Julie's Bicycle
SUSTAINING CREATIVITY

FIT FOR THE FUTURE: INVESTING IN ENVIRONMENTALLY SUSTAINABLE BUILDINGS

A GUIDE FOR THE ARTS

ARTS COUNCIL ENGLAND

Contents

Foreword

We are at a pivotal moment in history. Faced with unprecedented ecological crises and a growing realisation that we are living beyond limits which our planet can support, there can be no doubt that the time to act is now.

There are many positive signs that momentum is building; the green economy is slowly transforming our global energy infrastructure; the trend from the investment community to divest from fossil fuels is gathering pace; and more and more voices are speaking out. There are real indications that countries around the world are gearing up to reach a meaningful and binding agreement to reduce greenhouse gas emissions during COP21, the 21st United Nations Conference on Climate Change, which takes place in December this year.

Over the last few years the arts in England have demonstrated increasing levels of understanding on environmental sustainability and climate change and started to take real and concerted action. Many have already understood the financial and reputational benefits of taking action and the implications of failing to act. There is an emergent vision and desire to lead change in this area. Those who are leading have also recognised the value of culture and cultural buildings in catalysing environmental change, not least through the role they play with artists, audiences and communities.

Arts Council England has played a pivotal role in creating the momentum for environmental change within the arts sector, notably with the introduction of its environmental reporting programme for revenue funded organisations in 2012, a programme in partnership with Julie's Bicycle. The 2015-2018 capital grants programme is a key strategic funding programme to address Arts Council England's goal of **"arts, museums and libraries which are resilient and environmentally sustainable".**

The role of capital investment in creating more resilient and environmentally sustainable organisations is one of the priority areas for Julie's Bicycle's 2015-2018 partnership with Arts Council England, and this guide is one of the first key actions in this area.

Over the last seven years, Julie's Bicycle has been gathering evidence and data on how the arts in England are embedding environmental sustainability into their operations, business models, governance structures and work with audiences, art and artists. This guide and, in particular, the many inspiring case studies it brings together, is the beginning of a better understanding and evidence base on the positive contribution which investing in more sustainable buildings can make to the environmental, financial, social and cultural sustainability of the arts. It tells an exciting story of change for the better and resilience, a story which we will continue to develop and tell.

Alison Tickell, Director, Julie's Bicycle

1 Introduction

1.1 Investing in sustainable buildings

We are facing ecological crises on an unprecedented scale. The air we breathe, the water we drink, the ecosystems that keep the planet healthy - prerequisites for social, financial, and cultural health - are under threat, and we all have a responsibility to act, without delay.

"We are entering a world of peak oil, peak water and peak phosphorous[1], a world that is globally interconnected yet ecologically impoverished. A world with seven billion people and counting. A world where every single major ecological system is in decline and the rate of that decline is increasing. A world where global temperature increases mean shifting rainfall distributions, acidified oceans and potentially catastrophic sea-level rise. Nothing less than a sea change in building, infrastructure and community design is required."

Living Building Challenge 3.0 - A Visionary Path to a Regenerative Future, International Living Future Institute, 2014[2]

Buildings are a major source of impact on the environment and on our quality of life and work. The way that they are designed, constructed, maintained and operated has a major role to play in determining the extent to which we can live within the limits that our planet can support. Instead of being merely 'less bad', environmentally sustainable buildings make a positive contribution to addressing the ecological crises we are currently facing, protecting the air we breathe, the water we drink and the ecosystems that keep the planet healthy.

According to the UK Green Building Council, globally buildings account for around 35 per cent of resources, 40 per cent of energy use, consume 12 per cent of the world's drinkable water and produce nearly 40 per cent of global carbon emissions[3].

Cultural buildings define place, community and identity, and are, at their best, vortexes of creativity and vibrant cultural expression, where people can learn, challenge and enjoy collective experiences. The context in which they do this matters and, at a time when environmental sustainability is fast becoming the greatest challenge (and in some eyes, opportunity) of the 21st century, there are ethical and practical implications for our cultural estate.

Many arts organisations have already understood how these issues relate to their resilience, the financial and reputational benefits of taking environmental action, and the implications of failing to act. A growing number are investing in more sustainable buildings; as demonstrators of low carbon living and connectors to nature; as a means of future proofing their organisations; providing a healthy and inspiring environment for the people who use them, from staff and artists to audiences and communities, and; to catalyse environmental change.

In 2014, Julie's Bicycle in partnership with BOP Consulting, conducted a UK-wide survey of cultural leaders on environmental sustainability: Sustaining Creativity[4] . The majority of the 350 respondents said that environmental sustainability was relevant to their organisation and the arts; and over half had realised financial and reputational benefits.

