportunities

- Capital Framework.
- Long Term Maintenance (LTM) programme.
- Research and Enterprise Office Academic Bids.
- Individual Academic Bids.

External Opportunities

Salix Finance

Salix Finance Ltd provides interest-free Government funding to the public sector to improve energy efficiency, reduce carbon emissions and lower energy bills. Salix is funded by the Department for Business, Energy and Industrial Strategy. The loan repayment period is currently five years.

Energy Service Agreement (ESA)

This ESA enables the installation of single or multi technology services solutions funded by 3rd party finance. The University benefits from the efficiency savings and pays a unit rate or tariff across the assets lifetime.

Solar Power Purchase Agreements (SPPA)

The SPPA helps organisations access immediate cost and carbon savings using solar on-site generation. The design, development, installation, operation and maintenance are delivered in a single contract. The University gets cost stability over the life of the asset via a fixed priced (p/kWh) for the electricity generated.

Discounted Energy Purchase (DEP)

The DEP typically applies to CHP plant and allows the installation of the technology at no cost to the University. The design, development installation, operation and maintenance are delivered in a single contract. The University pays fixed price (p/kWh) for the electricity generated over the lifetime of the asset (typically 10-15 years).

9.0 Carbon Offsetting

Carbon offsets represent the final step to achieving a “net zero” carbon building.

Where all feasible measures for reducing the carbon impacts have been reasonably exhausted, offsets can be utilised to cover any residual carbon.

The offsets purchased should be commensurate with any outstanding carbon to achieve a net zero carbon balance and should be procured directly or via recognised existing offsetting frameworks.

Net Zero Carbon – Construction: Offsets should be commensurate with the carbon impacts determined at practical completion.

Net Zero Carbon – Operational Energy: Offsets should be commensurate with the carbon impacts determined annually.

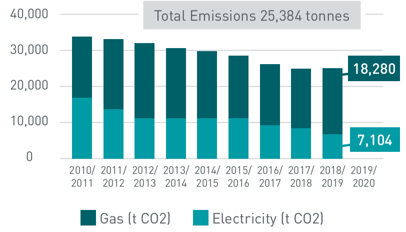
Appendices

A: Estate Strategy and Energy Strategy Roadmap

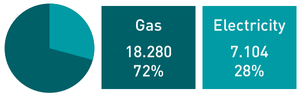
	2020	2024	2025	2030	2035	2040	2050
Estate Strategy COVID-19 is having a significant impact on the University's capital projects and has led to most being deferred or even stopped. The intention is to reprioritise the programme when the full financial impact of the crisis is known.	School of Design and Creative Arts - new build		Manzoni Refurbishment		Refurbishment or demolition of all buildings constructed or refurbished prior to 2015		
	Students Union - new build		Refurbishment David Collett and Towers		Further phases of Student Village new-build/refurbishment		
	LTA and Squash Courts - new build		Service Infrastructure Upgrade and Investment in sustainable tech		Development of LUSEP phases 3 and 4		
	London 2.0		Demolish: 3D design, Edward Barnsley and Fine Arts		Refurbishment of Hazlerigg and Rutland		
	Sports Park Pavillion 2		Demolish: Sir Arnold Hall and Campus Services offices		Redevelopment of Central Park: Brockington, Wavy Top, Geography and EHB		
	Extension of School of Business and Economics		Construction of large capacity car parks LUSEP and E and W parks		SDC Game Changers not delivered in 2025-30		
	LUSEP Infrastructure inc Grow on Buildings		Brockington Extension Refurbishment				
	RSRIC - new build		T Building Refurbishment				
	Demolition of buildings		LUSEP Phase 3 and 4 sites: phased development				
	Re-development of Student Village to Minimum B grade standard						
			ABCE to support the development of the capital programme with expert advice on technologies that will help LU meet its zero carbon target				
			SDC - game changers				
Energy Strategy	New build - Passivhaus. Low Energy/Carbon Standards						
	Reduction in energy impact of the student village						
	LUSEP Power - WPD 7MVA Application		Refurbishment - Low energy/carbon standards				
	Onsite Renewable Energy - Solar PV		Decommission central park and Holywell Park CHP Units				
	Demolition of buildings - Carbon Reduction						
	LTM - Carbon Reduction Opportunities						
	Engagement with ABCE, CREST and academic support groups in the development of technologies that will help LU meet its zero carbon target						
	Decarbonisation of the National Grid (Electricity Generation)						
	Utilisation of Building Perfomance Data and Building Management Control Systems to Identify Energy Saving Opportunities, Improve Control of Buildings and support energy awareness campaigns						
			Low carbon thermal infrastructure technology opportunities and smart energy networks				
			Car park developments - solar canopy opportunities				
			LUSEP Phase 3 and 4 - Passivhause. Low energy/carbon standards				
			Onsite Renewables - opportunities				

