

Sustainable Spaces for Culture

A study into enhancing sector resilience through climate adaptation, energy efficiency compliance, and carbon reduction

November 2024

Copyright © 1976-2025 Buro Happold. All Rights Reserved



Project Team and Acknowledgements

Project Details

Project Name

Sustainable Spaces for Culture

Report Name

A study into enhancing sector resilience through climate adaptation, energy efficiency compliance, and carbon reduction

Prepared for

Greater London Authority and Arts Council England

Prepared by

Buro Happold Limited

Buro Happold

Ben Richardson

Director, Sustainability and Physics

Fergus Anderson

Associate Director, Sustainability and Climate Change

Fred Hagley

Senior Engineer, Sustainability and Physics

Alex Couling

Consultant, Sustainability and Climate Change

Elisabetta Maria Patanè

Engineer, Sustainability and Physics

<https://www.burohappold.com/>

Greater London Authority

Amanda Decker

Senior Programme Manager, Creative Enterprise Zones

<https://www.london.gov.uk/>

Arts Council England

Sabine Unamun

Senior Relationship Manager, London

<https://www.artscouncil.org.uk/>

Interviewees

Angela Wachner - General Manager, Bush Theatre

Eline van der Vlist, - Chief Executive, Space Studios

Jon Carvell - General Manager, Wigmore Hall

Lisa Mustoe - Service Lead for Libraries and Heritage, Merton Libraries

Lucia Pietroiusti - Head of Ecologies, Serpentine Galleries

Marc Fleming - e8architecture, Project Architect, Paddington Arts refurbishment

Melanie Coles - Head of Operations and Visitor Services, Institute of Contemporary Arts

Michael Taylor - Head of Trusts Foundations & Government, Serpentine Galleries

Paul Kenealy - Building Operations Facilities Manager, Institute of Contemporary Arts

Richard Short - Building Operations Facilities Manager, Institute of Contemporary Arts

Robert Mckay Forbes - Property Director, Space Studios

Steve Shaw - Director, Paddington Arts

William Ellis - House Manager, Wigmore Hall

Glossary

ACE	Arts Council England
CRA	Climate Risk Assessment
EPC	Energy Performance Certificate
GLA	Greater London Authority
LETI	Low Energy Transformation Initiative (LETI) is a voluntary network of built environment professionals, supporting the transition of the UK built environment to net zero.
LSOA	Lower layer Spatial Output Areas (LSOAs) are made up of groups of Output Areas (OAs), usually four or five. They comprise between 400 and 1,200 households and have a usually resident population between 1,000 and 3,000 persons.
MEES	Minimum Energy Efficiency Standards
RCPs	Representative Concentration Pathways (RCPs) are a method for capturing those assumptions within a set of scenarios. The conditions of each scenario are used in the process of modelling possible future climate evolution.
UKCP18	UK Climate Projections (2018) is a set of tools and data that project how the UK climate may change in the future.
UKGBC	UK Green Building Council (UKGBC) is a membership-led industry network to support sustainability in the built environment through learning, policy and advocacy.

Contents

01	Executive Summary	5
02	Introduction	10
03	Policy, Guidance and Support	13
04	Methodology	19
05	Overall Resilience of London’s Cultural Infrastructure	26
06	A Deeper Look at Resilience	33
07	Conclusion	62
08	Appendix	70

1

Executive Summary

Overall Resilience of London's Cultural Infrastructure

London faces extreme temperatures and varied precipitation patterns, leading to water scarcity and surface water flooding.

Temperature hits **40°C** causing wildfires and infrastructure disruptions

2022 heat-related deaths **387** LONDON **3,271** England

Rainstorms caused **2,000+** properties to be flooded

Flooding Costs **£82,000** per business

The majority of cultural buildings **have not** been designed to manage climate risks.

Climate impacts pose a risk to the business continuity as spaces become unusable during extreme weather.

COMMUNITY SUPPORT
Cultural spaces provide:

HEALTH & WELLBEING BENEFITS

allowing people to socialise, reducing isolation and offering learning opportunities

PUBLICLY ACCESSIBLE WARM & COOL SPACES

to seek refuge from extreme temperatures

ENERGY EFFICIENCY STANDARDS



SINCE 2023 MEES regulations require non-domestic rented properties to have an EPC E rating

EPC E
90% of London's cultural buildings have an EPC E or above

If raised to: **EPC C**
47% would remain lettable

If raised to: **EPC B**
ONLY 18% would remain lettable

Some of the factors affecting the physical vulnerability of buildings



MOST IMPACTED POPULATIONS

- The elderly
- Low-income households
- Marginalised communities
- Children
- Health conditions or disabilities

Purpose of Study

The Mayor of London has committed to achieving net zero carbon by 2030. As homes and workplaces account for 78% of the city’s CO₂ emissions—and with 80% of the existing building stock likely to remain in place in 2050—creative businesses, workspaces and artist-studio providers have a role to play in reducing their carbon footprint.

London is also experiencing increasing intensity and frequency of climate impacts. Impacts such as flooding and extreme heat are projected to increase across the century. Urgent and ambitious action is needed to adapt the city’s built environment, services and communities to a changing climate, increasing resilience to anticipated extreme weather events.

London’s cultural sector is varied, including museums, galleries, theatres, recording studios, artist and creative workspaces, workshops, live music venues and more. This study has been commissioned by the Greater London Authority (GLA) and Arts Council England (ACE) to assess the energy and climate resilience of the cultural sector.

London’s cultural infrastructure faces both climate and energy resilience challenges

The vast majority of London’s cultural infrastructure has not been designed to accommodate high temperatures. Nearly all organisations engaged in this study reported experiencing overheating, an impact that will only increase in severity as the climate changes. Extreme heat poses a risk to building users and business continuity, as spaces become unusable during peak temperatures. An estimated 72% of London’s 4,169 cultural buildings are in areas deemed at moderate-high to high overall climate risk according to the GLA Climate Risk Map. An estimated 8% are in high-risk areas.

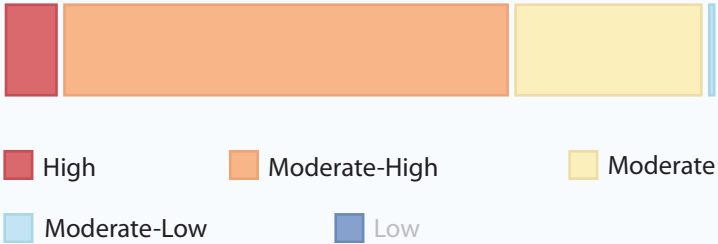


Figure 1.1 Climate risk of London’s cultural infrastructure, as per the LSOA risk ratings in the GLA Climate Risk Map

Much of London’s cultural building stock is also inefficient in its energy consumption and will fail to meet net zero carbon targets. Many of London’s cultural assets are housed in large, ageing buildings that are costly to maintain or retrofit. Current Minimum Energy Efficiency Standards (MEES) legislation requires non-residential rented properties to achieve an EPC of E or above. Analysis of publicly available EPC data has found that an estimated 90% of London’s cultural assets are currently achieving this. Whilst it is not yet determined whether there will be future changes to MEES legislation, if EPC requirements for non-domestic rented properties were to be raised to require an EPC rating of B, the analysis presented in this report finds that only 18% of London’s cultural infrastructure would remain lettable without retrofitting energy-saving interventions.

This indicates that if anticipated legislation changes were to be introduced, the cultural sector would need significant support to improve assets in line with standards. Rising energy costs have forced organisations to alter their operations to remain financially viable. Five of the seven organisations engaged in this study reported increasing energy costs as a challenge or influence in decision making. Some reported reducing opening hours to mitigate costs, whilst others have shortened periods that spaces are heated in winter months, meaning building users are subjected to colder conditions in winter.

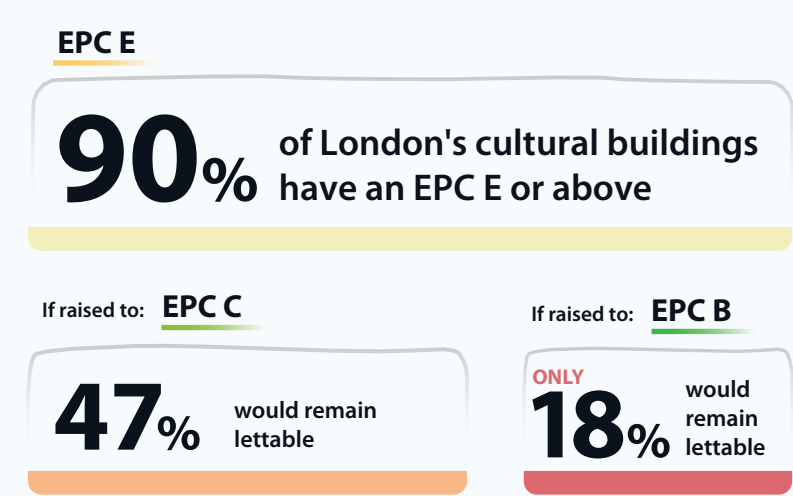


Figure 1.2 Current EPC ratings for London’s cultural infrastructure

Support is needed to enhance the resilience of cultural sector

The city’s cultural infrastructure—from libraries, theatres and galleries to community art centres and workspaces—not only allow people to experience culture, but also often play several roles beyond what might typically be understood as ‘cultural’. As well as providing spaces for people to socialise and collaborate, during periods of extreme weather many cultural venues become resilience hubs, providing refuge from extreme outdoor temperatures for free, both in winter and summer.

Based on a review of existing policy, guidance and support, as well as engagement with a range of London’s cultural sector organisations, a series of findings to support the resilience of London’s cultural sector have been developed. Findings are summarised below, refer to section seven for more detail.

For cultural sector organisations:

- ▶ Engage with staff when planning resilience interventions to ensure learning and knowledge from those who work in the building on a day-to-day basis are considered in planned action.
- ▶ Establish specific resilience role within the organisation to support strategic resilience planning.
- ▶ Build relationships with trusted advisors, designers and contractors to support good quality outcomes.
- ▶ Take a preventative approach to maintenance planning to reduce long-run costs.
- ▶ Invest in technical assistance to support decision making around resilience interventions.

For government and cultural sector development agencies:

- ▶ Support and facilitate knowledge sharing between cultural sector organisations to develop sector specific resilience knowledge, building on existing research and reports.
- ▶ Establish carbon reduction and climate resilience training and awareness raising programmes for operations teams.
- ▶ Develop technical guidance for adapting cultural buildings to climate change.
- ▶ Ring-fence targeted support and funding for the resilience of cultural infrastructure.
- ▶ Engage with cultural sector organisations around potential changes to MEES legislation.
- ▶ Support the mainstreaming of material circularity initiatives.
- ▶ Where cultural infrastructure is providing resilience services for local communities, such as cool/warm spots, recognise this and provide additional support.

2

Introduction

Background

London and the UK are leading centres for culture and the creative industries globally. London's creative sector generates £51.7 billion per year and one in five jobs in the city is a creative one.¹ The cultural infrastructure that supports the sector and its supply chain across England is varied, including museums, galleries, theatres, recording studios, artist and creative workspaces, workshops, live music venues and more.

The Mayor of London has committed to being net zero carbon by 2030. As homes and workplaces account for 78% of CO₂ emissions in London, and with 80% of the existing building stock likely to remain in place in 2050, creative businesses, workspaces and artist-studio providers have a role to play in reducing their carbon footprint.

Additionally, with extreme weather events such as flooding and extreme heat likely to continue, it is essential to improve the resilience of these buildings, many of which are older and less maintained spaces.

Scope of this research

This piece of research has been commissioned by the Greater London Authority (GLA) and Arts Council England (ACE) to triangulate three strands of enquiry:

1. The scale of the impact of the Minimum Energy Efficiency Standards (MEES) regulations on cultural infrastructure, and the sector's preparedness to legislative changes.
2. The degree to which cultural organisations are resilient to climate change.
3. Identify types of adaptations and interventions different typologies of cultural infrastructure will need to undertake to prepare for climatic changes, both in terms of facilities and business models.

Key terminology used in this report

- **Energy efficiency:** in the context of buildings, energy efficiency encompasses a wide range of strategies and practices aimed at reducing energy consumption while maintaining or improving overall performance.
- **Carbon:** this is short for carbon dioxide (CO₂) emissions. CO₂ is one of several greenhouse gases in the atmosphere that trap heat. As well as being produced through natural processes, CO₂ is released through burning fossil fuels, such as oil and gas. CO₂ emissions are a key metric used to measure building performance.
- **Net zero carbon:** when the amount of carbon emissions associated with an action are zero or negative. This can be achieved through reducing energy consumption and eliminating the use of fossil fuels.
- **Climate adaptation:** means anticipating the adverse impacts of climate change and taking action to prevent or minimise the damage they can cause. In buildings, adaptation interventions may include adding internal or external shading or improving stormwater drainage.
- **Climate mitigation:** means making the impacts of climate change less severe, by preventing or reducing the release of greenhouse gases into the atmosphere. In buildings, mitigation interventions may include replacing fossil fuel boilers with air source heat pumps and improving energy efficiency.
- **Active cooling systems:** Typically include any system that requires energy (electricity) to operate. For example, fans, air systems, chilled water systems. These can be very effective for mitigating heat stresses, but capital investment and operating costs can be high.
- **Passive cooling systems:** Any system or strategy that requires little to no energy input to operate. This can be as simple as a facilities management plan that requires windows to be opened to maximise natural ventilation. More complex passive cooling systems can be design to leverage natural forces like wind and thermal pressure (meaning hot air rises) to cool a building.

1. London's Creative Industries – Sector deep dive

The role of Energy Performance Certificates

For non-residential buildings, Energy Performance Certificates (EPC) indicate the energy performance of a building on a scale from A+ to G (with scores from 0 to 150), with A+ (scores under 0) the best available rating. The rating is based on the estimated regulated carbon emissions of the building, unlike domestic EPCs which are based on estimated running costs. The higher the rating, the lower the carbon emissions for regulated services. A building with an A+ EPC uses less energy (or an equal amount) than it generates (usually through solar panels).

EPCs have been used in this study as regardless of MEES legislation, for non-residential properties they provide an indication of carbon emissions and therefore a way of understanding which cultural infrastructure typologies will need the most support to transition to net zero.

Structure of the report

Section three provides a review of existing energy efficiency and climate resilience policy, at the local and national scale, as well as summarising the guidance that is already available for cultural sector organisations to support resilience.

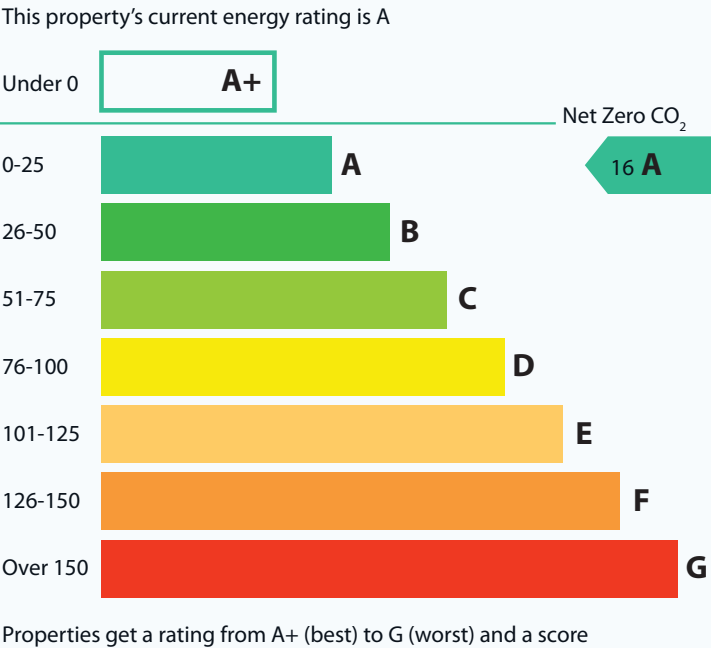
Section four describes the mixed methods approach adopted in this study.

Section five further sets out the context of this study, outlining the key climate and energy resilience risks that London’s cultural infrastructure is facing.

Section six provides a review of cultural and energy resilience for typologies examined in this study. London-wide analysis of climate and energy resilience has been conducted where data is available. Case study analysis has also been carried out for each typology, providing a more detailed review of cultural organisation’s experiences navigating energy and climate resilience.

Section seven summarises key takeaways from the analysis as well as a list of potential adaptation interventions that could be implemented in London’s cultural infrastructure, along with commentary on the associated co-benefits and trade-offs of actions. This section also provides findings for key stakeholders to support the resilience of the cultural sector.

Energy rating and score



3

Policy, Guidance and Support

In order to establish the policy context, relevant strategy documents for the cultural sector have been reviewed, as well as policies and strategies published by the GLA and key existing and emerging national guidance and regulations. The review has focused on policy, guidance and technical and financial support relating to (1) energy and carbon (e.g., initiatives to support energy efficiency improvement, phase out fossil fuels and support renewable generation) and (2) climate adaptation (e.g., mitigate overheating with shading, install permeable surfaces for flood management, or support the development of climate action plans).

► National commitments and regulations

Energy and carbon

The Energy Efficiency Regulations 2015 establish a minimum level of energy efficiency for rented property in England and Wales. From April 2023, all non-domestic rented properties have been required to obtain at least an Energy Performance Certificate (EPC) E rating, unless they have a valid exemption. Whilst not yet mandated, consultation has been carried out by the previous government on raising [Minimum Energy Efficiency Standards \(MEES\)](#) for non-domestic rented properties to a minimum of EPC B by 2030.

The Mayor of London has set a target for London to be net zero carbon by 2030. This is more ambitious than the UK target, which is to achieve net zero greenhouse gas emissions by 2050.

Climate change

The [Climate Change Act 2008](#) provides a legally binding framework to cut UK greenhouse gas emissions and adapt to climate change, including a requirement to complete a Climate Change Risk Assessment (CCRA) every five years. The National Adaptation Programme (NAP) sets out how the risks will be addressed. Considerations pertinent to the built environment and business in the third NAP (2023-2028) primarily target the residential sector through NPPF updates, with the aim to support to local authorities and protect the financial sector. The Department for Business and Trade will survey business readiness for climate impacts and provide advice, which is assumed will include the cultural sector.