"It is exciting to think about the impact the arts and culture is already having – **and what more it can achieve"**

Jane Tarr, Director, Organisational Resilience and Environmental Sustainability, Arts Council England

1.2 A guide for the arts

What this guide is for

There are many approaches to environmentally sustainable buildings, depending on an organisation's vision, resources, and capacity. Whether incremental or more radical, an organisation will need to secure investment; establish its measures of success; balance environmental requirements with the needs of building users and stakeholders; navigate a range of technology options, and; build sustainability into operations post-investment. This guide has been developed by Julie's Bicycle to support arts organisations in this process.

Arts Council England's 2015-2018 capital grants programme is a key strategic programme linked to its goal of

"arts, museums and libraries which are resilient and environmentally sustainable".

Ensuring that this money provides long-term value means building best environmental practice into every capital project, to avail of the financial, social and environmental opportunities which good planning and design can provide.

Who this guide is for

This guide is for directors and managers of arts organisations planning to apply for Arts Council England capital grants, though the information is applicable to any capital project. It will support you in integrating environmental sustainability in capital projects from conception through to completion. It focuses mainly on larger capital projects, major refits and refurbishment, redevelopment of existing buildings and infrastructure, but is also relevant to smaller capital projects and new builds. It is not a step-by-step guide for funding applications, nor a technical guide to environmental solutions for buildings. The focus is only on environmental sustainability - social sustainability issues, notably diversity, equality and accessibility are not covered.

What this guide covers

The guide covers:

- guidance on integrating environmental sustainability across the different phases of building projects and understanding and monitoring environmental performance;
- a range of case studies from arts organisations;
- signposting to further information and resources;
- an overview of solutions for more environmentally sustainable buildings and;
- a comprehensive listing of the key relevant sources of funding and finance.

1. 20 million tonnes of phosphorus are mined every year, 80% for fertilisers. It ends up in rivers, lakes and oceans killing fish and dramatically reducing the productivity of waters. It is a critical non-renewable resource. http://horizons.innovateuk.org/cards
2. http://living-future.org/lbc
3. http://www.ukgbc.org/about-us/why-we-do-it
4. http://www.juliesbicycle.com/resources/sustaining-creativity-survey-results

2 The value of environmentally sustainable buildings

2.1 A positive response to environmental challenges

An environmentally sustainable building isn't just a building which cuts energy costs. It can make a positive contribution to addressing the environmental challenges with which we are currently faced, and their financial and economic implications, notably:

- an increasingly risky reliance on fossil fuels and rising energy costs;
- increased pressure on our natural resources, leading for example to water scarcity and increased costs of water, materials and waste disposal;
- the loss of species and biodiversity, essential to the ecosystems which provide us with clean air, water, soil, food etc., and;
- environmental pollution and its impact on the natural environment and our health.

About 45 per cent of carbon dioxide emissions in the UK come from energy used in domestic and non-domestic buildings for heating, cooling, lighting, ventilation etc.

The UK construction industry uses more than 400 million tonnes of material every year (timber, steel, etc.) making it the UK's largest consumer of natural resources. Throughout their life cycle – from extraction, transportation and manufacturing of raw materials, to use and disposal – building materials can have many adverse environmental impacts: using energy and generating carbon; depleting natural resources; and negatively affecting natural systems and human health.

Water is used throughout the lifetime of a building – through material use, construction and in building use. Issues around water are likely to increase with the impact of climate change, e.g. increased periods of drought as well as more precipitation. Water is already being extracted from river basins and aquifers which negatively impact on the ecology and biodiversity of landscapes. Treating water also entails significant energy use, further contributing to climate change.

The construction and demolition sector is the largest contributor of waste in the UK, responsible for generating 120 million tonnes of waste every year and generating one third of all UK waste.

Contaminants (chemical, energy, noise, heat or light) resulting from building activities can have a negative impact on natural systems (air, water, soil, plants, animals) and human health. These include surface water run-off, nitrous oxide emissions from heating systems, ozone depleting substances (ODS) commonly used in refrigerant gases, and a range of chemicals used in materials and equipment such as Volatile Organic Compounds (VOCs), flame retardants and polyvinyl chloride (PVC).

The biodiversity of the planet provides many critical benefits to humanity. In the UK, 39 per cent of habitats and 27 per cent of priority species are in decline. Species are going extinct at 100 times the normal rate and there are fears that we are partaking in the sixth mass extinction. Much of this is due to the changing climate, but also rapid urbanisation. Buildings can have a major negative impact on biodiversity and the ecological value of a site, destroying or disturbing existing habitats or reducing plant and animal diversity.

The above is based largely on information from the UK Green Building Council and Innovate UK, Forum for the Future and Aviva Investor's Horizons tool which explains key environmental topics to enable understanding and inform action.