Current emissions

Absolute Scope 1 and 2 Carbon Emissions – 2010 Baseline

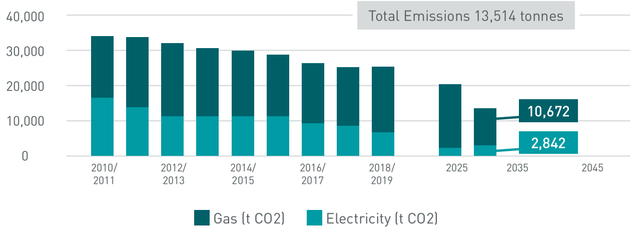


Main Campus Breakdown of Carbon Emissions

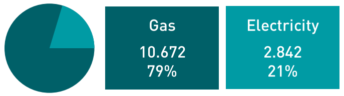


Emissions Projections - adopting a zero/low carbon approach to delivering the estate strategy

Absolute Scope 1 and 2 Carbon Emissions – 2010 Baseline

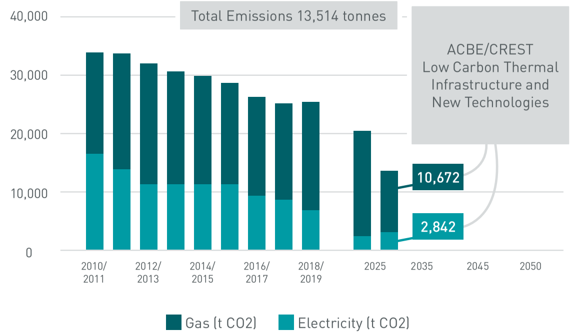


Main Campus Projected Carbon Emissions – 2030



Scale of decarbonisation Required to meet 2050 'Net Zero' tagets

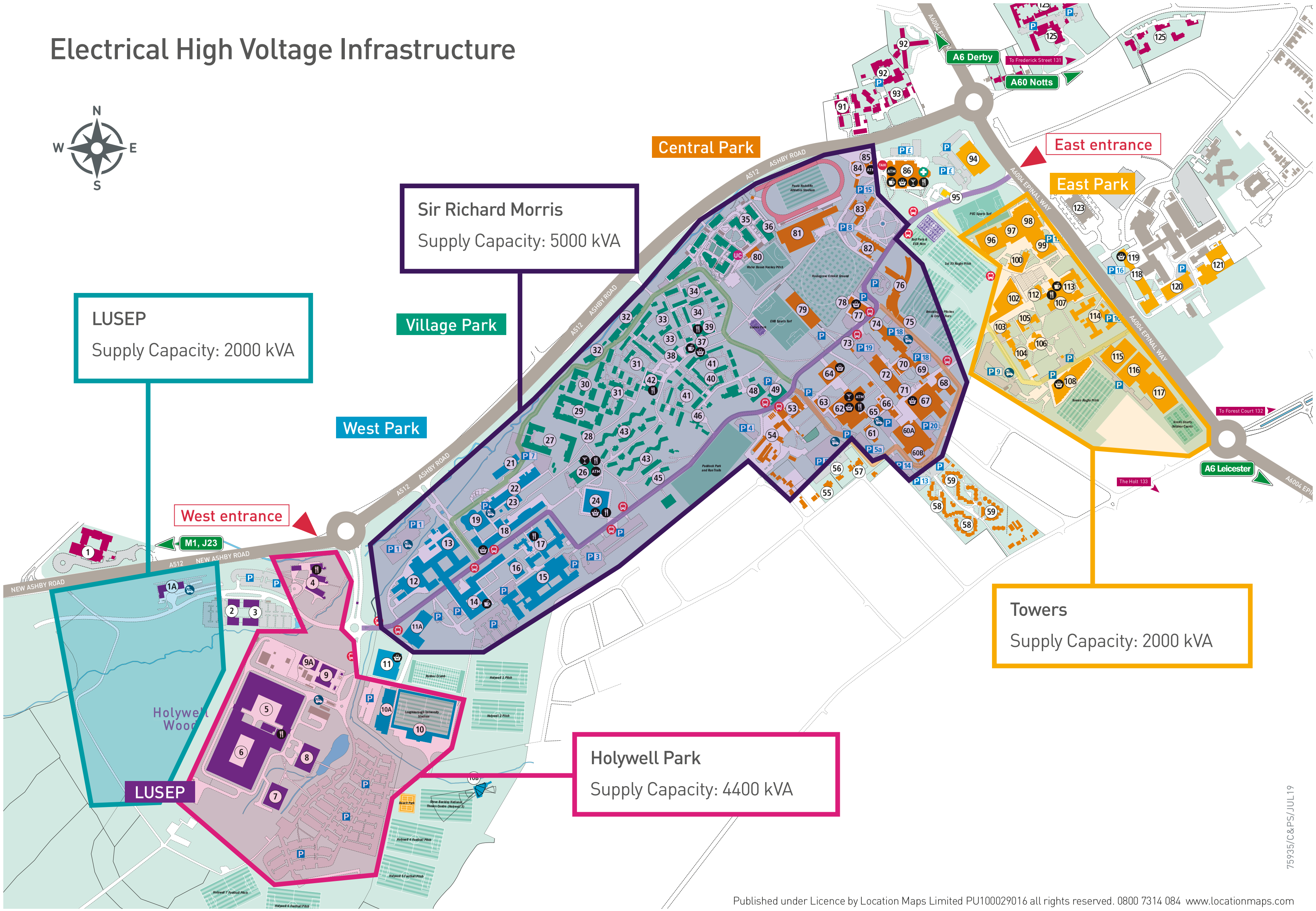
Absolute Scope 1 and 2 Carbon Emissions – 2010 Baseline