► Guidance

Energy and carbon

In 2022, the UK Government published the [Promoting Net Zero Carbon and Sustainability in Construction](#) guidance note to support the UK's construction sector in achieving the net zero target. The guidance note collates and builds on practical resources on decarbonisations for those procuring construction and programmes. A number of guidance documents have been produced by the third sector to support decarbonisation of the UK's building stock. For example, the UK Green Building Council's (UKGBC) [Key Considerations for Commercial Retrofit](#) provides guidance for landlords and building owners to retrofit commercial assets, whilst LETI's [Climate Emergency Design Guide](#) focuses on the decarbonisation of new buildings.

Julie's Bicycle's [Fit for the Future](#) guide summarises sustainable building best practices. The guide is aimed at the directors and managers of arts organisations and provides guidance on integrating sustainability across construction phases and monitoring environmental performance, as well as highlighting case studies to learn from. Julie's Bicycle's [Creative Climate Tools](#) are a set of carbon calculators developed specifically for the cultural sector, supporting cultural organisations to quantify and report on their carbon footprint.

Julie's Bicycle has also developed a set of [energy and water benchmarks](#) for performing arts venues and museums and galleries; however, these are based on 2015 data.

The [Arts Green Book](#), produced by Buro Happold, ACE and the GLA, also provides common guidance for improving the sustainability of arts organisations. The Arts Green Book provides an overview of specific challenges and opportunities that different types of arts sector organisations are experiencing.

The [Gallery Climate Coalition's Carbon Calculator](#) supports the decarbonisation of the visual arts sector and promotes zero-waste practices. The free carbon calculator tool helps estimate the carbon footprint of businesses, based on metrics common to most art galleries.

Historic England has recently published an advice note on [Adapting Historic Buildings for Energy and Carbon Efficiency](#). The advice note sets out general approaches that should be adopted when improving the energy and carbon efficiency of historic buildings. This note may be useful for cultural organisations housed in listed or historic buildings.

Climate change

The [London Climate Resilience Review](#) published in July 2024, provides headline findings about strategic gaps and opportunities in London's preparations for climate impacts, including the impact on London's building environment and infrastructure. For the cultural sector, the review recommends convening key partners to share best practice on adaptation within specific sectors and create adaptation plans and actions. The review found that the sector was already experiencing impacts of climate change, with extreme heat in particular a significant threat to operations. Organisations engaged in the review also reported a desire for advice on how to ensure adaptation would not compromise carbon reduction goals, for example, by reducing the need for active cooling, like air conditioning.

London's [Cultural Infrastructure Plan and Toolbox](#) set out what needs to be done to protect and grow the city's cultural facilities. The Plan is a seven-point action plan combining policy, funding, research and other tools to support cultural infrastructure. Whilst the Toolbox includes [support for culture and community spaces at risk](#), this focuses on funding and advice for cultural organisations at risk of losing their spaces. It is not however, focused on climate adaptation or organisations at risk as a result of climate impacts.

For those in the music sector, [Music Declares Emergency](#) provides advice for venues and studios on a range of sustainability and climate focused interventions, from writing an environmental action plan to putting an energy management strategy in place.

The National Museum Director's Council's [Green Museums: Tackling the Climate Crisis](#) guide highlights the different ways in museums are responding the climate emergency. The report provides case studies across three themes: research, public engagement and greening and estates and operations.

[Culture Declares](#) is a growing movement of over 1,500 cultural organisations and individuals who have come together to declare a climate and ecological emergency. They have developed a Culture Takes Action toolkit, setting out a three-stage process to develop a policy and action plan in response to the emergency.

Limited guidance has been published on adapting buildings to climate change. The UKGBC has some resources, such as the [Nature-based Solutions & Climate Resilience](#) however these are not sector specific. Historic England has also published guidance on [Climate Change and Historic Building Adaptation](#), which may be applicable to some of London's historic cultural venues.

► Technical support

Energy and carbon

The GLA's [Retrofit Accelerator – Workplaces](#) provides support in the form of guidance and advice to a range of government, educational and cultural and heritage organisations to implement retrofit measures. Support is available through the programme delivery unit, providing free end-to-end support for projects, and the RE:FIT framework of energy service companies, providing guidance on procuring retrofit services and works.

The [Home Survey Tool](#), developed as part of the Theatre Green Book, supports theatre owners and operators to make their buildings more sustainable. It provides a Sustainability Plan in the form of a downloadable excel spreadsheet to support theatres to understand the scale of the challenge.

For the cultural sector, the Julie's Bicycle and Arts Council England (ACE) [Building Net Zero Energy](#) programme supports organisations to become more energy efficient and decarbonise their buildings. The programme provides self-service resources and training on energy management, as well as technical support.

Climate adaptation

Cultural Adaptations' [Adapting our Culture Toolkit](#) supports cultural organisations and institutions across Europe to plan for a sustainable, resilient and climate-changed future. The toolkit supports organisations to understand adaptation, identify how climate change will impact their operations and work, and support them to develop an adaptation action plan.

► Financial support

Energy and carbon

The Theatres Trust has a number of grant schemes to support improvements and urgent repairs to theatres. The [Theatre Improvement Scheme](#), in association with the Wolfson Foundation, supports capital funding for theatres to improve their environmental sustainability. The scheme has been renewed in 2024, with a further £510,000 to be awarded over the next three years.

For cultural infrastructure owned by public sector bodies, the [Public Sector Decarbonisation Scheme](#) provides grants to fund heat decarbonisation and energy efficiency measures. Phase 4 of the scheme, confirmed in February 2024, has a funding pot of £1.17 billion to 2028.

The GLA's [Green Finance Fund](#) was launched at London Climate Action Week 2023 to lend up to £500 million to projects to help London meet its net zero ambitions through improvements in energy efficiency, clean transportation or renewable energy. Museums accredited through the Arts Council Museum Accreditation Scheme are eligible for funding.

For voluntary, community and social enterprise organisations, the [VCSE Energy Efficiency Scheme](#) is available. The scheme supports organisations to undertake an independent energy assessment to identify energy saving measures and offers capital grants of between £2,000 and £150,000 that can be used to install energy efficiency measures identified. Arts Council England's [Capital Investment Programme](#) provides financial assistance to cultural and creative organisations to extend and upgrade existing spaces. [Arts Council England](#) also supports cultural sector organisations through a range of funding, such as the National Lottery Project Grants, Cultural Development Fund and Museum Estate and Development Fund. Whilst these are not directly aimed at building performance upgrades, a proportion of the funding can be used towards this.

Climate adaptation

The City Bridge Foundation offer a number of funding opportunities for London based social and environmental initiatives. The Environment and Sustainability funding programme supports community organisations to mitigate and adapt to climate change through grant funding. This programme is not specific to the cultural sector, but some cultural organisations may be eligible.

Whilst the desktop review found limited climate adaptation focused funding dedicated to the cultural sector, there are broader green funding programmes that cultural organisations may be able to access.

Action in the EU: the Energy Performance of Buildings Directive

The revised [Energy Performance of Buildings Directive](#) entered into force in all European Union (EU) countries in May 2024 with the aim of increasing the rate of retrofit, particularly for the worst performing buildings in each country.

The directive contributes to the target of reducing building sector greenhouse gas emissions by at least 60% by 2030, compared to 2015 levels, and achieving a zero carbon building stock by 2050.

The directive includes the gradual introduction of minimum energy performance standards for non-residential buildings based on national thresholds. This is intended to encourage the retrofit of buildings with the lowest energy performance.

4

Methodology

A mixed methods approach has been adopted for this study. The first stage was a London-wide analysis of (a) EPC datasets to assess the compliance readiness of cultural infrastructure assets to anticipated MEES legislation, and (b) UKCP18 data to provide an overview of projected climate impacts that London’s cultural infrastructure assets will face. The second stage was an analysis into seven case studies, representing a cross-section of London’s cultural infrastructure.

This study considers seven cultural infrastructure typologies. These have been developed by grouping the typologies used in the GLA Cultural Infrastructure Map. [Table 4.1](#) shows how the typologies defined in this study relate to the GLA Cultural Infrastructure Map typologies.

Table 4.1 Use typologies

Typology defined in this study	GLA Cultural Infrastructure Map - typologies	Number of assets
Libraries and archives	Archives, Libraries	891
Multi-artform buildings	Arts centres	26
Museums and galleries	Commercial galleries, Museums and public galleries	553
Music performance venues	LGBT venues, Music recording studios, Music rehearsal studios, Music venues all	622
Studios and workspaces	Artist workspaces, Creative coworking desk spaces, Creative workspaces, Fashion and design, Jewellery design, Makerspaces, Making and manufacturing, Prop and costume making, Set and exhibition building, Textile design	1,023
Theatre and dance rehearsal space	Dance rehearsal studios, Theatre rehearsal studios	469
Theatre and dance venues	Dance performance venues, Theatre	462

London-wide analysis

Analysis of EPC data to determine energy resilience baseline

The MEES data analysis aims to assess the energy efficiency of London’s cultural infrastructure and identify which categories are likely to be the most vulnerable to MEES legislation changes. This is used to determine the energy resilience of the sector.

The objectives of the analysis are:

- 1. Identify a sample of assets to represent the overall energy performance of the London’s cultural infrastructure
- 2. Filter sample set by typology to determine energy resilience across the cultural sector.

The GLA Cultural Infrastructure Map provides a list of 4,169 assets. These were matched with their respective EPC ratings, publicly available from the Energy Performance of Buildings Register.² Pre-processing of the EPC data was carried out to match addresses to cultural infrastructure assets. The way address data is reported between the GLA Dataset and the EPC Dataset are different. Therefore, matching was achieved using multiple rules, as follows:

- 1. **Rule 1** - Address matching probability, scoring from 0 to 100 ([Table 4.2](#)). The higher the likelihood (100), the higher the chance that the address and/or combination of information are identifying the same asset.
- 2. **Rule 2** - Simple rule based on one variable, matching the Typology and EPC Category based on a Dictionary ([Table 4.3](#)).
- 3. **Rule 3** - Review of EPC lodgement date for most recent certificate ([Table 4.4](#)).

A test was performed to identify the minimum probability score to be achieved, to determine if the same building is identified across the two datasets. A subset of data was used for the test; generated with a simple rule-based filter on Address Name. Of the 4,169 assets in the GLA Dataset, only 32 were identified in the EPC Dataset. The same test was performed with Rule 1 to find lowest probability score to obtain the exact same 32 buildings using more than one variable ([Table 4.2](#) – noted with *). The test found that the minimum probability is 48. By applying this probability threshold and Rule 2 and 3, a final dataset of 1,274 EPCs was generated and used for the analysis.

2. Energy Performance of Buildings Data England and Wales (opendatacommunities.org)

Table 4.2 Example of Rule 1: Address Matching and Probability score

	GLA Dataset		EPC Dataset		
	Variables		Variables	EPC (1)	EPC (2)
Rule 1: Address Matching and Probability score	Name	Baring Archive	ADDRESS2*	8-10 Moorgate	2 Moorgate
	address1*	8-10 Moorgate	ADDRESS3*	-	-
	address2	-	ASSET_RATING	B1 Offices and Workshop businesses	B1 Offices and Workshop businesses
	address3	EC2R 6DA	ASSET_RATING_BAND	G	E
Probability score				100	78

*Used for the comparison

Table 4.3 Dictionary: Matching typology and EPC Category

Typology defined in this study	Category in EPC Dataset	
	Category	Building Type
Studios and workspaces	B1	Offices and workshop businesses
Libraries and archives	B8	Storage and distribution
	D1	Non-residential Institutions - Education
Multi-artform buildings	D1	Non-residential institutions - community / day centre
Museums and galleries	D1	Non-residential institutions - libraries museums and galleries
Music performance venues	D2	General assembly and leisure plus night clubs and theatres
		Theatres/cinemas/music halls and auditoria

Table 4.4 Example of Rule 2 and 3: Extracted data

				EPC Dataset		
				EPC (1)	EPC (2)	
Rule 2	Typology in GLA Dictionary	Dataset	PROPERTY_TYPE	A1/A2 Retail and Financial/ Professional services	B1 Offices and Workshop businesses	
		Rule Outcome		n/a	Y	
Rule 3	EPC most recent lodgment date	Dataset	LODGEMENT_DATE	01/02/2012	16/11/2022	
		Rule Outcome		outdated	most recent	
	Name		address1	address3	ASSET_RATING_BAND	Typology
Extracted Data	The Arab British Centre		10 Gough Square	EC4A 3DE	D	Multi-Art Form Buildings

GLA Climate Risk Map data

Mapping the cultural infrastructure assets to the GLA’s Climate Risk Map provides an indication of the level of climate risk of London’s cultural infrastructure. The risk score assigned by the Climate Risk Map is a score up to 60, indicating areas with ‘low’ to ‘high’ risk. It is important to note that these scores have not been normalised or manipulated to hold significant meaning on their own, the findings of this analysis serve as supplementary commentary for understanding the broader picture of the resilience of London’s cultural infrastructure.

As the GLA climate risk data does not categorise risks and associated numerical values between ‘low’ and high, this study assumes an equal distribution across the scale, attributing the following climate risk descriptions to numerical scores: low (0-12), moderate-low (13-24), moderate (25-36), moderate-high (37-48), high (49-60).

Analysis of UKCP18 data to determine climate baseline

Analysis of climate data projections from the MET Office UKCP18 datasets has been carried out to understand the future climatic scenarios for London.

Due to data availability and anticipated impact on cultural assets, the assessment has considered the following variables:

- ▶ Forecast changes in temperature
- ▶ Forecast changes in rainfall
- ▶ Likelihood of heatwaves
- ▶ Likelihood of droughts.

The assessment considered two emissions pathways:

- 1. Medium emission scenario:** using RCP4.5, this pathway represents an approximate minimum level of future climate change to which adaptation will be necessary, with approximate global temperature increases of 1.7-3.2°C by 2081-2100. RCP4.5 is described by the Intergovernmental Panel on Climate Change (IPCC) as a moderate scenario in which emissions peak around 2040 and then decline.
- 2. High emission scenario:** using RCP8.5, this pathway represents a rate of global warming that could occur if action to mitigate climate change fails to go beyond current pledges. This pathway sees approximate global temperature increases of 3.2-5.4°C by 2081-2100.

Whilst the latest IPCC report on adaptation uses Shared Socio-economic Pathways (SSPs), the best available climate data from the Met Office, UKCP18, uses Representative Concentration Pathways (RCPs).

UKCP18 datasets are available in multiple combinations of spatial disaggregation, emissions scenario and time period. We selected data from two datasets that give a robust understanding of long-term climatic trends for different emissions scenarios (probabilistic data), alongside a more detailed understanding of the potential impacts of the high emissions scenario (regional data). For all analyses, results are based on the median.

A summary of the results of the UKCP18 analysis can be found in Appendix A.

Table 4.5 UKCP18 Datasets Analysed

UKCP18 Dataset	Emission scenario available	Indicator	Assessment
Probabilistic (25km)	RCP2.6, RCP4.5, RCP6.0, RCP8.5	Mean temperature (°C)	Annual average
		Max temperature (°C)	Maximum seasonal average
		Precipitation rate (%)	Average annual and seasonal
Regional (12km)	RCP8.5	Max temperature (°C)	Daily
		Rainfall (mm)	Daily
		Additional analysis	
		Heatwave	Daily max temperature projections assessed against Met Office definition of heatwave – 3+ days exceeding 28°C
		Drought	Daily rainfall projections assessed against definition of absolute drought – 15+ days with less than 0.25 mm rainfall

Case study analysis

Site visits

Interviews with buildings and operations staff were carried out for each of the case study building categories. These were typically undertaken on-site and followed by a tour of the building / venue(s). Interviews were recorded with permission from attendees and notes written up following those conversations which were shared with participants for comment and clarification. The Museums and Galleries case study was solely online due to scheduling constraints.

Questions followed broadly the six key themes outlined below:

- **Building description:** Description of the building use and function.
- **Building demographics:** Who are the building’s primary users, what purpose does the building serve, what is the relationship like with the local community?

- **Key Challenges:** What are the major challenges and risks to operations, are these impacted by climate change (now, or anticipated to be in the future)?
- **Actions taken:** What action has the organisation taken so far? What are the mains drivers for action?
- **Major Barriers:** What are the major barriers restricting the organisation’s ability to change and adapt?
- **Progress so far:** What is the organisation’s perception of where they are along their journey towards being future-proof and resilient?
- **Further support:** What further support does the organisation need in order to enhance energy and climate resilience?

Climate risk assessment

To provide a more in-depth view of the climate vulnerability of London’s cultural assets, a rapid climate risk assessment (CRA) has been carried out for the case study sites. Due to the constraints of this project, the CRA has focused on the impact of heat and surface water flooding.

The level of physical risk to each hazard has been determined as a function of exposure and sensitivity. Exposure considers the physical hazards that a building is likely to be exposed to within its expected life span, along with any environmental factors that may have an influence, including current and future climatic conditions. Sensitivity is the degree to which the building and its operations will be impacted by climate change.

The risk score determined is out of five, with one indicating low risk and five indicating high risk.

The following data has been used in the climate analysis.

Table 4.6 Data used in building level CRA

	Exposure	Sensitivity
Heat	UKCP18 analysis	Qualitative data from site visit
Surface water flooding	Defra Risk of Flooding from Surface Water ³	Qualitative data from site visit

3. Defra Data Services Platform

5

**Overall Resilience
of London's Cultural
Infrastructure**

Overall Resilience of London's Cultural Infrastructure

London faces extreme temperatures and varied precipitation patterns, leading to water scarcity and surface water flooding.

Temperature hits

40°C

causing wildfires and infrastructure disruptions

2022 heat-related deaths

387 LONDON 3,271 England

Rainstorms caused

2,000+ properties to be flooded

Flooding Costs

£82,000 per business

The majority of cultural buildings **have not** been designed to manage climate risks.

Climate impacts pose a risk to the business continuity as spaces become unusable during extreme weather.