There is no single definition of an environmentally sustainable building. The range and scope of possibilities is expanding all the time as technologies and values shift in response to environmental challenges, and buildings are hugely diverse. We can, however, identify some key characteristics:

- An environmentally sustainable building is designed for the long-term (at least twenty years), taking upfront, running and maintenance costs into consideration.
- It combines a mix of technological, behavioural and procedural solutions - the right fit for the size, scale, location and activities of the organisation using it.
- It addresses a range of environmental impacts:
    - using low or zero carbon energy sources
    - making wise use of space, materials and natural resources
    - avoiding waste
    - conserving water
    - using healthy, non-toxic materials and
    - curbing noise, air and soil pollution
- The environmental elements of the building support the wellbeing of those using it – staff, art, artists, audiences, communities - and the natural environment around it.
- Those responsible for the building can easily track its impacts and performance.
- It supports and enables an organisation to fulfil its mission, creating financial, social and cultural value, within the planet's capacity to support us.

> "The solutions brought about in the world of cultural centres are often unheard of in other sectors. They result from the creative clash between architects, designers, artist, managers, volunteers, students, technicians, audience and neighbours."

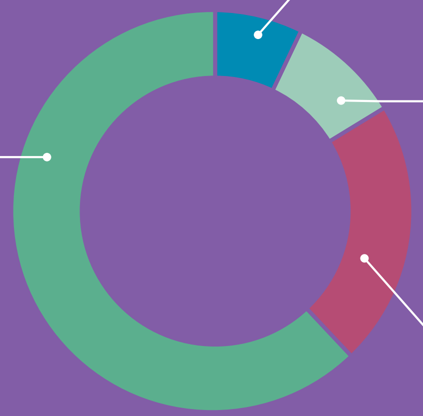
Peter Lényi, the Design Handbook for Cultural Centres, Truc sphérique, December 2014[5]

Throughout this guide you will find examples of different approaches to investing in and creating more environmental sustainable arts buildings, covering a range of projects in terms of scale and type of investment, art form and location, and environmental solutions. A overview of the case studies is provided in **Appendix 1**.

5. The 'Design Handbook for Cultural Centres' is a collection of 123 small and bigger stories about unused places which were transformed into cultural centres, based on work by architect Peter Lényi in co-operation with the Trans Europe Halles network. http://designhandbook.bigcartel.com/product/design-handbook-for-cultural-centres

e&P LIVERPOOL

The new Everyman was 10 years in the planning and took over two years to build. Funding was secured from various sources:



over £1.9 million of private funding

£2.5 million from the Northwest Regional Development Agency

£5.9 million from the European Regional Development Fund

£16.8 million from the Arts Council's Large Capital Grant Programme

The new building opened in March 2014 to great acclaim from audiences and critics, winning various awards including the 2014 Royal Institute of British Architects (**RIBA**) **Stirling Prize,** the UK's most prestigious architecture prize, and, along with the architects Haworth Tompkins, the 2014 **WAN Performing Spaces Award,** which recognises and rewards the most inventive, imaginative designs conceived for the performing arts. It also achieved an **'Excellent' BREEAM rating** (Building Research Establishment Environmental Assessment Method).

The original Everyman Liverpool was housed in a chapel built in 1837. Having initially considered a new build project in a much larger and more expensive building on a new site, the project evolved into a **reuse of the existing site** extended by the acquisition of the adjoining building and a small parcel of land to the rear. The existing structures were dismantled and the 19th century bricks salvaged for reuse as the shell of the new auditorium. A dense design both **made the most efficient use of the existing site footprint and transformed what was originally there.**

The new Everyman uses a **highly sustainable, largely natural ventilation system** throughout, notably in the auditorium where air is finally exhausted through the four brick chimneys at the top of the building. Where mechanical ventilation could not be avoided, principally in the basement bistro, **heat is recovered from extract air and used to warm fresh air** being brought into the building. The auditorium heating comes from **air source heat pumps,** like fridges in reverse, extracting heat from the outside air and delivering it inside at much higher efficiency than gas boilers**. A small scale gas fired Combined Heat and Power** (CHP) unit generates electricity and uses the heat generated for hot water and space heating. Offices and ancillary spaces are ventilated via opening windows and vents at high level.

The fully exposed concrete structure and reclaimed brickwork walls provide excellent **thermal mass** (thermal mass enables buildings to absorb and release heat in step with its daily heating and cooling cycle), while the **orientation and fenestration design** optimises solar response – the entire west façade is designed as a large screen of moveable sunshades.

Where possible, **LED lights** are used, providing the same light as the old 60W tungsten lamps but using only 8W. They can also be dimmed to different levels depending on time of day and use, reducing energy used and giving warmer light as they are dimmed.

The demolition of the old building was largely by hand, **maximising the amount of materials that could be recycled**, including bricks reused in the new building. 25,000 bricks from the old Everyman were used; bar, counters and table tops are made from Iroko wood recycled from old laboratory bench tops; the sliding doors reuse timber from the shuttering used to cast the board marked concrete around the building; flooring in the theatre is made from recycled rubber and back of house flooring from a mix of recycled cork and rubber.