Carbon offsetting

B: Electrical HV Infrastructure

Electrical High Voltage Infrastructure



Sir Richard Morris
Supply Capacity: 5000 kVA

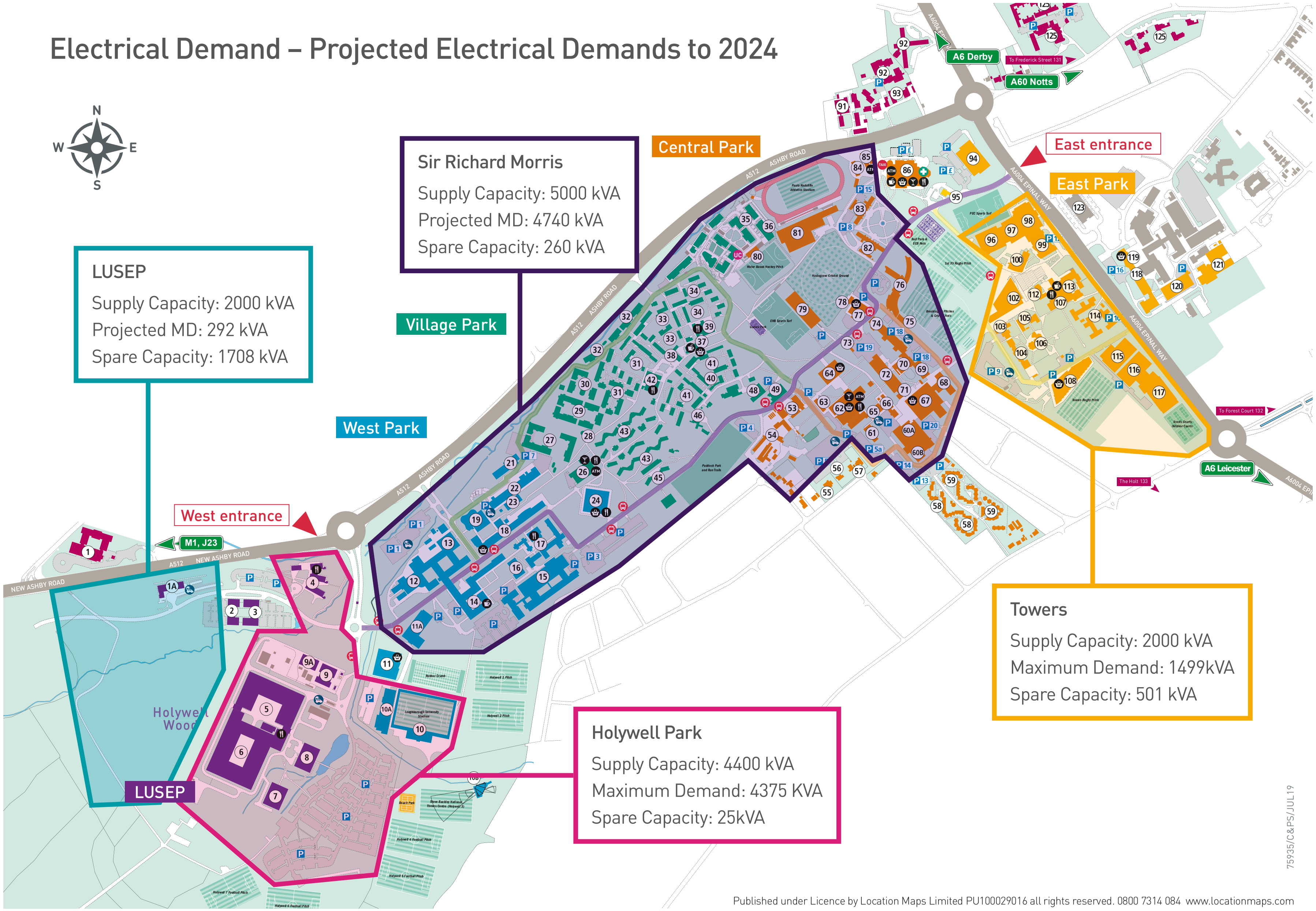
LUSEP
Supply Capacity: 2000 kVA

Towers
Supply Capacity: 2000 kVA

Holywell Park
Supply Capacity: 4400 kVA

C: Projected Electrical Demand to 2024

Electrical Demand – Projected Electrical Demands to 2024



LUSEP
Supply Capacity: 2000 kVA
Projected MD: 292 kVA
Spare Capacity: 1708 kVA

Sir Richard Morris
Supply Capacity: 5000 kVA
Projected MD: 4740 kVA
Spare Capacity: 260 kVA

Holywell Park
Supply Capacity: 4400 kVA
Maximum Demand: 4375 KVA
Spare Capacity: 25kVA

Towers
Supply Capacity: 2000 kVA
Maximum Demand: 1499kVA
Spare Capacity: 501 kVA

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D: LUSEP Phase 3 and 4 Development

77365/C&PS/Jan2020