COMMUNITY SUPPORT

Cultural spaces provide:

HEALTH & WELLBEING BENEFITS

allowing people to socialise, reducing isolation and offering learning opportunities

PUBLICLY ACCESSIBLE WARM & COOL SPACES

to seek refuge from extreme temperatures

ENERGY EFFICIENCY STANDARDS



SINCE 2023

MEES regulations require non-domestic rented properties to have an EPC E rating

EPC E

90% of London's cultural buildings have an EPC E or above

If raised to: EPC C

47% would remain lettable

If raised to: EPC B

ONLY 18% would remain lettable



MOST IMPACTED POPULATIONS

- The elderly
- Low-income households
- Marginalised communities
- Children
- Health conditions or disabilities

Climate change is already impacting the livelihood and wellbeing of London's residents and businesses, with these effects projected to increase in severity in the near future. In July 2022, temperatures in London hit 40°C, resulting in wildfires and disruptions to critical infrastructure and services. In 2022, there were 3,271 heat-related deaths in England⁴ and 387 in London⁵. Urgent and ambitious action is needed to adapt our built environment, services and communities to a changing climate and increase resilience to anticipated extreme weather events.

London is in an area of extreme water stress. This will be exacerbated by increasing temperatures and more varied precipitation patterns. Despite increasing water stress, surface water flooding also poses a key risk to London's population and built assets. In July 2021, London was hit by two extreme rainstorms, causing major damage and disruption, flooding more than 2,000 properties with stormwater and sewage.⁶

The impacts of the climate crisis will not be felt equally across London. Low-income households, elderly people, marginalised and minority communities, children and young people, and those with existing health conditions or living with disabilities are the most vulnerable to climate impacts, but wellbeing and productivity impacts will be felt across London.

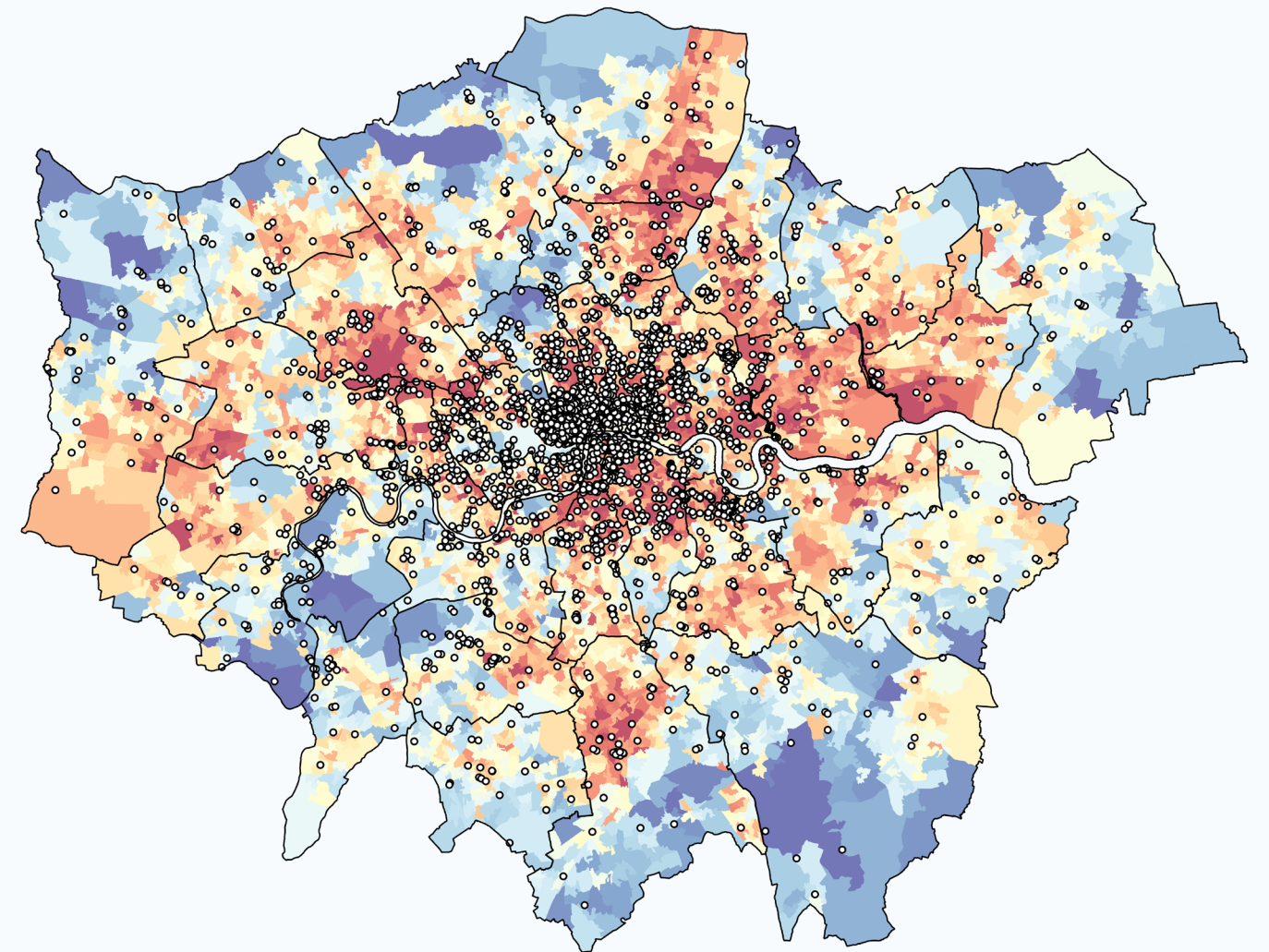


Figure 5.1 London's cultural infrastructure assets overlaid on the GLA Climate Risk Map

4. Excess mortality during heat-periods - Office for National Statistics (ons.gov.uk)

5. Heat mortality monitoring report: 2022 - GOV.UK (www.gov.uk)

6. The London Climate Resilience Review – July 2024

London’s cultural sector is physically and socially vulnerable to climate impacts

London’s 4,169 cultural buildings—which range from large scale venues to heritage buildings and workspaces—are at risk from a variety of climate-related hazards.

The vast majority of London’s cultural infrastructure has not been designed to accommodate more intense and prolonged high temperatures. As we experience more frequent and intense heatwaves, extreme temperatures will pose a risk to building users and business continuity, as spaces become uncomfortable—or worse, unusable—during peak temperatures. The London Resilience Review found that London’s cultural sector, including theatres, galleries and museums are already experiencing the consequences of climate change. With higher temperatures, poorly adapted buildings, and disrupted public transport impacting visitor numbers, which the sector relies on.⁷

The increasing levels of flash flooding that the capital is set to experience will also disrupt operations and put building users at risk. Many cultural organisations are in precarious financial positions. The average cost of flooding to a business is £82,000.⁸ As such, the financial impact of such events could have significant consequences on the financial sustainability of organisations.

The vulnerability of a building to overheating and flooding are dependent on a number of factors, such as building fabric components (including building material, structure, windows and ventilation systems), as well as the building’s surroundings and proximity to green space.

The GLA Climate Risk Map provides a visual representation of overall climate risk across London. Overall climate risk has been calculated using 13 metrics, including flood risk, surface temperatures, socio-economic indicators and access to open space.

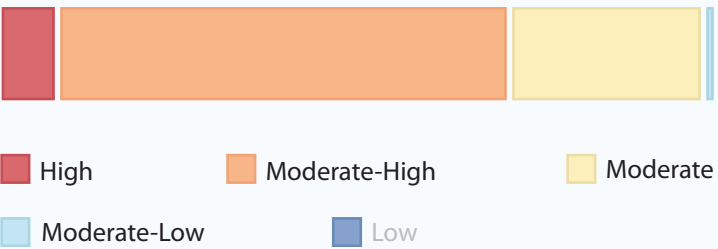


Figure 5.2 Climate risk of London’s cultural infrastructure, as per the LSOA risk ratings in the GLA Climate Risk Map

7. The London Climate Resilience Review – July 2024
8. Heat mortality monitoring report: 2022 - GOV.UK (london.gov.uk)

Mapping the cultural infrastructure assets to the GLA's Climate Risk Map provides an indication of the level of climate risk of London's cultural infrastructure. [Figure 5.1](#) shows a higher density of cultural infrastructure within central London, where the overall climate risk is higher. As shown in [Figure 5.2](#), 99% of London's cultural infrastructure assets are located in Lower layer Super Output Areas (LSOAs) for which the climate risk score 'moderate' or above (4,108 properties). An estimated 72% of assets are located in areas with moderate-high risk or above.

To better understand the climate risk facing London's cultural infrastructure, a building-level climate vulnerability assessment has been carried out for each of the eight case studies engaged in this study. This finds that across the sector, heat poses the most significant risk, with all organisations scoring three out of five or above. Surface water flooding is also a priority hazard for London. However, for the case studies analysed, surface water flooding is a less significant risk.

Further information on the case studies is presented in section six.

Risk of priority hazards

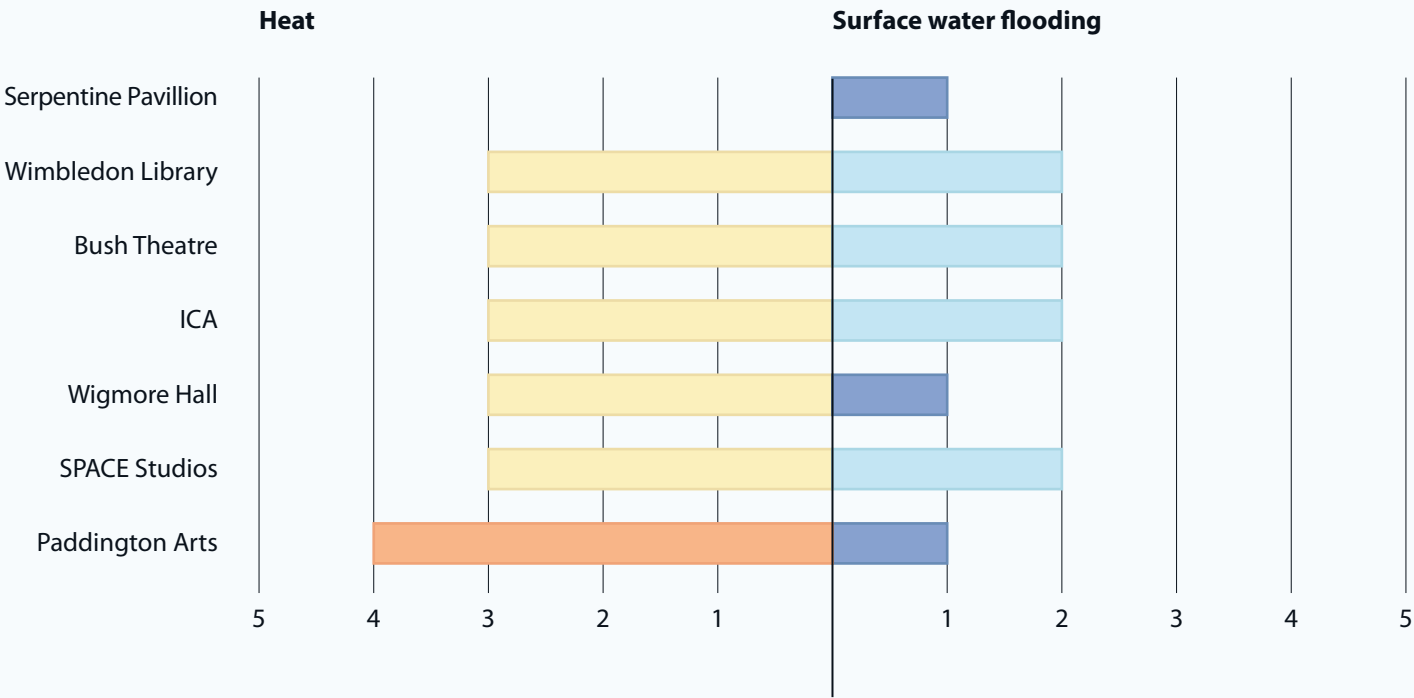


Figure 5.3 Climate risk of case studies to priority hazards

London’s cultural sector will need support to meet anticipated changes to MEES legislation and transition to net zero

Since April 2023, landlords of non-domestic rented properties have only been permitted to rent out their property if it achieves at least an Energy Performance Certificate (EPC) E rating, unless they have registered a valid exemption.

Plans for national legislation, requiring commercial landlords to achieve an EPC C from 2027 and an EPC B from 2030, were scrapped by the previous government in 2023. At the time of writing, it is unclear whether the new Labour government will reintroduce this legislation; the Labour party manifesto refers to the residential sector meeting MEES standards by 2030, but does not address non-residential buildings. However, given the significant proportion of London’s cultural organisations that are housed in large, ageing buildings that are costly to maintain or retrofit, EPC improvements may be challenging to meet without support to enable the retrofit of these assets.

Analysis of the EPC ratings has been undertaken to determine the energy resilience of London’s cultural infrastructure. Whilst data availability has not enabled the matching of EPCs for all of London’s 4,169 cultural assets, EPCs have been matched to 1,275 assets, which is considered to be statistically representative. Refer to the methodology for the matching approach used.

As shown in [Figure 5.4](#), 90% of London’s cultural infrastructure buildings (for which data could be obtained) currently have an EPC rating of E or above. However, if MEES requirements were raised to an EPC C rating, only 47% of venues would remain lettable without energy efficient interventions. This figure falls to only 18% if regulations were to require a minimum EPC rating of B.

Regardless of whether MEES changes come into force, the energy performance of London’s cultural sector will need to be improved in order to meet local and national net zero targets.

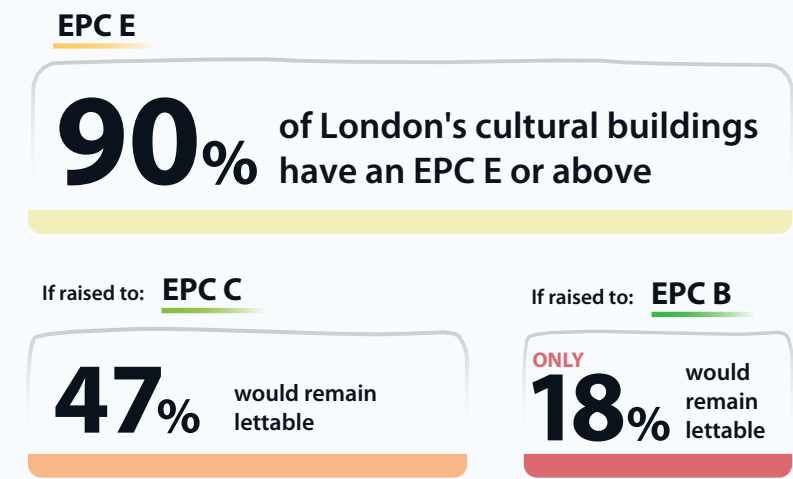


Figure 5.4 Current EPC ratings for London’s cultural infrastructure

London's cultural assets support the resilience of their local communities

London's cultural infrastructure is central to the city's character as a global capital for arts and culture. Its cultural assets and creative industries are essential for London's success and the wellbeing of all Londoners. The city's cultural infrastructure—from libraries, theatres and galleries to community art centres and workspaces—not only allow people to experience culture, but also often play several roles beyond what might typically be understood as 'cultural'.⁹ These spaces form vital parts of their local communities: allowing people to socialise and collaborate, improving wellbeing and reducing isolation, as well as offering opportunities for skills and training.

During periods of extreme heat, venues such as museums have reported experiencing increased footfalls as people come to them to find a cold place to sit or spend the day.¹⁰ However, whilst heat refuges can be vital to support local communities to manage high temperatures, as heatwaves continue to become more frequent, this could put pressure on such organisations, and challenges may arise around maximum safe visitor numbers. High energy prices and more extreme cold spells in the future will also result in higher demand for 'warm spaces' and '[warm welcomes](#)' for people to take refuge.

9. cultural_infrastructure_plan_online.pdf (london.gov.uk)

10. The London Climate Resilience Review – July 2024

6

**A Deeper Look
at Resilience**

Libraries and Archives

This category covers a wide range of different building typologies, organisations and operations. Across public and academic libraries, ownership models vary. As does the scale and age of buildings, from grand historic libraries to small, community run spaces.

Archives may include secure and climate-controlled storage for books, papers and other objects, but public archives will also have reading rooms, public facilities and offices. Archives are often held by organisations of different kinds, including large cultural organisations, and managed within the context of large estates.

OF THE
891 LONDON
LIBRARIES
AND ARCHIVES
503
ARE IN AREAS WITH
MODERATE-HIGH
CLIMATE RISK

Overall Climate Risk
High Low

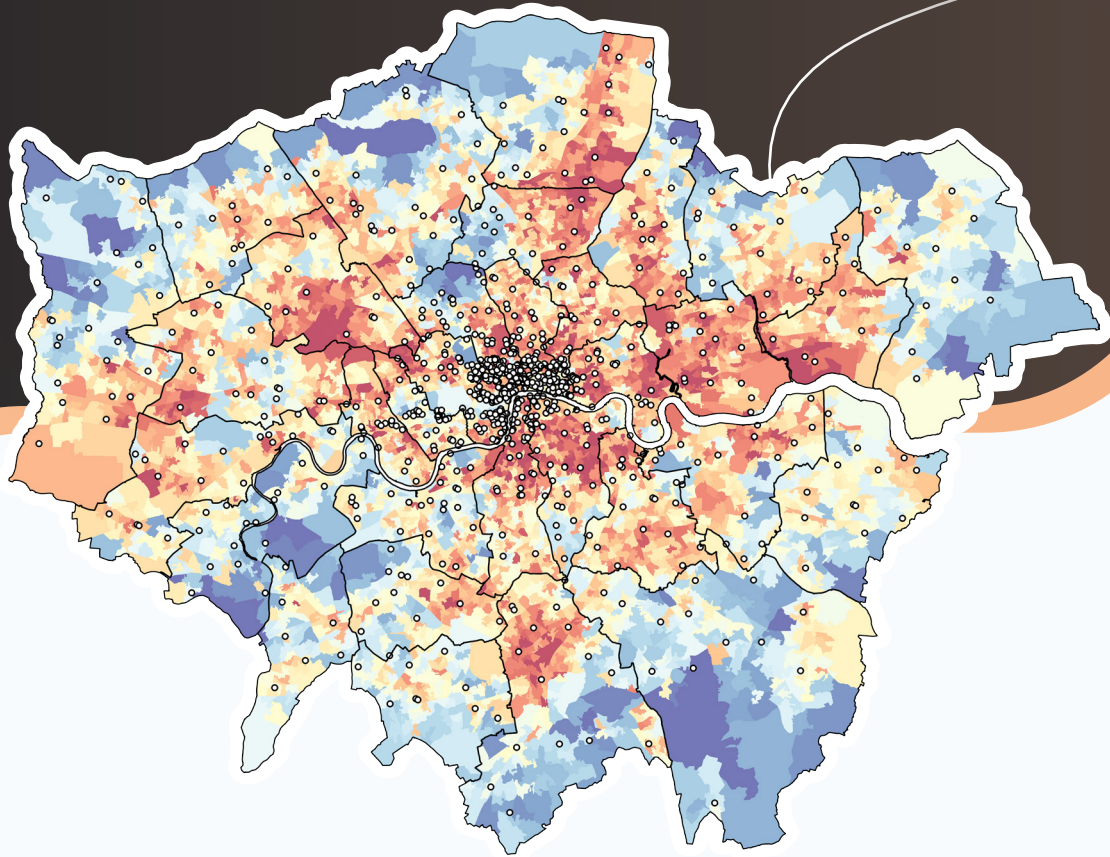
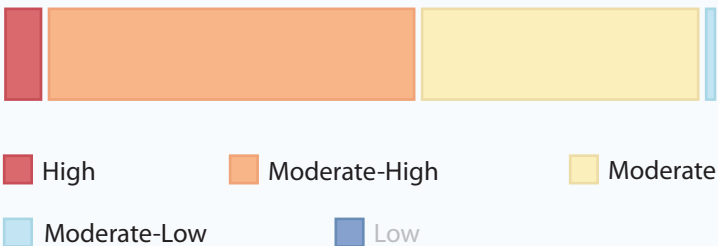


Figure 6.1 Libraries and Archives mapped onto the GLA Climate Risk Map

LIBRARIES AND ARCHIVES RESILIENCE

Climate risk

As shown in the graph below, the majority of London's libraries and archives (503 properties) are in LSOAs with a moderate-high level of climate risk, as per the GLA Climate Risk Map. A further 235 libraries and archives are in areas of moderate risk, whilst 53 are in areas of high risk.