Timber used throughout is from sustainable sources and carries Forest Stewardship Council (FSC) certification or equivalent. The **concrete uses ground granulated blast furnace slag, much less carbon intensive than conventional concrete** (GGBFS is a by-product from the production of iron which uses 80 per cent less energy and generates 93 per cent less carbon emissions in extraction, production and transportation). Where possible the products used for **finishes have low Volatile Organic Compound emissions**.

Rainwater is collected from the roof, filtered and used to flush toilets, reducing mains water consumption for flushing by up to 45 per cent per year. Aerated taps, dual flush toilets, leak detection and occupancy triggered shut-off valves also help to **conserve water**.

Despite its urban location, the Everyman was also able to undertake a number of **nature conservation** and **biodiversity enhancement** measures. The demolition of the old building largely by hand, ensured that bats were not harmed. The new building includes bat boxes and swift nesting boxes integrated into the brickwork below the chimneys and with beehives on the roof, Everyman honey will be available soon.

© Philip Vile

The steps taken to **reduce environmental impacts during construction** included:

- recycling 98.6 per cent of demolition waste;
- recycling 89 per cent of construction waste;
- monitoring site energy and water use and the impact of transport to site and;
- appointing a biodiversity champion to the site team to prevent harm to any flora and fauna.

Everyman Liverpool's sustainable new building now acts as **a 'creative hub', enabling the Everyman to realise it artistic, accessibility and environmental vision**. In addition to providing employment and training of apprentices in the construction process, it is a fully accessible public building and has created space for the Everyman to continue and expand education and community work and provide workspaces to support local writers.

2.2 Buildings policy and regulations

Arts organisations are already subject, directly or indirectly, to a range of policy and regulatory requirements relating to buildings energy and environmental performance. While the policy and regulatory framework is not always clear and consistent, what is clear is that investing in better performing buildings and being able to easily track this performance, is a positive step towards meeting and even being ahead of the curve in meeting these requirements.

Greenhouse gas (GHG) emissions reduction targets

The **UK Climate Change Act** sets legally binding target to reduce GHG emissions by 80 per cent by 2050 against a 1990 baseline. This has been translated by many local authorities into **regional and city-specific targets and action plans**, for example a 60 per cent carbon reduction by 2025 (London) and a 41 per cent reduction by 2020 (Manchester).

The **London Theatre Consortium**, a group of 13 theatres, has defined a carbon reduction target of 60 per cent by 2025 in line with the Mayor of London's 2008 target[6]. A number of **leading arts organisations in Manchester**, including the Manchester Art Gallery, Manchester International Festival and Royal Exchange Theatre, have set their carbon reduction targets in line with Manchester A Certain Future's[7] 41 per cent carbon reduction target by 2020. The **Whitworth** in Manchester set a 10 per cent carbon reduction for its redeveloped building in line with university targets.

Greenhouse gases (GHGs) contribute to climate change by trapping heat in the atmosphere. Each GHG has a different potential to contribute to global warming, known as its **Global Warming Potential** (GWP). The United Nation's Kyoto Protocol identifies seven GHGs to be addressed in the fight against global warming including Carbon Dioxide (CO2); Nitrous Oxide (N2O); Hydrofluorocarbons (HFCs) the three most common building-related gases. Each GHG has a different GWP, commonly expressed in **carbon dioxide equivalent (CO2e)**.

Buildings energy performance requirements

Building regulations include a requirement for a minimum target emission rate to be set for the energy performance of a building, based on the annual carbon dioxide emissions in kilograms per square metre of a notional building of the same type, size and shape as the proposed new/refurbished building. **Schedule 1 Part L of the Buildings Regulations: Conservation of Fuel and Power** deals with energy efficiency requirements.

The **Lyric Hammersmith** in London set targets for its new building in line with the Mayor of London's interim target to reduce carbon emissions by 20 per cent by 2015 (the longer term target is 60 per cent by 2025) and the London Borough of Hammersmith and Fulham's target to generate 10 per cent of energy needs from on-site renewable sources. In addition, under building regulations, the theatre was obliged to devote 10 per cent of the refurbishment costs to consequential improvements to the building's energy performance.

Energy Performance Certificates (EPCs) are required when a building is built, sold or rented and give an A–G rating of energy efficiency. Buildings with a floor area of over 250 square metres, occupied or part occupied by public authorities or institutions, providing public services to a large number of people are required to have the energy performance of their building assessed based on actual energy consumption and to publish a **Display Energy Certificate** (DECs) with an A-G rating to be displayed where it is clearly visible to the public.

6. http://www.london.gov.uk/priorities/environment/publications/delivering-londons-energy-future-the-mayors-climate-change
7. http://macf.ontheplatform.org.uk/

Carbon pricing and reporting

Some of the biggest artistic spaces already pay for their carbon emissions under **the Carbon Reduction Commitment (CRC) Energy Efficiency Scheme**. The CRC requires public and private sector organisations that use more than 6,000 MWh per year of electricity to measure and report electricity and gas usage and to buy allowances for every tonne of carbon emitted by this energy use.

Subsidies for renewable energy

Electricity generated from renewable sources (for example solar photovoltaic panels (PV) or small scale combined heat and power plants) can qualify for a **Feed-in Tariff** (FIT), a payment for each unit of electricity generated and fed back into the national grid. The non-domestic **Renewable Heat Incentive** (RHI) scheme makes payments to organisations that generate renewable energy and use it to heat their buildings (for example biomass boilers, solar thermal panels and ground source heat pumps). Policy on subsidies for renewable energy is changing however. For example, the government recently announced that onshore wind farm subsidies will close one year earlier than planned in 2016 rather than 2017. This should be considered when investigating renewable energy options. For further information on FIT and RHI see **Appendix 5. Funding and financing sources.**

As part of its redevelopment the **Chichester Festival Theatre** installed a ground source heat pump, eligible for payments under the Renewable Heat Incentive (RHI). The RHI application process was very detailed and required technical understanding and consultation with Ofgem to ensure compliance. Its recommendation to other organisations applying for RHI payments is to make sure that the application is either included within the installation contract or that they have the resources to make the application in-house, and, if a sub-contractor is making the application, to involve someone in-house to follow the process.

Biodiversity

Some buildings and building projects, especially those in rural locations, may be in **areas with special status** or designated as **protected areas** because of their natural and cultural importance[8]. If this is the case, specific restrictions and requirements on the protection of wildlife, plants and biodiversity may apply.

Chichester Festival Theatre's capital project involved a range of short and long-term measures to protect and enhance the biodiversity of its parkland setting, including planting with reference to the Sussex Biodiversity Action Plan.

Climate change adaptation

A further key area to be aware of for buildings located in areas at risk of extreme weather such as flooding, heatwaves or drought is **national and local climate change adaptation plans and programmes**.

Designing Buildings Wiki provides a comprehensive source of information on environmental legislation for buildings. You should always check the latest on policy and regulation requirements with the official national, regional or local government body.

The UK Green Building Council resources on climate change adaptation, including an overview of government adaptation plans and programmes.

The London Climate Change Partnership provides a range of resources on climate change adaptation and extreme weather, mainly but not only London-focused.

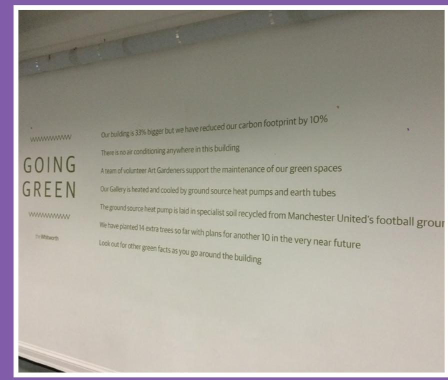
8. https://www.gov.uk/check-your-business-protected-area

2.3 The added value of sustainability

Many arts organisations which have already invested in more sustainable buildings have reaped financial benefits. They have also gained reputational benefits with their staff, artists, audiences and communities and have found that well-designed environmentally sustainable buildings can make an important contribution to the wellbeing of those using their buildings and creating and sharing in the cultural experiences they provide.

While the human health and wellbeing benefits of buildings are not the focus of this guide it is a growing area of interest, for commercial buildings and office buildings in particular. An example from the arts is the Story Museum in Oxford which, supported by the Happy Museum Project, worked with psychologists and well-being experts to influence designers and architects as they engineered their new capital developments[9].

9. www.happymuseumproject.org



the Whitworth

A commitment to a more sustainable future was at the heart of the recent redevelopment of the Whitworth. Part of the University of Manchester, the Whitworth was created in 1889 and sits in Whitworth Park. It houses some of the North West's finest historic and contemporary collections. The gallery has been actively engaged in environmental sustainability for the last seven years, with measures including installing LED lighting, a green roof and raising staff environmental awareness. In 2008 the gallery embarked on a **£15 million development** to extend and refurbish its historic building, with funding from the Heritage Lottery Fund, and the University of Manchester. Arts Council England provided an additional £1.8 million to complete the refurbishment.

Key environmental elements in the brief to the design team (the architects – MUMA, the M&E contractor – Buro Happold and structural engineers – Ramboll) were saving energy; reducing the carbon footprint by 10 per cent; exploring green technologies and achieving a BREEAM 'Excellent' rating (the rating is not yet completed).

Design considerations included an understanding of the site, analysis of the Manchester climate and geology, and options to use low and zero carbon technologies. Energy use and carbon emissions of the existing building were assessed, alongside staff and University of Manchester commitments to building use and long-term maintenance. Current environmental conditions for the collections and the gallery's desire for a more flexible environmental approach, in line with thinking emanating from the Bizot Group and National Museum Directors' Council, were also a key consideration. The **gallery team was closely consulted** throughout the project, as building users and experts on environmental conditions for the collections. The gallery's experience in making subtle shifts in environmental behaviour over the years also informed the brief.