EPC rating

The analysis of data from the Energy Performance of Buildings Register resulted in matching 56 libraries and archives to EPCs. This found that currently, 93% of libraries and archives have an EPC E or above. If MEES requirements were raised to an EPC B rating, only 25% of libraries and archives would remain lettable without energy-efficient retrofit measures. An estimated 45% of London's libraries and archives currently achieve an EPC C or above.



CASE STUDY

Wimbledon Library

LOCATION

35 Wimbledon Hill Rd,
London SW19 7NB

FUNCTION

Library and broad ranging
community services

CHARACTERISTICS

Victorian library with
a heritage façade

KEY USER GROUPS

Variety of community groups

About

Originally opened in 1887 as the Wimbledon Free Public Library, the building has been refurbished and adapted several times. The separate Marlborough Hall was incorporated in 1899.

In 2013, the underutilised backroom areas of the library were repurposed, turning them into places to work, share and grow businesses. In 2016, Merton Arts Space was created in Marlborough Hall, providing a flexible performance space available for hire.

The library is managed by a centralised operations team, who are also responsible for Merton's other libraries.

Role in the community

The library represents an anchor point within the local community, offering a huge range of services. In addition to access to books, computers and digital services, the library includes music recording space, co-working space and a cafe. The venue hosts a wide range of services from family and social support groups to health classes, citizens advice and events. Wimbledon Library is one of seven libraries in the Borough of Merton.

The library also acts as resilience hub in both summer and winter, offering a “warm space and cup of tea” during cold periods and providing a free, publicly accessible cool spot during heatwaves.

Climate risk assessment

HAZARD	RISK RATING
Heat	3
Surface water flooding	2



SUMMARY OF KEY CHALLENGES

- ❌ Overheating of office and library spaces.
- ❌ Ambition and need to adapt buildings and operations is not matched by funding available.
- ❌ Tendering process prevents long lasting relationships with contractors.
- ❌ Meeting gaps in local community infrastructure, as grassroots organisations have shut down or lost their venues, places additional pressure on the facility.

Addressing energy and climate resilience

CASE STUDY Wimbledon Library

KEY CHALLENGES

-  **Overheating of office and library spaces**

Several of the building's spaces overheat in summer. This is managed through active cooling systems in the offices. These are complemented by passive measures such as opening windows for cross ventilation and the use of the blackout blinds to prevent solar gain.
-  **Lack of funding available**

Whilst the operations team reported an interest and willingness to implement actions to support sustainable practice in line with local plans, funding to implement adaptations and programmes is not always available.
-  **Tendering process prevents long lasting relationships with contractors**

Whilst open procurement processes support transparency, the operations team reported that they often result in the appointment of contractors who have not previously worked with the building. Therefore, they lack an understanding of the specific needs and nuances of the space. This means building specific skills and knowledge is lost between projects.
-  **Community infrastructure requirements places pressure on facilities**

The operations team reported that the library has become home to several local organisations who are no longer able to remain in their previous venues. This has been for a variety of reasons, including buildings no longer being fit for purpose and rising costs meaning organisations can no longer manage upkeep or make necessary improvements.

ACTIONS TO SUPPORT RESILIENCE

-  **Centralised energy and water monitoring**

Across Merton's seven public libraries, there is centralised energy and water use monitoring. This enables annual usage trends to be monitored and warnings to be raised where issues arise from leaks or user behaviour changes.
-  **LED lighting and controls systems**

A key focus across Merton's libraries is the implementation of LED lighting and controls systems, including Passive Infra-Red (PIR) sensors for lighting and additional controls for heating systems. These allow the buildings to operate more efficiently and are considered 'easy wins' to roll out across multiple buildings where capital funding is available.
-  **Increased opening hours**

Funding from the ACE's Libraries Improvement Fund has allowed the Library to extend their opening hours by 90 minutes in the mornings and an hour in the evenings. This is particularly important during cold winters and hot summers, when the space can be used as a resilience hub by the local community.
-  **Focus on energy efficiency**

When planned works are undertaken, upgrades typically focus on the most efficient equipment available. For example, studies are currently being undertaken to determine the feasibility of transitioning to air source heat pumps when the current boilers reach the end of their service life feasibility.

Addressing energy and climate resilience

CASE STUDY Wimbledon Library

BARRIERS

-  **Working within the refurbishment schedule**

The Library has a limited budget to rapidly decarbonise. Any upgrades to new technology, such as changes to from boilers to air source heat pumps, must be completed as part of the standard refurbishment schedule. The operations team also reported concerns around maintenance and repairs for future more complex equipment given these limited annual budgets.
-  **A lack of library-specific sustainability working groups and guidance**

Library buildings are unique and varied and community use can increase pressure on energy consumption, meaning existing guidance does not necessarily capture the nuances and opportunities relating to sustainability challenges. The operations team reported they would benefit from peer-to-peer knowledge sharing around the management of sustainability challenges of library buildings. Similarly, specific target setting amongst libraries would help to drive change and establish shared approaches to these challenges.

KEY LEARNINGS

-  **Develop strong relationships and support from the local council where possible**

The Library is operated by the London Borough of Merton. This has enabled it to gain access to technical expertise around building improvements and upgrades. This has supported the building to adapt to local challenges.
-  **Leverage relationships with businesses focused on local community support**

Renting out space to local, community-focused businesses such as nurseries has increased revenue streams whilst also providing benefits to the local community and increasing footfall. Additional revenue has enabled for minor improvements to shared facilities, as well as enabling the installation of localised spot cooling, increasing comfort levels during summer.
-  **Ensure staff are consulted**

When works are planned, the Library typically consults with the day-to-day staff to ensure that all ideas, needs and specific day-to-day knowledge is incorporated in plans. This ensures buy-in at all levels of the process.
-  **Build economies of scale and standardisation across the local sector**

The centralised management and operations of the Library with Merton's other libraries enables standardisation of processes and sharing of resources. This supports flexibility of staffing and equipment and allows the operations team to benefit from economies of scale whilst undertaking improvement works.

Multi-Artform Buildings

Multi-artform buildings are diverse. London's 26 multi-artform buildings contain a wide variety of space, often used in very different ways from one week to the next. Occupancy patterns of these spaces also vary.

The mid-twentieth century saw the construction of numerous regional Arts Centres. Many of them have not been upgraded since, running on increasingly ageing services systems. Other multi-artform buildings occupy historic buildings such as townhalls, schools or libraries. A few are housed in newer, purpose-built premises.

OF THE
26 LONDON
MULTI-ARTFORM
BUILDINGS
19
ARE IN AREAS WITH
MODERATE-HIGH
CLIMATE RISK

Overall Climate Risk
High Low

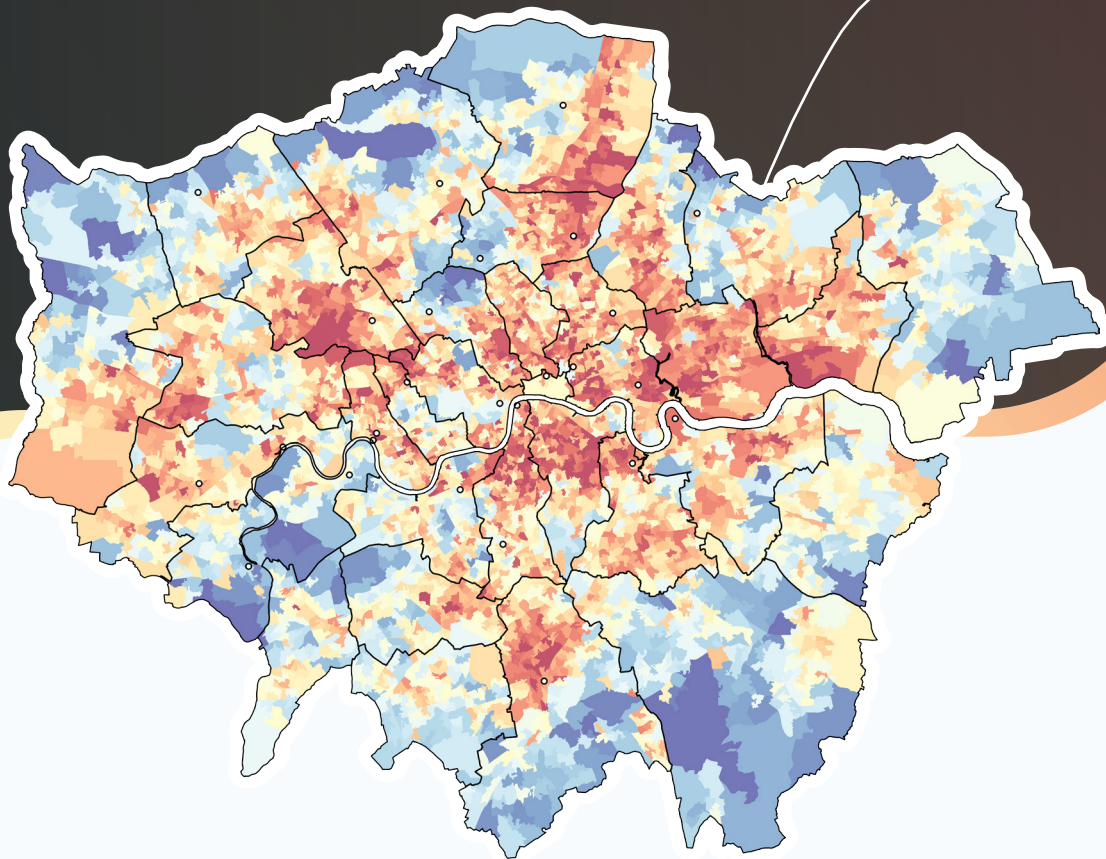
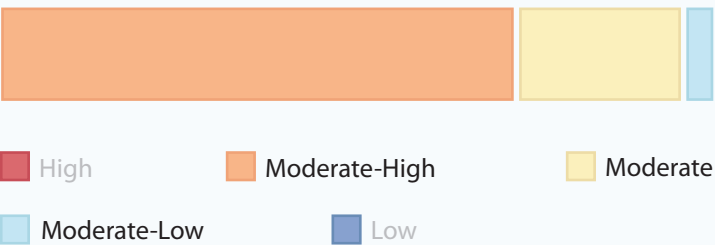


Figure 6.2 Multi-Artform buildings on GLA Climate Risk Map

MULTI-ARTFORM BUILDINGS RESILIENCE

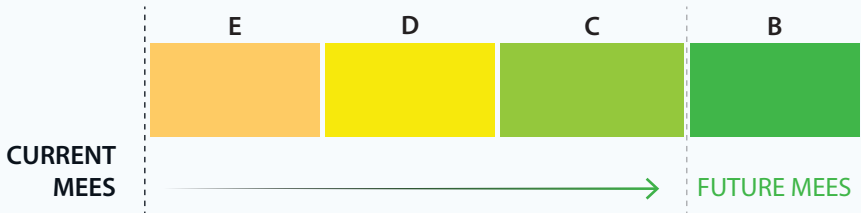
Climate risk

As shown in the graph below the majority of London's multi-artform buildings (19 properties) are in LSOAs with a moderate-high level of climate risk, as per the GLA Climate Risk Map. A further 6 libraries and archives are in areas of moderate risk. No multi-artform buildings are in LSOAs of high risk.



EPC rating

The analysis of data from the Energy Performance of Buildings Register, resulted in matching 13 multi-artform buildings to EPCs. This found that currently, all multi-artform venues have an EPC rating above an E. However, if MEES requirements were raised to an EPC B rating, only 23% of multi-artform venues would remain lettable. An estimated 54% of London's multi-artform buildings achieve an EPC C or above.



CASE STUDY

The ICA

LOCATION

The Mall, London, SW1Y 5AH

FUNCTION

Multi-form arts, cinema, performance, exhibition spaces and music / gigs

CHARACTERISTICS

Grade 1 listed Building

KEY USER GROUPS

Cinema/exhibition/performance goers, tourists, office space users

About

The Institute of Contemporary Arts (ICA) is one of London’s leading spaces for contemporary culture. They commission, produce and present new work in film, music, performance and the visual arts. The ICA was established in 1947 and has resided in its current home on The Mall since 1967.

Role in the community

The ICA is an internationally renowned multi-form arts venue with a diverse range of spaces accessible to the public. The ICA building contains two cinemas and a performing arts theatre, as well as exhibition spaces for artists. The building also has a number of office spaces on the upper floors that are let out to creative or arts-based groups, and smaller bookable workshop spaces that are often used by educational programmes or youth groups.

The ICA also houses a café that is open all day and often functions as an informal meeting space for creative workers, as well as a bar in the evening.

SUMMARY OF
KEY CHALLENGES

- ❌ Listed building status increases programme length, complexity and costs of interventions.
- ❌ Inefficient and aging systems increase energy costs.
- ❌ Roof leaks have damaged the building and its interiors.
- ❌ Overheating of performance spaces and lettable office spaces pose a risk to operations.

Climate risk assessment

HAZARD	RISK RATING
Heat	3
Surface water flooding	2



Addressing energy and climate resilience

CASE STUDY The ICA

KEY CHALLENGES



Grade I listing

The listed status often increases renovation/refurbishment programme times and costs, due to lengthy approvals process and the complexity of navigating the constraints. For example, constraints on where air source heat pumps can be installed outdoors caused the cost of the proposed interventions to rise significantly. This was because alternative locations and routes for the pipework had to be identified, leading to higher design and material expenses.



Inefficient and ageing systems leading to high energy costs

Electric, heating and lighting are run from basic manual systems. The heating system has no controls or zoning, meaning it is either 'on' or 'off'. Faulty valves mean heating can be on unnecessarily or turned off during cold snaps. Similarly, lighting can often be left on for extended periods when spaces are not being used. The building's boilers are aging and in need of replacement, but funding is a challenge.



Roof leaks causing damage to the building and its interiors

The flat roof has been repaired incrementally overtime. The increasing frequency of extreme rainfall in recent years has highlighted that major works are needed to prevent further damage to the building. However, funding is not available at the scale of investment needed.



Overheating

The performance space has no air conditioning. With a maximum capacity of 405 people it can become very hot in the summer, impacting user experience and health and safety. Overheating of the lettable office spaces during summer months is an increasing issue, presenting a risk to several major sources of revenue for the building.

ACTIONS TO SUPPORT RESILIENCE



Circular economy

To reduce waste from exhibitions, the operations team work with a variety of small networks to pass on materials for reuse. However, limited storage within the venue severely hampers the ICA's ability to retain elements for reuse.



Carbon emissions reporting

With support from Julie's Bicycle, carbon reporting has driven change across the organisation. For example, making people accountable for the emissions from their business travel has led to behaviour change and associated carbon reductions.

Addressing energy and climate resilience

CASE STUDY The ICA

BARRIERS

Poor commissioning of systems

The cinema space's ventilation system was upgraded during the pandemic, with the aim of maintaining comfortable summer temperatures. However, due to poor commissioning the systems fails to function properly.

Limited maintenance budget

The budget for maintenance is limited and mostly required to be used for essential repairs or regulatory compliance. This limits ability to invest pre-emptively, fixing issues when they arise before they become larger, more costly challenges.

Staff turnover and capacity

Staff turnover has affected the ability to plan long term and retain knowledge. Responsibility for sustainability action is split across individuals, leading to difficulty creating a coordinated strategy.

Division of responsibilities between landlord and tenant

The ICA leases the building from The Crown Estate, with the ICA responsible for upkeep and maintenance. This means that whilst costs lie with the ICA, they do not benefit from investments made in the long-term.

KEY LEARNINGS

Develop and maintain relationships with trusted contractors

Strong relationships between the operations team and trusted contractors who have worked regularly with the building—and therefore understand its complexities and challenges—has enabled them to anticipate issues and successfully carry out actions to address these.

Manage energy consumption through controls

The ICA has explored opportunities to reduce energy consumption through LED lighting in certain spaces. However, they have found the efficiency of direct bulb replacements from fluorescent to LED does not yield significant energy reduction benefits to justify the extra upfront investment. Full refurbishment of the entire lighting system to LEDs is considered to have too great a capital cost. Upgrading controls strategies throughout the building including occupancy and daylighting sensors is expected to see a greater return on investment.

Museums and Galleries

As with other categories, museums and galleries vary widely in age and scale, ranging from national collections in historic monuments to community facilities and open-air attractions. Many are housed in listed buildings, limiting the ability to implement adaptations.

Museum and gallery exhibitions are often in large, open-plan spaces, requiring heating, cooling and daylight control. Many will also include storage and archive facilities, requiring control of temperature and humidity. Some will also include office space, as well as other open and public spaces, such as cafes or bars.