The new build element of the project, including new galleries, learning spaces, promenades and a café, wraps around the old building. Sustainable features include:

- south facing **solar thermal panels** to provide hot water;
- improved insulation and **energy efficient boilers**;
- a **ground source heat pump** and;
- earth tubes for **natural ventilation**.

Collections are at the heart of the Whitworth and its activities and so **a flexible approach to environmental conditions was essential** to meet the environmental sustainability brief. The team reassessed the conditions of the British Standard BS 5454: 2000 (on storage and exhibition of archival documents) against broader parameters adopted by the Victoria & Albert Museum, National Trust and English Heritage. The proposed **parameters targeted 16-28°C and 30-70 per cent relative humidity** (RH) are more in line with the more recent PAS 198:2012 Specification for managing environmental conditions for cultural collections.

The Whitworth adopted a **high level heating and ventilation strategy** for the exhibition galleries using a **passive approach and broad parameters**. Conservation heating is used to control RH, and the refurbished exhibition galleries have been re-roofed and insulated. As expected, galleries are cooler in winter and warmer in summer; staff are briefed on what to expect so they can dress appropriately and are able to communicate their strategy to visitors.

A large part of the Whitworth collection was stored in inappropriate spaces in which the air-conditioning had to work hard and inefficiently against the poor thermal properties of the building fabric. Relocating the stores and exploring a passive approach to environmental control was an important early decision. By **bringing collections from eleven stores to one area in the basement away from offices, they could reduce the reliance on strict controls in multiple spaces contributing to energy saving**. Moving the collections also allowed the Whitworth to open up the impressive Grand Hall for use as a lecture theatre and function room.

The stored collections are now located in two areas. **Air-conditioning has been replaced with passive design techniques** including use of the thermal mass of the ground slab, air-tight structures and minimal air exchange rates, newly insulated ceilings and a new build surrounding the storage spaces, creating the buffering properties of a room within a room. Lime plaster is used for damping temperature and RH, while minimal interventive control is via a conservation heating approach.

Opening up the Whitworth and reconnecting visually with the park, necessitated a **new approach to lighting control and management of increased daylight** into gallery spaces – a challenge when the collections are predominantly light sensitive. Included in the strategy are louvres in roof lights, blinds and brise-soleil, all providing controlled natural daylight. The high performance **solar control glazing** minimises solar gain, whilst energy efficient **LED lighting systems** in exhibition galleries are linked to daylight sensors and occupancy sensors in back-of house areas. The intention is to set maximum exposure levels over specific exhibition periods, and monitor and balance cumulative exposure levels with the significance of objects.

Standard format and **reusable display systems** were introduced to enable easy, speedy and regular rotation. The Whitworth team source **sustainable materials** and invest in **staff skills and training**. Room sets are based around modular components usable across the range of its collections, providing flexible and cheap exhibition design. At the end of an exhibition, the set is dismantled, stored for future use, reconfigured and reused. Sets and materials no longer usable are passed onto other users within the local cultural community, or recycled as a last resort.

The Whitworth's new development includes an art garden, sculpture terrace, orchard garden and a bio-diverse roof. The Whitworth worked closely with landscape consultant Sarah Price, and took advice from an entomologist on the new landscaping plans to **protect and enhance biodiversity within the site**. There are plans for bee hives, and continuing programming that uses the collections and the adjacent park to raise awareness of sustainability to all audiences.

Embedding sustainability has reaped financial, reputational and stakeholder benefits for the gallery. Recently they have received £50,000 from Jo Malone for planting in the Orchard Garden, £26,000 via the University of Manchester Revolving Green Fund for LEDs and £350,000 from the Esmée Fairbairn Foundation for their Cultural Park Keeper programme. Most recently the Whitworth was the 2015 winner of the **Art Fund Museum of the Year Prize** (an award of £100,000) and, at the time of writing was **shortlisted for the 2015 RIBA Stirling Prize**, the UK's most prestigious architecture prize, and (awarded to Everyman Liverpool in 2014).

Staff engagement was positive and the gallery applied its experience with environmental **awareness-raising and behavioural change** during the capital project. This approach has reached across to the Whitworth's audiences and informs wider thinking, from its schools' programme to work with artists.

3 Integrating environmental sustainability across the project life cycle

3.1 Project inception

It is in the inception of a project that a building user or client's needs are explored and measures of success expressed. The earlier environmental sustainability is integrated into this process the better.