OF THE
553 LONDON
MUSEUMS AND
GALLERIES

289

ARE IN AREAS WITH
MODERATE-HIGH
CLIMATE RISK

Overall Climate Risk
High Low

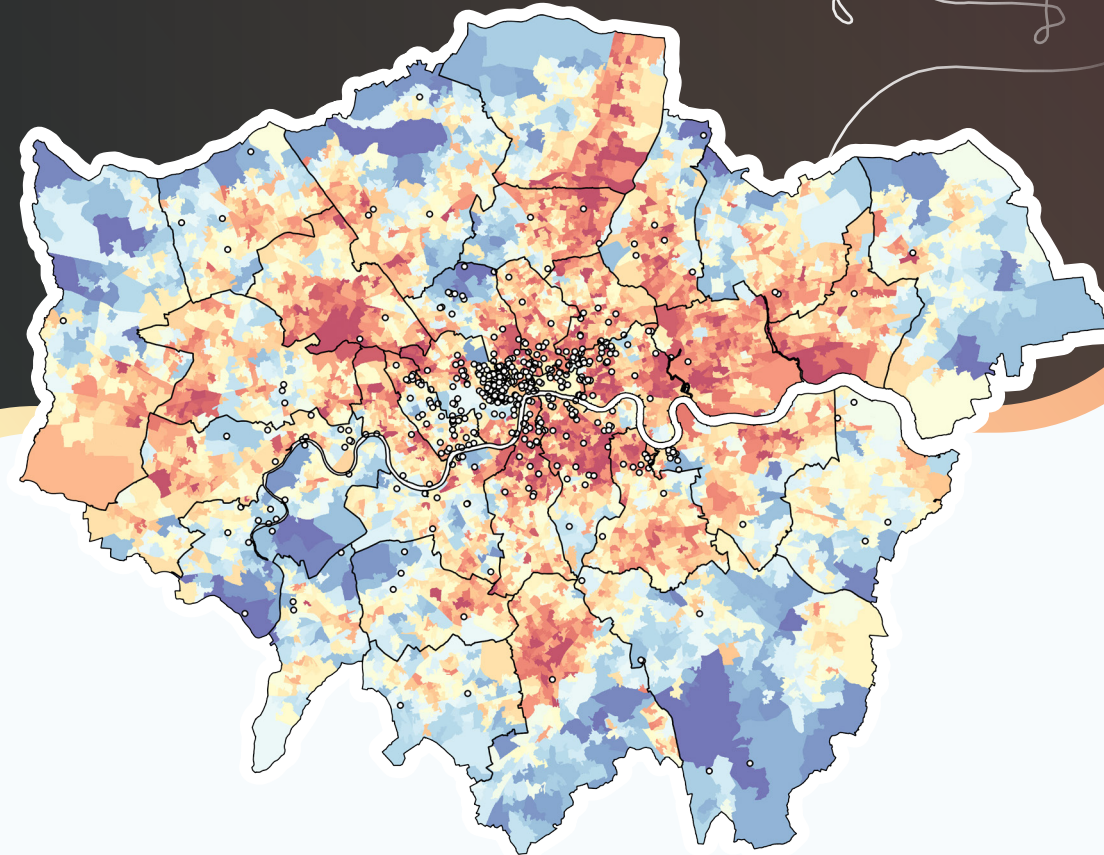
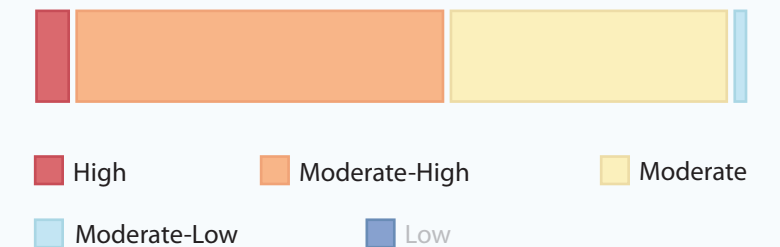


Figure 6.3 Museums and Galleries on GLA Climate Risk Map

MUSEUMS AND GALLERIES RESILIENCE

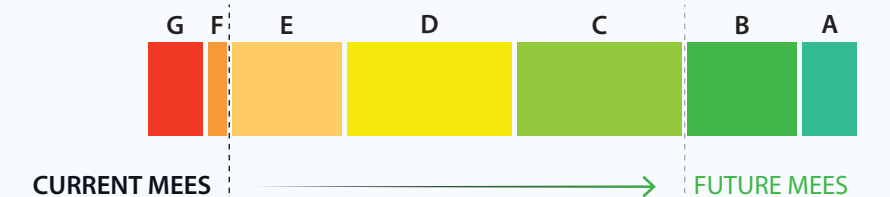
Climate risk

As shown in the graph below, the majority of London's museums and galleries (289 properties) are in LSOAs with a moderate-high level of climate risk, as per the GLA Climate Risk Map. A further 219 museums and galleries are in areas of moderate risk, whilst 30 are located in areas of high risk.



EPC rating

The analysis of data from the Energy Performance of Buildings Register, resulted in matching 37 museums and galleries to EPCs. This found that currently, 89% of museums and galleries have an EPC rating above an E. However, if MEES requirements were raised to an EPC B rating, only 24% of museums and galleries would remain lettable. An estimated 49% of London's museums and galleries achieve an EPC C or above.



CASE STUDY

Serpentine

LOCATION

Serpentine, Kensington
Gardens

FUNCTION

Gallery

CHARACTERISTICS

Both galleries are Grade II
listed

KEY USER GROUPS

Art gallery patrons, artists,
tourists

About

Serpentine is a contemporary art gallery located in Kensington Gardens. The galleries are spread across two buildings, situated to the north and south of the Serpentine Lake. The Grade II listed North Gallery combines a 19th century structure with a 21st century extension, whilst the South Gallery is a Grade II listed former tea pavilion.

Programming has included three strategic strands of activity running in parallel: Ecologies, Art Technologies and Public Practice. Each strand has had a gallery presence and delivers research and development led outcomes, including public engagement, online interaction and events.

Role in the community

Serpentine provides a programme of exhibitions, architecture, education and live events, free for all visitors. The Serpentine champions sustainability and resilience action through its programming, supporting visitors to engage with environmental, technological and civic issues.

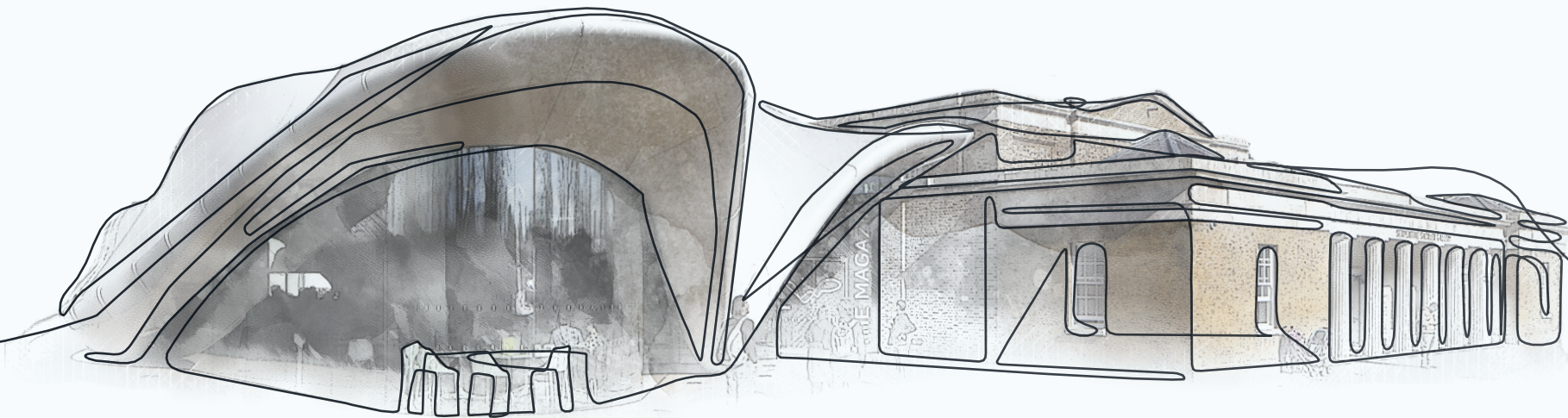
The exhibitions, architecture, education and public programmes have attracted up to 1.2 million visitors a year.

SUMMARY OF KEY CHALLENGES

- ❌ Research and development approach often not recognised by targeted funding opportunities.
- ❌ Lack of opportunity to contribute to environmental policy.

Climate risk assessment

HAZARD	RISK RATING
Heat	N/A ¹¹
Surface water flooding	1



11. Capacity constraints meant that a site visit was not undertaken for the Serpentine. Therefore, the heat risk assessment has been omitted.

Addressing energy and climate resilience

CASE STUDY Serpentine

KEY CHALLENGES

Research and development approach often not recognised by targeted funding opportunities

Serpentine's exploratory research-based approach to environmental challenges means that many project outcomes are often not considered with KPIs or criteria set out in funding applications, which can be narrow in scope. This creates barriers for implementing ideas that are multi-faceted or touch on a range of sustainability challenges.

ACTIONS TO SUPPORT RESILIENCE

Embedding environmental action in operations and programming

The ecological crisis is embedded in Serpentine's operation and decision-making structure through the Ecologies strategic programming strand. This ensures environmental concerns are considered across decision making, programming and implementation; supporting the organisation and visitors to engage with ecological challenges.

Installation of solar panels

As a result of Tomás Saraceno's 2023 'Web(s) of Life' exhibition, Serpentine installed solar panels at its Grade II listed South Gallery. This has since paved the way for other institutions to undertake similar works.

Cross-industry engagement

The first contemporary art organisation to create a curatorial role dedicated to art and ecology, Serpentine has engaged with other institutions, supporting them to establish ecological roles within their operations.

Education and awareness raising through programming

Many Serpentine exhibitions raise awareness of environmental concerns. For example, Back to Earth developed 50+ environmental campaigns, culminating in an exhibition. The Pollinator Pathmaker installation, a living sculpture made of plants, created by artist Dr Alexandra Daisy Ginsberg, raises awareness of the importance of endangered pollinators as well as supporting biodiversity in the Royal Parks. Similarly, the 2023 'Web(s) of Life' exhibition was designed to be responsive to the weather. Mechanical ventilation was turned off, resulting in spaces becoming uncomfortably warm and some areas of the galleries being closed, encouraging visitors to consider the exhibition's ecological themes.

Addressing energy and climate resilience

CASE STUDY Serpentine

BARRIERS

Lack of opportunity to contribute to environmental policy

The Serpentine reported that art and culture are often perceived as communicators of environmental policy, rather than influencers or contributors. Cultural institutions offer an intersection of ideas and innovations in relation to addressing the climate and biodiversity crises and its intersection with society, which can inform policy. As such, the Serpentine advocates for the agency of cultural organisations in environmental policy.

KEY LEARNINGS

Enabling programming to create interventions for building sustainability

Due to the exploratory nature of the Serpentine's Ecologies programme, multiple avenues are explored beyond limitations typically set by research institutions. This can lead to the development of new and exciting developments, beyond the status-quo.

Support a long-term approach to create more sustainable outcomes

The integrated ecologies approach has been in place for a decade. As such, it is deeply embedded within the organisational culture and at all levels of decision making. Securing funding for the long-term is essential and leads to deeper, more effective sustainable solutions.

Recognise that not all co-benefits can be predicted at project outset

Due to the research and artist-led nature of the Serpentine's work, it is not always possible to quantify or predict the direct and indirect benefits at the project outset. For example, a podcast was established to increase the reach and output of the galleries, whilst minimising associated carbon footprint. This network subsequently proved essential during the COVID-19 pandemic; a benefit that could not have been foreseen.

Work in broad partnerships with organisations with shared environmental goals

Working in joint and cooperative initiatives that bring advocacy to community through the cultural field and the Arts can support environmental action and advocacy.

Music Performance Venues

Music venues are diverse. They range from concert halls and massive stadia to rooms above pubs, repurposed churches or community spaces. The vast majority of smaller venues operate on very short leases, creating little opportunity for improving building fabric, even if funding was feasible; 93% of Music Venue Trust members are tenants, with lease periods averaging no more than 18 months.¹² Whilst there are a greater number of large purpose-built venues that are owned and operated by larger companies who are more likely to have the financial capacity to make improvements, they may not prioritise sustainability.

OF THE
662 LONDON
MUSIC
PERFORMANCE
VENUES

414

ARE IN AREAS WITH
MODERATE-HIGH
CLIMATE RISK

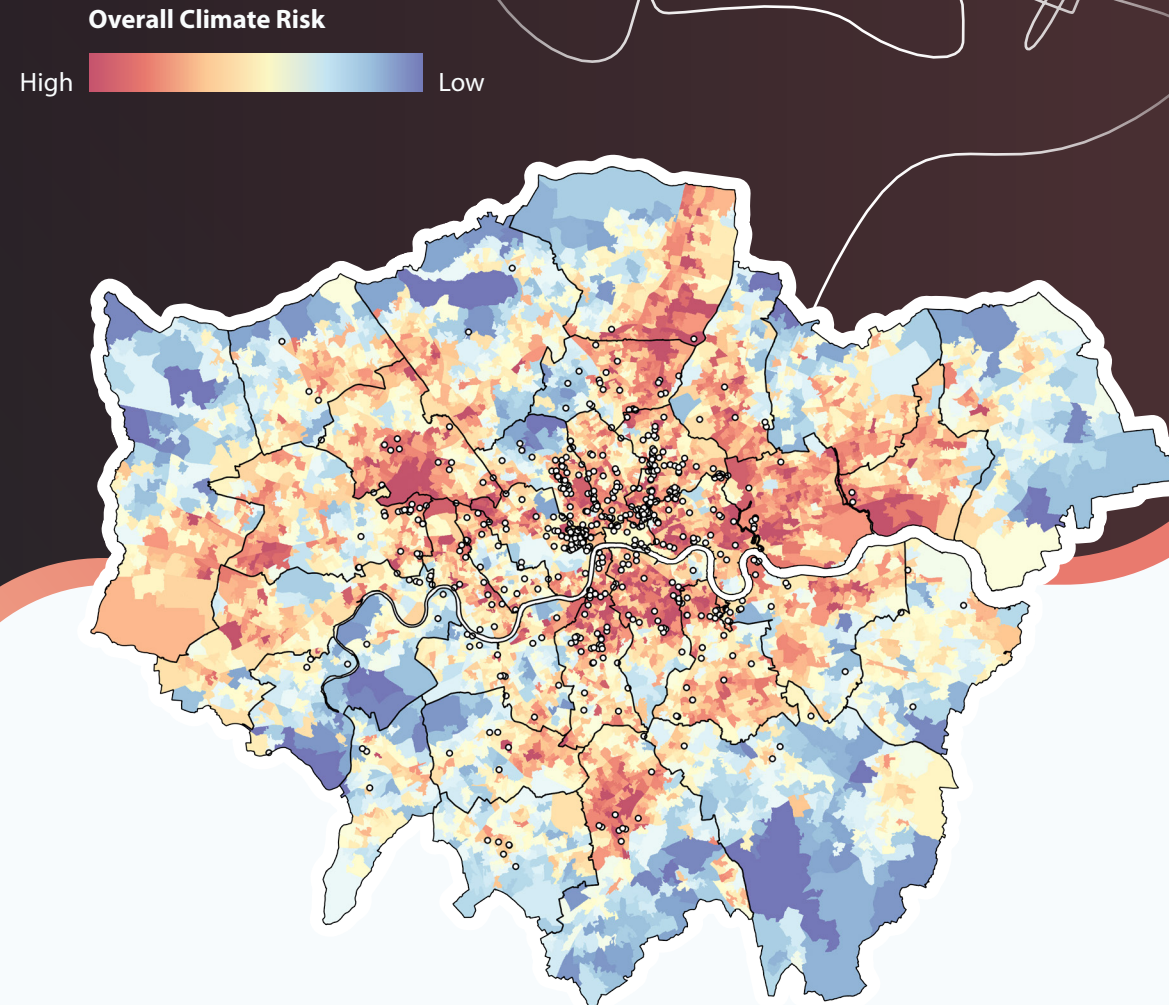


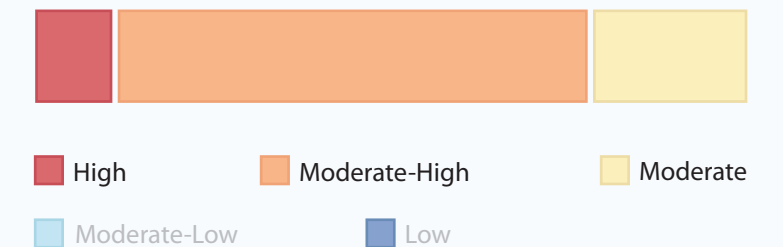
Figure 6.4 Music Performance Venues on GLA Climate Risk Map

12. Music Venue Properties Announce Second Purchase (musicvenuetrust.com)

MUSIC PERFORMANCE VENUES RESILIENCE

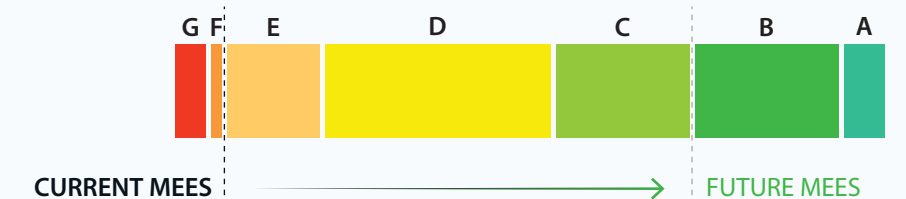
Climate risk

As shown in the graph below, the majority of London's music performance venues (414 properties) are located in LSOAs with a moderate-high level of climate risk, as per the GLA Climate Risk Map. A further 153 music performance venues are located in areas of moderate risk, whilst 70 are located in areas of high risk.



EPC rating

The analysis of data from the Energy Performance of Buildings Register resulted in matching 52 music performance venues to EPCs. This found that currently, 94% of music performance venues have an EPC rating above an E. However, if MEES requirements were raised to an EPC B, only 27% of music performance venues would remain lettable. An estimated 47% of London's music performance venues achieve an EPC C or above.