3.1.1 Understanding building use, user needs and performance

Environmental sustainability should be seen as a way of enhancing the building user's experience (staff, audience, art, artists etc.) as opposed to a constraint. **Determine a baseline for building user satisfaction at the start of the project**. Carry out a building user survey and make plans to carry out a further survey post project. For large projects in particular it is advisable to work according to **Soft Landings framework.**

Soft Landings is a framework to ensure buildings meet performance expectations and deliver outcomes that will benefit clients and end users making buildings perform better from day one. It aims to enable clients to gain more value from their design team during briefing, pre-handover and long-term operations. It provides a mechanism for ensuring that the operational needs of the building are fully considered and included along with performance requirements in procurement and contractual obligations. This ensures designers and contractors are motivated and engaged to improve the performance of a building in the crucial first months of the building use and beyond.

Building User Survey Methodology

The Institute for Sustainability's online Guide to Building Performance Evaluation including questionnaires for user surveys and guidance on infrared thermography, U-value testing and air leakage testing

Building Services Research and Information Association (BRSIA) and the Usable Buildings Trust Soft Landings

The **Whitworth** positively engaged with staff throughout its capital project, closely consulting the gallery team, as both building users and experts on environmental conditions for collections, as part of their aim to establish a more flexible environmental approach to collection storage. Engaging with staff, visitors and other stakeholders on environmental behaviour change was, and continues to be, a key area of focus for the gallery to ensure the sustainability of their building in use. For example, as the galleries are cooler in winter and warmer in summer; staff are briefed on what to expect so they can dress appropriately and are able to communicate their strategy to visitors.

Understand the current environmental performance and issues for your building to inform decision-making and the brief for your project. Energy consumption for heating and cooling is almost always the largest direct source of carbon emissions so addressing energy consumption at the outset is fundamental. Look at other environmental issues, especially in relation to the size and location of your building, the nature and scale of your activities, e.g. water conservation, flood risks and biodiversity. For further guidance on methods and tools on understanding a building's performance see Chapter 4. Understanding, evaluating and monitoring environmental performance.

In April 2015, the **Lyric Hammersmith** opened its new Reuben Foundation Wing, an **extension to the existing West London theatre** which houses rehearsal and studio spaces, a cinema, workshops, recording studio, music practice rooms, offices and teaching spaces. The opening celebrated the culmination of a major redevelopment which included the first **major facelift for the existing building** in thirty years and the creation of a new extension doubling the size of the building.

The **£20 million** project began on-site in 2012. 'It was funded by Arts Council England, the Department for Education, London Development Agency, North Fulham New Deal for Communities and the London Borough of Hammersmith and Fulham.

The purpose of the redeveloped building was to enable the Lyric to expand its programme of activity with young people andemerging and professional artists. Building on its long-standing environmental commitment and working with Rick Mather Architects, a further aim was to **create a leading sustainable cultural building** and to achieve a BREEAM 'Excellent' rating for the existing refurbishment and the new building.

At the start of the project, the Lyric already had a **solid understanding of the existing building's environmental impacts and carbon footprint**. The targets set for the new build were in line with the Mayor of London's interim target to **reduce carbon emissions by 20 per cent by 2015** (the longer term target is 60 per cent by 2025) and the London Borough of Hammersmith and Fulham's target of **generating 10 per cent of energy needs from on-site renewable sources**. In addition, under building regulations, the theatre was obliged to devote 10 per cent of the refurbishment costs to consequential improvements in the building's energy performance.

'In the early stages of the design, a Sustainability Consultant was commissioned to produce an **Energy Strategy Report**. This report considered options for low and zero carbon technologies including solar thermal and photo-voltaic panels, ground and air source heat pumps and a combined heat and power plant as well as financial impacts.

The redevelopment uses passive cooling i.e. **natural ventilation**, wherever possible. Mechanical air-cooling will only be used where absolutely necessary. **Air source heat pumps**, a renewable source of energy, are expected to provide a 25 per cent reduction in carbon emissions and a 12 per cent reduction in energy usage. The oil-fired heating system was replaced by a **high efficiency gas boiler**. An **insulated render system and double glazed windows** were installed to improve the thermal performance of the building. **Natural light** is used where possible. **LED lighting and lighting controls** were also introduced. **Low water usage sanitary systems** were installed and the theatre has a **green roof** with a biodiverse selection of plants. **Solar photovoltaic panels** will generate electricity when installed (the theatre is awaiting the necessary permissions). **Recycled and reclaimed materials** were used where possible for fixtures and fittings, for example the office desks are made from scaffolding boards.

The Lyric's **Green Team** is made up of a cross section of the organisation, all of whom are passionate about reducing the Lyric's carbon emissions and making the organisation more sustainable. The team has been developing and implementing a range of environmental initiatives since 2010. This will stand the theatre in good stead to ensure that **in use its building makes a positive contribution to environmental sustainability**. The Lyric is the first arts venue to achieve a 3 Star rating under the Industry Green certification scheme[11], and it has achieved this over the last three years.