CASE STUDY

Wigmore Hall

LOCATION

36 Wigmore Street,
London, W1U 2BP

FUNCTION

Classical musical performance,
practice and broadcast

CHARACTERISTICS

Grade II listed building,
built in 1901

KEY USER GROUPS

Classical musicians, audience

About

Wigmore Hall specialises in chamber and instrumental music, early music and song. It presents around 500 concerts every year. Wigmore Hall's learning and participation programme aims to make the arts more accessible, working with families, schools, young people and people living with dementia through their Music for Life programme.

The Hall was refurbished in 2004, improving audience comfort in the auditorium, including new seats and air conditioning throughout, as well as providing improved retail and hire out potential. The backstage areas were renovated in 2015.

Role in the community

The building has heritage and legacy stretching back nearly 125 years, with many of the great musicians and composers of the 20th Century having performed in the space. The Hall operates for eleven months of the year, with a break in August for maintenance. During operating months, a minimum of nine concerts are held a week, including lunch time recitals and a learning program, as well as working with artists within the community, supporting musicians at all stages of their careers.

Equality, diversity and inclusion are central to Wigmore Hall's mission, with events ranging from parent-toddler sessions to programmes for people living with dementia and their carers.



Climate risk assessment

HAZARD	RISK RATING
Heat	3
Surface water flooding	1

SUMMARY OF KEY CHALLENGES

- ⊘ Heavy rain causes challenges to roof and capacity of rainwater systems.
- ⊘ Balancing conflicting priorities: graded status, climate adaptation, auditory experience.
- ⊘ High costs associated with maintaining steady internal temperatures.

Addressing energy and climate resilience

CASE STUDY Wigmore Hall

KEY CHALLENGES

Impact of heavy rainfall

Wigmore Hall has experienced an increase in the impact of heavy rain over the last few years. It has a complex roof which has undergone significant repairs and is currently in good condition. However, constant maintenance is needed to prevent the Hall's rainwater systems being overwhelmed, causing damage to the interior.

Maintaining internal conditions

Significant changes in temperature and humidity can impact instruments, causing them to go out of tune or become damaged. Ensuring conditions remain constant in both front and back of house requires careful management of temperatures. This comes with associated energy costs.

Constraints given the listed building status

There are significant limitations on what can be achieved due to the Hall's listed status and the age of the systems that are in place. For example, narrow rainwater pipes become easily blocked by debris and limescale and their complex routes with twists and turns mean that they become overwhelmed during heavy rainfall.

ACTIONS TO SUPPORT RESILIENCE

Repair and maintenance to roof

The Hall's roof has undergone constant repairs and maintenance and must be observed regularly. Lead work has also recently been completed over the main space.

Energy saving measures

The Hall has undergone various refurbishments over the years, including measures to reduce energy use. Recently, lighting within the building was upgraded to LEDs to meet regulations. This came at a significant capital cost and had to be done sensitively to respect the listed building status and preserve the visitor experience. Secondary glazing has also been installed on most back of house windows, improving thermal comfort and reducing energy costs.

Improving thermal comfort

The most significant works undertaken have been the installation of ventilation and cooling systems in the Main Hall. This significantly improved comfort levels within the auditorium and the systems have been extended to also serve the back of house, improving occupant comfort throughout. The Hall's building management systems also allows the temperature to be accurately maintained and systems to be monitored and controlled.

Addressing energy and climate resilience

CASE STUDY Wigmore Hall

BARRIERS



High running costs

The fabric of the building is uninsulated, meaning that prior to the addition of heating and cooling systems, the space was often uncomfortable. Now the temperature is more easily managed, but the energy use for heating and cooling is high, increasing the building's operational carbon and running costs.



Prioritising investment towards public spaces

Wigmore Hall consist of two buildings: the Hall itself and an office space next door. The Hall is the priority for investment, which has resulted in poor thermal comfort for the office space, especially during the hottest summer months.



Maintenance is a continuous challenge

Due to the Hall's age, there is a constant need for repairs. It is crucial to take preventative action early to avoid further damage to the historic features, which could lead to even more significant and costly repairs.



Managing cashflow to carry-out works

Cashflow is a challenge, making it difficult to manage a large capital project like upgrading all the lighting to LEDs. The return on investment takes a long time to materialise.

KEY LEARNINGS



Take a long-term view on maintenance planning

Wigmore Hall has a structured plan of works and interventions for maintenance. This has enabled the operations team to keep on top of an extensive list of required works. Work is carried out proactively and to a high standard, with early interventions avoiding more expensive repairs in the long run.



Build and maintain relationships with trusted designers

The same architecture practice has supported Wigmore Hall's renovation work for the past 20 years. This has allowed them to develop a deep understanding of both the space and the needs of its users, enabling them to provide carefully considered design advice.



Cultivate a strong foundation of funders to enable proactive action

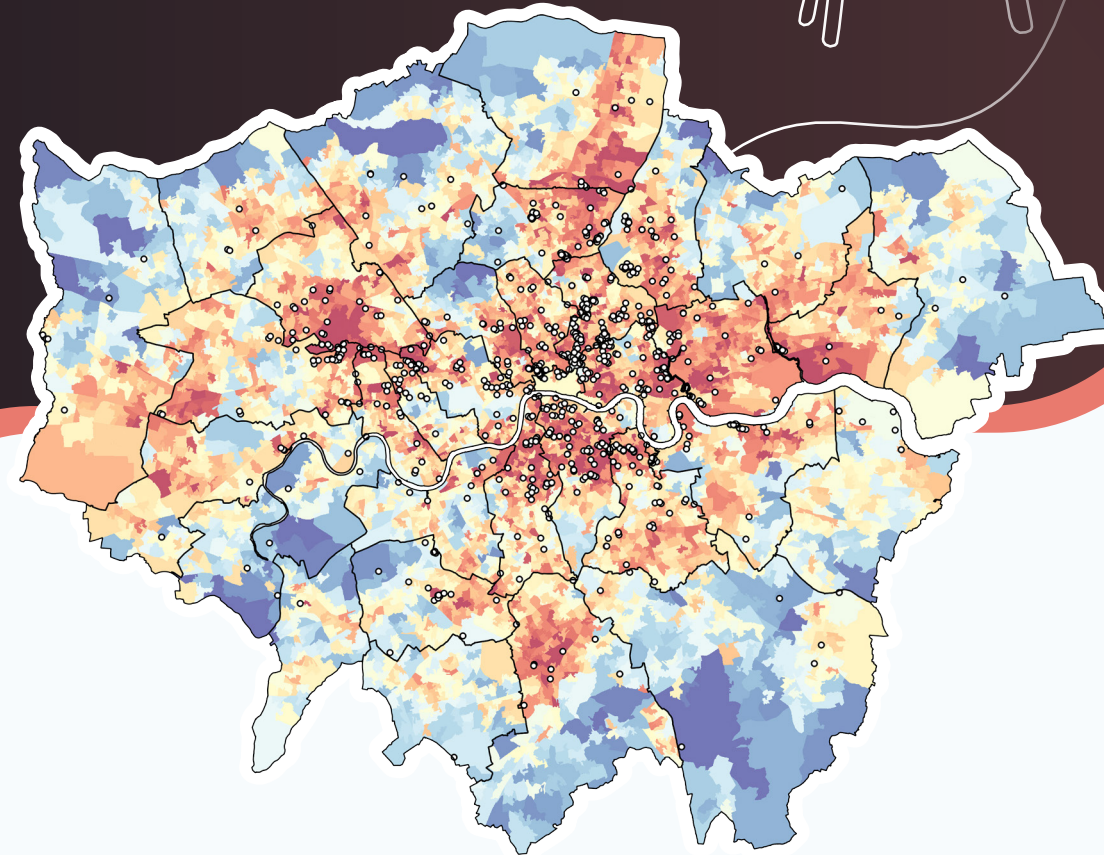
Wigmore Hall is currently well supported by an international group of donors who believe passionately in the importance of the unique experience provided at the venue. This has enabled the operations team to take a proactive approach to climate adaptation.

Studios and Workspaces

Studios and workspaces cover a wide variety of spaces in which the arts are made. London's studios and workspaces range from offices and shared artist studios to industrialised manufacturing facilities. They may be housed in purpose-built facilities, or in converted industrial buildings. Typically, they are not owned by end-users and are often occupied on short leases. This may also include 'meanwhile use' spaces, made available short-term by developers, but without the possibility for significant improvement.

OF THE
1019 LONDON
STUDIOS AND
WORKSPACES
773
ARE IN AREAS WITH
MODERATE-HIGH
CLIMATE RISK

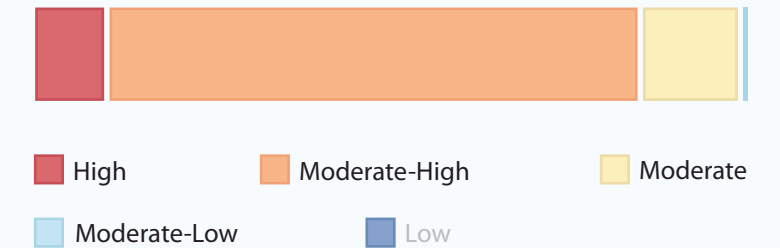
Overall Climate Risk
High Low



STUDIOS AND WORKSPACES RESILIENCE

Climate risk

As shown in the graph below, the majority of London's studios and workspaces (773 properties) are located in LSOAs with a moderate-high level of climate risk, as per the GLA Climate Risk Map. A further 135 studios and workspaces are located in areas of moderate risk, whilst 101 are located in areas of high risk.



EPC rating

The analysis of data from the Energy Performance of Buildings Register, resulted in matching 679 studios and workspaces to EPCs. This found that currently, 90% of studios and workspaces have an EPC rating above an E. However, if MEES requirements were raised to an EPC B rating, only 19% of studios and workspaces would remain lettable. Across all typologies in this study, this is the lowest share of assets with an EPC B or above. An estimated 44% of London's studios and workspaces achieve an EPC C or above.

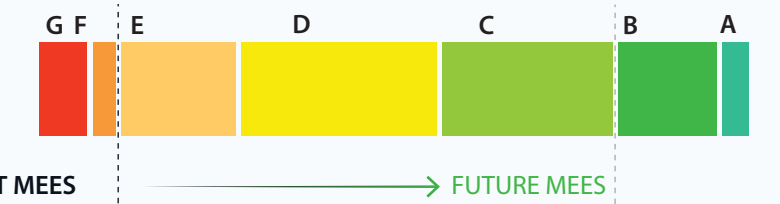


Figure 6.5 Studios and Workspaces on GLA Climate Risk Map

CASE STUDY

SPACE Studios

LOCATION

Multiple locations

FUNCTION

Art Studios

CHARACTERISTICS

Various typologies; typically converted industrial buildings

KEY USER GROUPS

Artists working across a variety of styles and physical media

About

SPACE (Space Provision, Artistic Cultural and Educational) is London’s largest studios provider, supporting artists since 1968. SPACE runs 20 studio buildings across eight London boroughs and Colchester, providing affordable creative workspace for more than 880 artists. As part of this study, site visits have been carried out at SPACE’s Martello and Deborah House, both located in Hackney, London.

SPACE also works with artists, partners and people in the communities neighbouring their studio sites, to promote engagement with creativity and the arts.

Role in the community

SPACE have a consistent 99% occupancy rate. There is a huge demand for artist workspaces, particularly in locations close to peoples’ homes and communities. Many artists fit creative work around other commitments or income streams, meaning that the availability of affordable workspaces close to amenities such as schools and transport hubs is beneficial.

SPACE’s Martello studio has been at the heart of the local community since the 1970s and has influenced the development of the community around it. SPACE provides affordable, flexible spaces for grassroots as well as established artists to develop their art.

Climate risk assessment

HAZARD	RISK RATING
Heat	3
Surface water flooding	2



SUMMARY OF KEY CHALLENGES

- ⊘ Falling supply of useable spaces.
- ⊘ Risk of stranded assets as changes required under MEES legislation are deemed uneconomical.
- ⊘ EPC rating recommendations do not always take into account the purpose of SPACE studios.
- ⊘ Lack of efficient heating and cooling systems combined with increasing energy costs impacts thermal comfort.

Addressing energy and climate resilience

CASE STUDY SPACE Studios

KEY CHALLENGES

Loss of useable space due to development

Many of SPACE's studios are located in converted industrial buildings, benefiting from lower costs and flexible floor plates. However, these spaces are becoming less common, as development tends to favour demolition and redevelopment over adaptive reuse.

MEES legislation

The Minimum Energy Efficiency Standards (MEES) although not yet implemented represent a significant risk to SPACE's operations, as they are likely to directly affect the converted industrial buildings with large lettable floorspaces that are typically used as artist workspaces. This has required them to consider future plans carefully to avoid being left with stranded assets that are not lettable.

Inadequate information driving decision making

SPACE have found consultants often struggle to understand their unique building requirements and user needs. However, though EPC ratings do not accurately reflect SPACE's needs and the recommended improvements are often unsuitable for how their buildings operate, these ratings still heavily influence decision making.

Efficient heating and cooling

Many of SPACE's converted industrial buildings lack efficient heating and cooling systems. In buildings where heating is available, increased heating costs have forced SPACE to limit the months in which they heat their studios, meaning studios can get incredibly cold during those months. Similarly, during summer months, some studios overheat.

ACTIONS TO SUPPORT RESILIENCE

Considering future legislation

SPACE manage their portfolio carefully in line with future legislation. For example, they reported not taking on leases of less than five years and carefully considering energy efficiency and building condition during contract renewals to mitigate impacts due to MEES compliance. SPACE also include protections in their leases to future-proof their tenancies, such as ensuring matched investment from the building owner for any EPC related improvements they wish to make during their tenancy. Where possible, SPACE aim to own their buildings so they have the freedom to make upgrades necessary and preserve investment in the long term.

Building upgrades

SPACE have carried out major updates to some of their buildings. For example, in 2015 they renovated Deborah House, extending it upwards, improving insulation, fixing leaks, upgrading windows to double glazing and incorporating a green roof. These measures have resulted in reduced maintenance costs and improved internal conditions, meaning artists can spend more time in their studios. The measures have also resulted in an EPC rating of C. SPACE hope to improve this to B by 2030 through upgrading all lighting to LED, the replacement of the gas boiler and the possible addition of solar panels. At Martello, some upgrades to glazing have been carried, as well as remedial repairs to electrical systems. A solar panel system is to be installed this year, and all lights will be changed to LEDs. These measures are projected to improve the EPC rating to a B.

Addressing energy and climate resilience

CASE STUDY SPACE Studios

BARRIERS



Limitations on funding

SPACE is a not-for-profit organisation, meaning cashflow can be a challenge for building upgrades. Whilst upgrades are planned across their portfolio, they are reliant on available funding, which is often only able to for certain measures, or capped at unrealistic amounts in relation to the scale of the building. Previous funding they have received from ACE and local councils has enabled improvements.



Grid capacity

SPACE reported challenges with electrical capacity in some venues, with limits on drawing electricity from the local grid and power outages during peak times. This is an increasing risk, particularly as they consider the move to all-electric systems, increasing overall demand and reducing the resilience that their gas boilers currently provide.



Limited space availability

SPACE also reported considerable pressure on the kind of old, industrial spaces they inhabit, citing the demolition and redevelopment of such spaces into housing, office and retail as the driver. With conversions often not taking into consideration the types of space and communities it is replacing.



Rising cost of living

SPACE reported being impacted by the cost-of-living crisis, with fewer tenants renewing leases. In order to mitigate this, SPACE has supported users to downsize or share studio spaces to help manage costs.

KEY LEARNINGS



Acknowledge the importance of EPCs

In order to manage the impacts of anticipated EPC legislation, when taking on new assets, SPACE prioritise buildings with an EPC B rating or above, in order to future-proof investment.



Take steps to future proof investment in rented properties

When taking on new leases, embedding protections, such as ensuring matched investment from building owners to any EPC related improvements ensure that investment is protected in the long run.

Theatre and Dance Rehearsal Space

London's theatre and dance rehearsal spaces vary in size, from small studios used by solo artists or small groups to large halls that can accommodate full-scale productions. As well as theatre and dance rehearsal spaces, they are commonly also used for workshops, training sessions or auditions. These spaces may be stand-alone rehearsal studios, or part of theatres and performance venues open to the public.

OF THE
469
302
LONDON
THEATRE
AND DANCE
REHEARSAL
SPACES
ARE IN AREAS WITH
MODERATE-HIGH
CLIMATE RISK

Overall Climate Risk
High Low

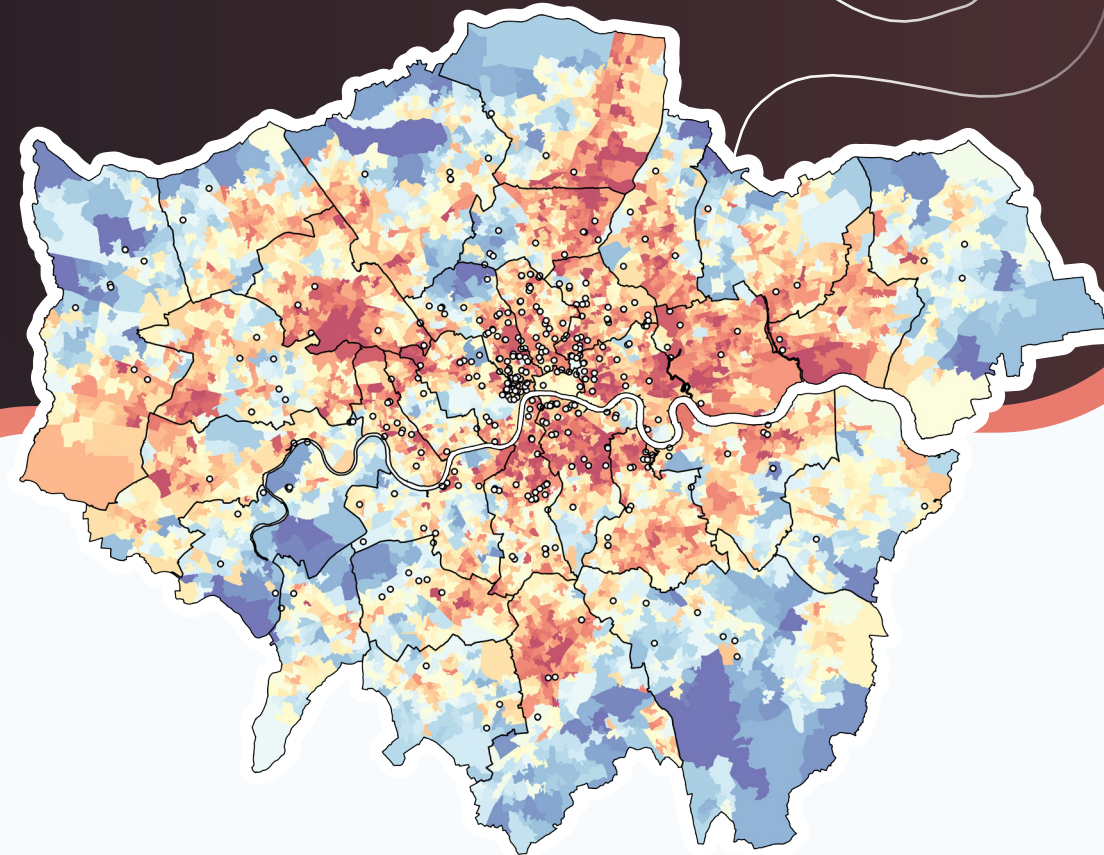
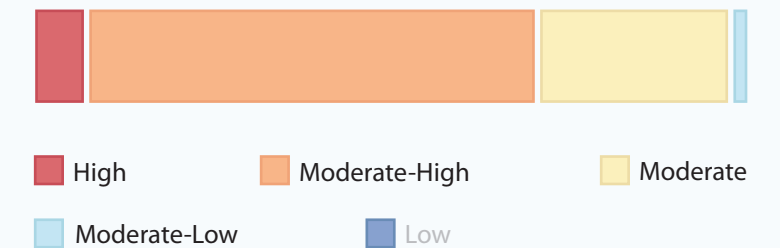


Figure 6.6 Theatre and Dance Rehearsal Spaces on GLA Climate Risk Map

THEATRE AND DANCE REHEARSAL SPACES RESILIENCE

Climate risk

As shown in the graph below, the majority of London's theatre and dance rehearsal spaces (302 properties) are located in LSOAs with a moderate-high level of climate risk, as per the GLA Climate Risk Map. A further 127 theatre and dance rehearsal spaces are located in areas of moderate risk, whilst 33 are located in areas of high risk.



EPC rating

EPC analysis has not been carried out for theatre and dance rehearsal spaces as insufficient data was available to match to EPC certificates to cultural infrastructure assets identified as theatre and dance rehearsal spaces. Refer to methodology for further detail on the matching approach.

CASE STUDY

Paddington Arts

LOCATION

32 Woodfield Rd,
London, W9 2BE

FUNCTION

Multi-form Arts

CHARACTERISTICS

Refurbished
commercial building

KEY USER GROUPS

Young people; digital media
professionals; local community
groups; council groups

About

Paddington Arts is a multi-form youth arts organisation, specialising in performing and digital arts. The organisation also offers spaces for hire for use by the local council and community, educational organisations and local businesses.

The building has been owned and operated by Paddington Arts since 1990. In 1997, the building was refurbished using funding from lottery grants. Paddington Arts is currently in the process of securing funding for a new building addition and upgrade, to be completed in 2025.

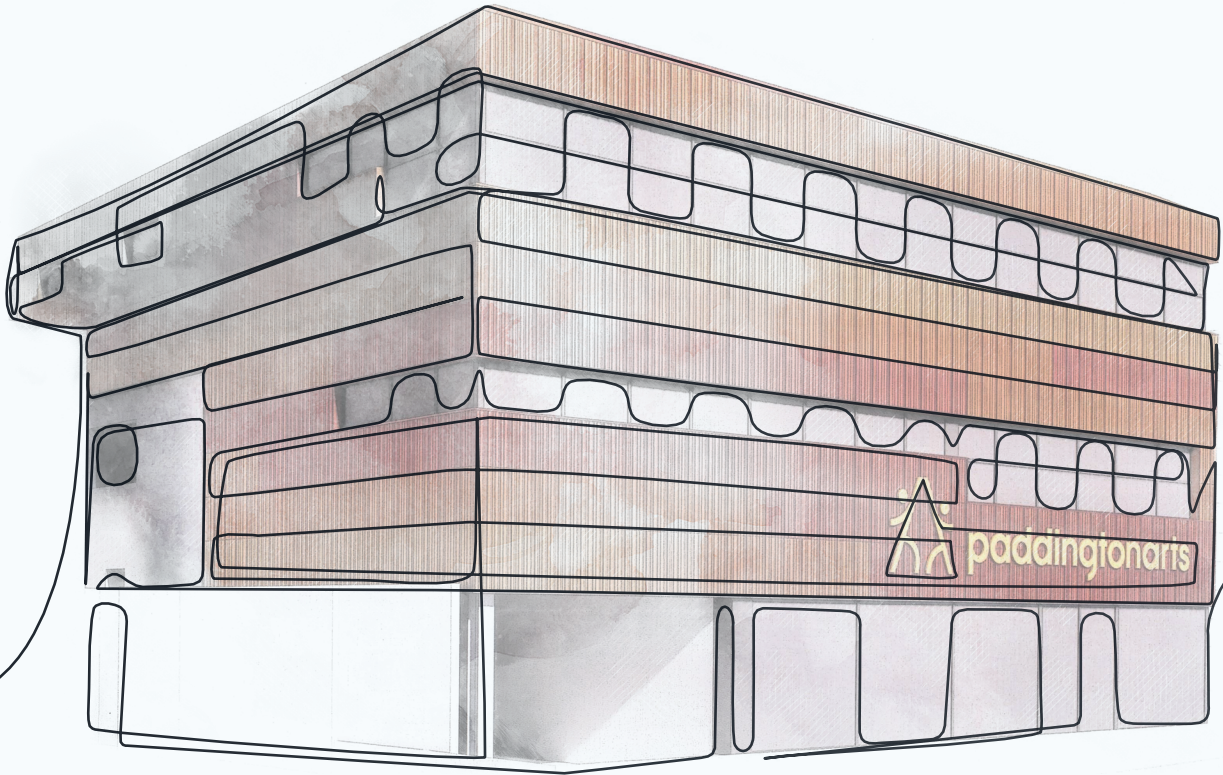
Role in the community

In addition to supporting youth in the Arts, Paddington Arts are one of the few spaces available in the local area to hire for events, classes and community activities, as well as offering longer-term rental of office space. The venue is used by a wide range of users locally, providing a valuable community asset.

A key objective of the planned expansion is to provide more services to the local community, which is currently limited. The expansion will allow Paddington Arts to offer a greater range of activities, including the addition of a community cafe, supporting their connection with and contribution to the local community.

Climate risk assessment

HAZARD	RISK RATING
Heat	4
Surface water flooding	1



SUMMARY OF KEY CHALLENGES

- ❌ Lost majority of public funding in 2015.
- ❌ Overheating of the 'Pyramid' space in the summer.
- ❌ Getting the 'right advice' from consultants.
- ❌ Balancing priorities.

Addressing energy and climate resilience

CASE STUDY Paddington Arts

KEY CHALLENGES

Establishing new funding streams

Paddington Arts lost public funding in 2015, impacting the organisation's ability to address climate and energy concerns, as funding is required for core works. The planned expansion will provide more opportunities, supporting longer-term financial security through additional lettable rooms and a public cafe.

Overheating

The 'Pyramid' space, one of the venue's main spaces, is located on the second floor with a glass roof. This space suffers from overheating in the summer. Passive systems were incorporated in the original design of the space, but fail to work effectively. To manage overheating and ensure the space can comfortably be used during summer months, a mechanical cooling system has been installed. This has been successful, however, it has raised energy consumption.

Getting the 'right advice' and understanding trade-offs

The Paddington Arts team reported challenges in understanding trade-offs between potential sustainability measures. For example, the team are considering transitioning to heat pumps for the planned expansion but reported concerns around potential increases in running costs and the waste associated with replacing existing systems.

Balancing priorities

Challenges were also reported around balancing sustainability actions with other challenges and priorities, such as child safety, diversity and inclusion. Noting the need to consider what can be done practically in terms of sustainability, alongside delivering the organisation's central mission of youth art's programs.

ACTIONS TO SUPPORT RESILIENCE

Energy consumption

Paddington Arts has implemented a number of interventions to improve the sustainability of their operations. For example, solar panels have been installed to generate electricity and all theatre lighting as well as most of the lighting in the rest of the building has been replaced with LEDs to reduce consumption.

Supporting biodiversity

The building also includes a small section of green roof to support local biodiversity. A key benefit of the green roof is its ability to sustain itself, requiring no maintenance since 2010.

Sustainability commitments

Paddington Arts has also signed up to a sustainability charter to further explore the sustainability challenges that they are facing.

Reducing carbon emissions

Audits have been carried out by both the local authority and consultants looking at further interventions to reduce the carbon impact of both the building and operations. Paddington Arts are currently looking into how they can apply for funding to implement some of the measures identified in the audits.

Addressing energy and climate resilience

CASE STUDY Paddington Arts

BARRIERS



Lack of expertise

The operations team reported that whilst they have been able to educate themselves to a certain point on sustainability, they can't become experts as this needs to sit alongside their central mission of encouraging young people's self-expression through the Arts.



Conflicting advice

It was also noted that finding the right course of action is not always straightforward, as the 'right advice' tends to change over time. As a result, the operations team has learned to critically evaluate recommended interventions.



Managing costs

Balancing the cost of carbon mitigation interventions has also been a barrier for Paddington Arts. Whilst the organisation is keen to support local and national commitments to reach net zero, in practice the cost of such interventions can be prohibitive and outweigh the direct benefits to the organisation.



Understanding interventions fully

A lack of clarity over what is needed to implement recommended measures has also been a barrier for Paddington Arts. The team had recently received a report recommending a boiler upgrade to a heat pump, with an estimated cost. However, following a feasibility study it emerged that this would also require upgrading the existing pipework, which was not initially clear and comes at an additional cost.

KEY LEARNINGS



Develop relationships with trusted advisors

Developing strong relationships with trusted advisors, including architects and engineers, has supported the operations team to understand the impact of possible design interventions in order to make implement impactful and practical actions.



Align sustainability priorities with local plans

Aligning the sustainability ambitions of the organisation with Westminster City Council's plans has enabled Paddington Arts to become more ambitious in their sustainability action plans.



Establish an efficient operational structure

Close links between Paddington Arts' day-to-day management, leadership and Board of Trustees allows the operation to adapt quickly and efficiently to evolving challenges.

Theatre and Dance Venues

There are 458 theatre and dance venues in London. Theatre and dance venues cover a range of typologies, from historic venues, many of which have listed building status, and contemporary performance spaces to community centres or school halls. As well as performance spaces, many of these include other public facilities such as cafes or bars for performance goers as well as the general public.

OF THE
458 LONDON
THEATRE
AND DANCE
VENUES
289
ARE IN AREAS WITH
MODERATE-HIGH
CLIMATE RISK

Overall Climate Risk
High Low

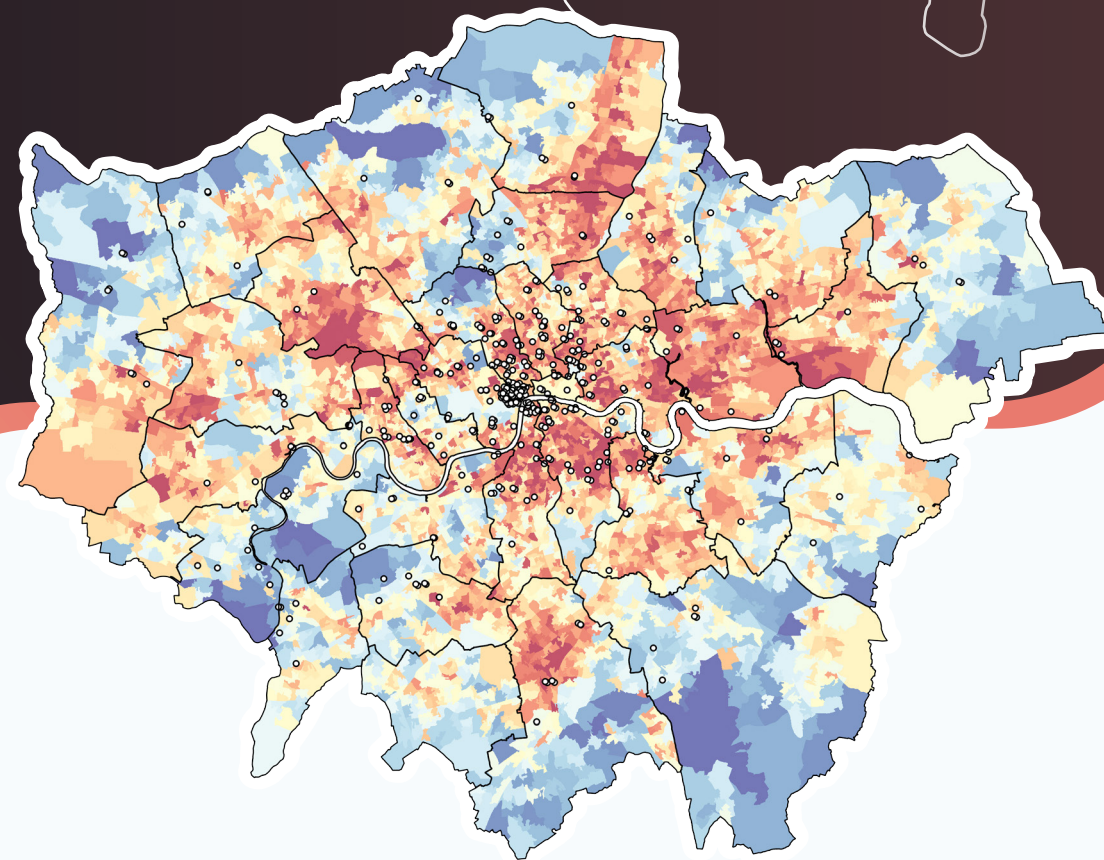
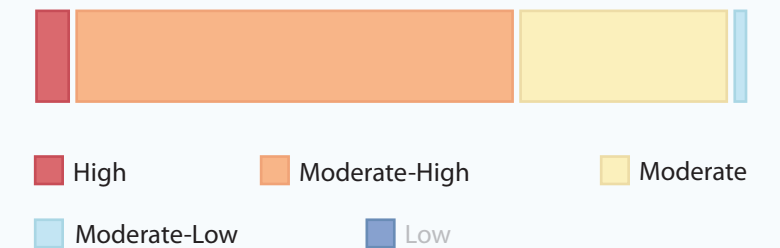


Figure 6.7 Theatre and Dance Venues on GLA Climate Risk Map

THEATRE AND DANCE VENUES RESILIENCE

Climate risk

As shown in the graph below, the majority of London's theatre and dance venues (289 properties) are located in LSOAs with a moderate-high level of climate risk, as per the GLA Climate Risk Map. A further 135 theatre and dance venues are located in areas of moderate risk, whilst 33 are located in areas of high risk.



EPC rating

EPC analysis has not been carried out for theatre and dance venues as insufficient data was available to match to EPC certificates to cultural infrastructure assets identified as theatre and dance venues. Refer to methodology for further detail on the matching approach.

CASE STUDY

Bush Theatre

LOCATION

7 Uxbridge Road,
London, W12 8LJ

FUNCTION

Theatre, Café/Bar, Reading
rooms, script library, meeting
and rehearsal spaces

CHARACTERISTICS

Victorian library, converted
into a theatre in 2011

KEY USER GROUPS

Theatre goers, performers,
writers, community groups

About

Bush Theatre is housed in a Victorian library. The building was extended in the 1950s and 60s and was converted into the current theatre space in 2011. An additional extension to expand the foyer lobby was completed in 2017.

Bush Theatre is a registered charity and relies on the support of donors.

Role in the community

The Bush Theatre is a hub for the performing arts within the local community, providing two performance spaces. The building also contains an attic rehearsal space and writer's room, along with a bar and café, garden terrace and Script Library, the largest public theatre reference library in the UK.

The Theatre also has two 'young' companies supporting children and young people through the arts. As several smaller, grassroots venues have closed in the local area, the Bush Theatre, along with other local organisations, have been required to fill these gaps within the community.

SUMMARY OF KEY CHALLENGES

- ⊘ High operational costs limiting opening hours.
- ⊘ Overheating in offices, lobby and rehearsal rooms.
- ⊘ High cost of heating impacting occupant comfort in winter months.
- ⊘ Lack of specialist knowledge to compare highly technical tender documents.

Climate risk assessment

HAZARD	RISK RATING
Heat	3
Surface water flooding	2



Addressing energy and climate resilience

CASE STUDY Bush Theatre

KEY CHALLENGES

-  **Increasing operational costs has led to restricted opening hours**
High running costs (heating, cooling and electricity) has forced the Theatre to reduce its opening hours. Limiting opening hours to during performances. This has meant that the Theatre no longer provides an informal community meeting space.
-  **Overheating**
The recently refurbished lobby features a highly glazed west-facing façade. When the building is open to the public, the external doors are open, preventing overheating. However, due to reductions in public hours, the doors now remain closed, causing overheating. Additionally, both the attic rehearsal space and office spaces often overheat. Requiring users to decamp to other areas of the building or revert to working from home.
-  **Increased heating costs impacting comfort during winter**
In order to manage increased heating costs during winter, the operations team must limit the heating times for spaces, both daily and seasonally. As a result, occupants often have to use the space when it's cold, especially during unexpected cold snaps or changes in weather outside typical heating months.
-  **Lack of specialist technical knowledge**
Despite having high carbon/green literacy within the organisation, the operations team do not have the specialist technical knowledge to identify and separate the most suitable solutions from increasingly technical tender packages.

ACTIONS TO SUPPORT RESILIENCE

-  **Solar panels, additional roof insulation and green roof**
Solar panels have been installed to offset increasing energy costs. During summer, these generate around 5% of energy use. Further solar panels are planned, with the aim of generating 10-15% of the building's energy use. Additional insulation has been added to the Victorian roof and a green roof created above the main performance space, improving thermal comfort, reducing water run-off and supporting biodiversity.
-  **Passive ventilation management strategies**
During heatwaves and periods of high temperatures in summer months, passive ventilation is implemented. All openable windows and doors are opened first thing in the morning to support air flow and cool internal space.
-  **Sustainability strategy**
The Theatre is planning a number of sustainability interventions, including a switch to local electric domestic hot water, passive solar shading elements, further solar panels and air source heat pumps.
-  **Supporting material circularity**
The Theatre aims to reuse and repurpose as many of its production materials as possible. Through its 'Bushcycling' initiative, pieces of set materials are repurposed for multiple productions, before they are donated to local schools and drama groups. Production materials are also tracked internally, supported by Julie's Bicycle.

Addressing energy and climate resilience

CASE STUDY Bush Theatre

BARRIERS



Lack of storage space

The in-house workshop allows significantly more material re-use than would be otherwise possible. However, the lack of on-site or local storage for materials limits the extent to which materials can be re-used.



Balancing artistic pursuits with sustainability

It is challenging for productions to balance the support needed for creative freedom and the pursuit of artistic excellence, with the need to reduce waste and minimise carbon emissions.

KEY LEARNINGS



Develop trusted contacts for projects

As the Theatre has undertaken a number of large capital projects in the past decade, they have developed a list of trusted contractors who are able to provide advice, consultation and recommendations. Developing relationships with contractors who understand the complexity and sensitivity of the building and organisation has given the operations team confidence in carrying out works.



Gain access to specialist technical advice

The operations team has been able to access specialist technical advisors through the local council, supporting them with planned projects.

7

Conclusion

An estimated 99% of London’s cultural venues are located in areas of moderate to high climate risk and 88% are at risk from anticipated MEES changes

► **Areas surrounding cultural venues are at risk from climate impacts.**

Mapping London’s cultural infrastructure assets to the GLA’s Climate Risk Map has found that almost all cultural assets are in LSOAs of moderate overall climate risk or above. An estimated 72% are in areas of moderate-high overall risk, whilst 8% are in high-risk areas.

► **If anticipated MEES standards are introduced, the majority of London’s cultural infrastructure would require retrofit measures to remain lettable.**

Currently legislation requires non-residential rented properties to achieve an EPC of E or above. Analysis of publicly available EPC data has found that an estimated 90% of London’s cultural assets are currently achieving this. However, the proportion achieving at least an EPC C or EPC B are significantly lower, at 47% and 18% respectively. Indicating that if anticipated legislation changes were to be introduced, the cultural sector would need significant support to improve assets in line with standards. Regardless of MEES changes, the low EPC ratings across the sector indicate that significant action will be required to raise energy efficiency in order to achieve net zero targets.

Whilst London's cultural infrastructure is diverse, similar energy and climate resilience challenges are reported across the sector

► **Extreme temperatures throughout the year are impacting both operations and user experience.**

Almost all organisations engaged in this study reported disruption to operations because of extreme temperatures. Impacts range from the ability to use or rent out spaces during summer months, to concerns around rising energy costs and the emissions impact of increased cooling demands. During winter months, the combination of poorly insulated buildings and the rising cost of energy has led to many building users facing uncomfortable indoor temperatures, as venues are unable to afford heating costs.

► **Many of London's cultural organisations are housed in listed buildings, often with inefficient or aging systems.**

The historical architecture and design are celebrated by London's cultural organisations housed in such buildings. However, the listed status of these buildings can make both maintenance works and sustainability improvements challenging and costly, requiring additional approvals and often resulting in lengthened and more expensive programmes.

► **Meeting gaps in local community infrastructure places additional pressure on cultural organisations' operational capacity.**

Many of London's cultural infrastructure assets serve their community beyond their 'cultural' provision. In recent years, as rising energy costs have meant that grassroots community organisations are no longer able to afford the rent and upkeep costs of their own venues, the breadth of activities and community support that is met through cultural infrastructure has increased, placing additional pressure on the operations of such venues.

► **There is a lack of sector specific knowledge to support those who want to make sustainable changes.**

Due to budget constraints, particularly for smaller organisations, many organisations have little time to engage in sustainable practices and lack expertise. Where operations teams do understand sustainability challenges and want to implement changes, a lack of sector specific guidance for both the energy and climate resilience of cultural infrastructure was reported as a significant barriers. Organisations also reported the need for secure long-term funding that supports both internal structural and cultural shifts towards sustainable practice. For example, the ability to hire dedicated sustainability champions who can create joined up thinking and strategic plans across all sections of the organisation.

► **Whilst there is a willingness to engage in resilience action across the sector, financing is a key constraint.**

Whilst organisations engaged in this study ranged from grassroots, community organisations to larger, nationally established venues, almost all reported funding as a key challenge to implementing adaptation measures. Many organisations have low profit margins, meaning cashflow for larger CAPEX projects is challenging. Where funding is available, it is often in cycles and frequently comes with limitations stipulating how it can be spent. It was reported that funding does not always follow 'Lean, Clean, Green' best practice, meaning it is not as efficient as it could be. These constraints limit organisations' autonomy to implement measures as and when they deem necessary given their specific circumstances and needs.

Despite these challenges, many organisations are taking action to improve the resilience of both their operations and building stock.

► **There is a focus on energy efficiency, primarily driven by rising energy costs.**

Many organisations reported having retrofitted lighting systems with LEDs, improving efficiency and reducing operational costs. This has commonly been implemented alongside upgrading control strategies, with sensors or daylight monitors to maximise benefits. Whilst operational teams are aware of the carbon emissions reductions created through improved energy efficiency, this is commonly a secondary benefit of such interventions, with reduced running costs reported as the primary driver.

► **Upgrades to building fabric are also being carried out to support energy efficiency and thermal comfort.**

Many organisations reported undertaking glazing and insulation upgrades, either as standalone works or as part of wider renovation plans, to improve building performance. Reported upgrades have also included features such as green roofs, supporting local biodiversity and reducing run-off rates, as well as the installation of solar PVs.

► **Where support is available, organisations are investigating possible carbon mitigation actions.**

Some organisations reported carrying out analysis for further interventions to reduce the carbon impacts of operations. For example, the feasibility of transitioning from gas boilers to air source heat pumps. However, these have primarily been carried out in partnership with existing support programmes or through targeted funding. Similarly, some organisations reported undertaking carbon reporting, supported by Julie’s Bicycle.

► **Material reuse initiatives are being led from the bottom up.**

To reduce waste from exhibitions and performances, organisations are taking action to reuse and repurpose materials. The ICA works with a variety of small networks to pass on materials for repurposing, however, they reported storage is a key challenge. Similarly, the Bush Theatre’s ‘Bushcycling’ initiative repurposes production materials for multiple productions, before materials are donated to local schools and drama groups. Organisations reported that a greater ability to plan would enable better design for deconstruction strategies to improve re-use of materials.

► **Passive ventilation management strategies can improve resilience to heat at little to no cost.**

During heatwaves and periods of high temperatures in summer, strategically managed passive ventilation can reduce overheating. For example, the Bush Theatre reported developing a simple strategy around morning ventilation that supports air flow and successfully cools internal spaces. Similarly, ensuring lobbies and external doors are closed during winter can help reduce heat loss.

► **Cultural organisations have diversified revenue streams to build resilience to rising operational costs.**

Many cultural organisations reported offering broader services than may be deemed as ‘cultural’, renting out spaces to local businesses or community groups, increasing revenues and strengthening connections with their local community.

Potential adaptation actions for priority hazards

Many organisations engaged in this study reported challenges understanding the trade-offs between climate adaptation measures and carbon reduction measures. The table on the following page provides a summary of potential adaptation measures that are relevant to the priority hazards identified in the climate analysis. Commentary is provided on the co-benefits and potential negative impacts of each intervention, to support decision making. However, trade-offs will be influenced by building characteristics and location. This list is not exhaustive but has focused on interventions that are relatively low cost and simple to implement.

Adaptation measure	Heat wave	Drought	Heavy precipitation	Flooding	Commentary on co-benefits	Commentary on potential negative impacts
External shading / shutters	✓ ✓ ✓				▶ Limits solar gains by reducing the entry of sunlight and heat into the building. ▶ Reduces energy demand and costs for cooling.	▶ Elements that protrude from the building's structure are at risk of uplift from high winds. ▶ Trees used to create shade should be carefully selected to avoid them being uprooted during storms (causing damage). ▶ Can reduce access to natural light. ▶ Challenges to implementation on listed or protected buildings.
Green roofs / green facades, particularly on sun exposed side of building	✓	✓	✓	✓	▶ Supports biodiversity. ▶ Provides significant noise reduction. ▶ Reduces 'heat island' effect, reducing surrounding temperatures. ▶ Solar panels (PVs) can be combined with a green roof; vegetation can reduce the surrounding temperature and improve PV efficiency. ▶ Reduces energy demand for cooling. ▶ Increases water uptake of soil.	▶ Increases the amount of material required in structural elements, resulting in higher embodied carbon. The depth of substrate can be reduced in conjunction with suitable planting to reduce the load. ▶ There is a risk of vegetation being uprooted during storms and flooding and causing damage. ▶ If the roots are too close to the building foundations, they can increase vulnerability to subsidence.
Flood resilient landscaping (permeable surfaces, planting and water management)			✓ ✓	✓ ✓	▶ Supports local biodiversity. ▶ Reduces 'heat island' effect, reducing surrounding temperatures.	▶ There is a risk of vegetation being uprooted during storms and flooding and causing damage. ▶ If the roots are too close to the building foundations, they can increase vulnerability to subsidence.
Night ventilation	✓ ✓		⊘		▶ Reduces energy demand for cooling and ventilation. ▶ Works well with older buildings that have high 'thermal mass', such as heavy stone/concrete constructions.	▶ Risk of rainwater penetration during summer deluges. ▶ Can pose a security risk if windows etc. are left open.

Key

✓ Positive impact

⊘ Negative impact

Adaptation measure	Heat wave	Drought	Heavy precipitation	Flooding	Commentary on co-benefits	Commentary on potential negative impacts
Use of efficient appliances, in terms of both water and energy consumption	✓ ✓	✓ ✓			▶ Reduces energy demand for cooling and ventilation and associated carbon emissions. ▶ Reduces water demand.	▶ No negative climate adaptation impacts have been identified.
Active cooling and ventilation appropriate to the building's needs	✓ ✓		⊘	⊘	▶ Provides immediate cooling in periods of extreme heat. ▶ Can provide further relief when passive ventilation measures are no longer efficient.	▶ High additional energy consumption and costs compared to passive solutions. ▶ Standing water as an effect of flooding might damage the electrical components of outdoor active cooling units. ▶ Driving rain may cause damage when dirt and debris enter the unit. ▶ Ineffective during power outages.
Enable passive airflow through the building for ventilation	✓ ✓		⊘		▶ Reduces energy needed for cooling and ventilation. ▶ Can be implemented as an operational strategy by management or operations teams for little to no cost by opening windows strategically.	▶ There may be instances during the year where internal temperatures may become high unless active mechanical cooling is used. ▶ Risk of rainwater penetration during summer deluges.
Light-coloured and reflective materials on roofs, walls, windows and blinds	✓ ✓				▶ Limits solar gains by reducing the entry of sunlight and heat into the building.	▶ Risk of creating a glare effect. High albedo coatings can be dazzling and cause daily discomfort for people on the exterior of the building. ▶ High reflection rates can intensify light pollution and disturb local biodiversity.

Findings for key stakeholders

Findings for cultural sector organisations

► **Engagement with staff around resilience interventions supports success.**

Organisations reported value in engaging with staff when planning resilience interventions. Embedding day-to-day knowledge and needs in resilience interventions can help ensure action is effective and will support building users. Gaining buy-in from staff at all levels also encourages engagement with and awareness of resilience practices.

► **Investing in resilience positions within organisations supports sector specific knowledge and prioritises long-term solutions.**

Most organisations reported responsibility for sustainability planning is split across roles. However, it was noted that the ability to introduce a permanent sustainability-focused role within operations teams would enable knowledge building and support strategic resilience planning in the long-term. Organisations engaged in this study who have invested in a long-term sustainability approach have demonstrated significantly greater levels of understanding and resilience than those who—largely due to funding and capacity constraints—are reliant on quick fix solutions.

► **Building relationships with trusted advisors, designers and contractors supports good quality outcomes.**

Almost all organisations reported the value of building long lasting relationships with trusted professionals. These relationships support operations teams to understand design interventions and support decision making. Working with designers and contractors who are familiar with the building and its uses also maximises the impact of interventions. This was reported to be particularly important for listed buildings; benefiting from contractors who understand the nuances of the buildings and their infrastructure.

► **Taking a preventative approach to maintenance planning saves costs in the long run.**

Many cultural organisations are housed within old buildings, ranging from historical theatres and music halls to converted industrial warehouses. Organisations reported benefits in taking a long-term approach to preventative maintenance, saving costs in the long run. Leveraging improved awareness of sustainability interventions, so that they can be incorporated into planned maintenance works, can also improve efficiencies.

► **Value of technical assistance in supporting decision making around resilience interventions.**

Organisations reported that identifying the right path for resilience interventions is not always straightforward, with the ‘right advice’ changing over time. It was also noted that tender packages are becoming increasingly technical, with operations teams often not possessing the expertise for internal valuation. Access to technical assistance, through support or funding programmes enables organisations to better understand the impact and feasibility of building improvements and resilience interventions.

Findings for government and cultural sector development agencies

► **Support knowledge sharing between cultural sector organisations.**

As demonstrated through this study, London’s cultural infrastructure is hugely varied, in terms of building typology, uses and ownership models. However, operations teams are experiencing similar challenges. Supporting cultural organisations to collaborate and learn from each other, through peer-to-peer knowledge sharing around resilience interventions can support sector wide adaptation. This could also be achieved, for example, through the creation of an open-access database of successful interventions and their impacts, facilitating learning from others.

► **Establish carbon reduction and climate resilience training and awareness raising programmes for operations teams.**

Many operations teams reported challenges in understanding the technical aspects of resilience interventions, impacting ability to review tender documents and make decisions around interventions. Upskilling operations team members through intensive (1-2 day) training programmes would build capacity of existing staff. This could include education on ‘easy win’ climate adaptation measures, so they can be incorporated into planned upgrades and maintenance works.

► **Develop technical guidance for adapting cultural buildings to climate change.**

The need for sector specific energy and climate adaptation guidance is evident from the review of policy, support and guidance set out at the start of this report. This need was also commonly noted by organisations. This could be through published guidance and targets. Whilst Julie's Bicycle published water and energy use targets for the cultural sector in 2015, these are now significantly behind equivalent figures published by LETI in the Climate Emergency Design Guide, given the progress that the built environment sector has made in terms of resource efficiency in the past decade. Updating these will set a target for cultural institutions to work towards when implementing changes. Guidance could also be provided through the creation of a cultural sector Adaptation Accelerator programme.

► **Establish targeted support and funding for the resilience of cultural infrastructure.**

Financial support such as grant funding for resilience action is needed for sector wide adaptation. Funding could be targeted towards establishing resilience specific roles within cultural organisations, to carry out building and operation specific resilience assessments, develop strategic resilience plans and upskill staff internally. The GLA's existing Culture at Risk support could expand its understanding of risk to consider energy and climate challenges, supporting long-term resilience challenges, rather than only supporting organisations at breaking point. Additionally, funding for resilience upgrades should allow greater flexibility, supporting organisations to make investments in line with the nuances of their assets. This could be regulated by requiring the involvement of technical advice or demonstrating that interventions are part of a plan that follows the 'Lean, Clean, Green' energy hierarchy.

► **Engage with cultural sector organisations around potential changes to MEES legislation and net zero transition.**

Whilst it is not yet determined whether there will be future changes to MEES legislation, if EPC requirements for non-domestic rented properties were to be raised to require an EPC rating of B or above, less than one-fifth of London's cultural infrastructure as it stands today would remain lettable. Engagement with the cultural sector should be carried out to better understand the capacity of organisations to meet these changes if they are to come into law, as well as develop a roadmap for improving efficiency across the sector.

► **Support the mainstreaming of material circularity initiatives.**

Whilst circularity initiatives are emerging across the sector, assistance is needed to roll this out sector wide. This could be through assisting with storage provision, education or awareness campaign, or connecting stakeholders to wider networks. Additionally, recording material flows would provide data to track progress and could be used to form a London cultural sector material bank, facilitating the reuse of materials between organisations and keeping materials in use for as long as possible.

► **Where cultural infrastructure is acting as a resilience hub for its local community, recognise this and provide additional support.**

Many of London's cultural organisations provide significant social value to their local communities, including providing a space to escape from extreme weather during summer and winter months. Whilst many cultural organisations are willing to open their doors to local residents, it places additional strains on already limited capacity. For example, through the need for increased staff or security in public areas. Where venues are operating as resilience hubs, they should be recognised as such by their local authority climate action planning and have the opportunity to apply for additional support if required.

8

Appendix

Summary of UKCP18 analysis for London

Table 8.1 Summary of UKCP18 analysis

Indicators	Unit	Medium emission scenario		High emission scenario	
		short-term (2040-2059)	long-term (2070-2089)	short-term (2040-2059)	long-term (2070-2089)
Mean annual temperature increase	°C	1.4	2.3	1.9	3.6
Max summer temperature increase	°C	2.4	3.9	3.4	6.3
Maximum heatwave* duration	Days / year	Data not available		11	24**
Number of hot days (>28 °C)	Days / year	Data not available		25	62**
Mean summer precipitation change	%	-12	-21	-15	-31
Mean winter precipitation change	%	9	14	11	21
Maximum summer 1-day precipitation	mm / day	58	57	58	58
Maximum winter 1-day precipitation	mm / day	42	48	42	48

Indicators	Unit	Medium emission scenario		High emission scenario	
		short-term (2040-2059)	long-term (2070-2089)	short-term (2040-2059)	long-term (2070-2089)
95th percentile, max summer 1-day precipitation	mm / day	83	87	85	94
95th percentile, max winter 1-day precipitation	mm / day	59	63	62	70
Days of drought***	Days / year	Data not available		23	19
Days of low rain (<0.25mm rainfall)	Days / year	Data not available		179	183

Note on absolute droughts: in practice drought as it affects water supplies can be dependent on complex infrastructure and demand factors. In addition, a single day of rainfall might indicate the end of a drought by this definition, but in practice not fully restore water supplies. This analysis is therefore indicative only.

* Heatwave defined as 3 consecutive days exceeding 28°C
** Long-term heatwave and hot days analysis based on 2070-2079, due to data availability
*** Drought is defined as 15 consecutive days with less than 0.25mm of rainfall

Sustainable Spaces for Culture

A study into enhancing sector resilience through climate adaptation,
energy efficiency compliance, and carbon reduction

November 2024