11. http://www.juliesbicycle.com/services/industry

3.1.2 Defining environmental ambition and measures of success

Think about how improving the environmental sustainability of your building can contribute not only to overall project vision, but to your financial, cultural and social sustainability, long term plans and purpose as an arts organisation. **Be clear on your definition of environmental success, taking your review of building use and performance into consideration**. Define your level of environmental ambition and set specific targets accordingly. Consider if there are any regional, local or other (e.g. university) targets to which your targets could be aligned. For further guidance see Chapter 4. Understanding, evaluating and monitoring environmental performance.

National Theatre

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The National Theatre - NT Future
NT Future is the National Theatre's **£83 million redevelopment programme**. The redevelopment started in 2010, completion in 2015. £52.5 million was raised by the NT through donations from individuals, trusts and foundations, and £7.5 million from the NT's own earnings from War Horse; with the remainder from Arts Council England (£20.5 million) and the Heritage Lottery Fund (£2.5 million).

Alongside allowing audiences closer engagement with the theatre, both on stage and behind the scenes, one of the major aims of the project is **to improve the sustainability of the building and its finances**, in accordance with the NT's broader business objective: 'The NT operates in a financially and environmentally responsible manner, whilst striving to increase self-generated income.' The redevelopment aims **to generate an extra £1 million a year** from having more seats in the new Dorfman Theatre, new catering facilities and an improved shop, and by **targeting a 30 per cent reduction in energy use**.

The project, designed by Haworth Tompkins Architects, **focuses on making better use of what it already has**, keeping new build to a minimum – only 5 per cent of the whole building – and renewing its 1970's equipment and infrastructure.

The theatre has installed a **Combined Heat and Power plant** (which generates heat from waste exhaust) as well as a **ground source heat pump** (GSHP) in the new building. It is also introducing a **new cooling strategy** using 'ice' storage, which is more energy efficient than traditional cooling systems. The thermal envelope of the workshop buildings has been improved by installing **roof and wall insulation** (non-existent in the original design), **double glazed rooflights** and **a green (sedum) roof**.

The installation of the CHP has already resulted in energy savings, but it will not be possible to accurately quantify savings until all new 'smart' control systems and the Building Management System (BMS) are commissioned, and have had a settling in period.

Data delivered via electrical sub-metering installed in strategic positions across the site is now being monitored and will be used to target areas showing unusually high demand and investigate how energy is used in these areas and inform procedural and behavioural improvements.

LED lighting is being introduced in the foyers and external public areas. A new **smart lighting control system** using movement sensors and ambient lighting controls to utilise **natural daylight** is being rolled out in the office areas as part of a re-wiring project.

The NT plans to install a **water extraction plant** in 2015, utilising the reservoir from the local London aquifer, a more sustainable supply of non-potable water than treated potable water. A 'bore hole' of 125 metres was sunk down below the foundations of the new building, which will provide 100 cubic metres per day, enough to fully meet the building's demand for non-potable water i.e. sanitary and washing facilities and evaporative cooling towers.

Working with contractors experienced in installing new sustainable technologies and with a good understanding of environmental strategies has been important in the construction process, to avoid delays with installation and day-to-day operational problems in the early stages of use.

3.1.3 Establishing the brief and project team

Share your project vision and ambitions with the project team. Clients are ultimately responsible for realising the project vision and ambitions. So properly exploring and articulating the vision and ambition as a client and sharing this with the project team is essential. It is also advisable to assign a sustainability champion within the project team.

Key environmental elements in the **Whitworth's** brief to the design team (the architects – MUMA, M&E contractor – Buro Happold and structural engineers – Ramboll) were saving energy; reducing the carbon footprint by 10 per cent; exploring green technologies and achieving a BREEAM 'Excellent' rating. Current environmental conditions for the collections and the gallery's desire for a more flexible environmental approach, in line with thinking emanating from the Bizot Group and National Museum Directors' Council, were also key considerations.

Alongside the artistic vision and accessibility, environmental sustainability was at the heart of the redevelopment of the **Everyman Liverpool**. A central element of the design brief was that the new building be economical to operate, staff and maintain, and address environmental concerns as well as financial sustainability. Priorities for the project were set out with the overarching heading 'Minimise Running Costs' – a short hand for sustainability readily understood by everyone - and rounded off with 'Sustainability – the extra mile'. The stated project aims included: 'improving on the minimum statutory requirements and best practice' and achieving a 'Very Good' BREEAM rating. The Official Journal of the European Union (OJEU) tender instructions for the design team included a requirement for sustainable construction, low carbon design and sustainable use throughout the life of the building.

Include specific environmental and other performance outcomes and targets in the project brief both for internal purposes and for the designers, architects, engineers and constructors. This will help to make sure your vision is realised despite contractual complexities, especially with design and construction procurement. **Plan regular reviews of progress against the project brief and performance requirements throughout the project**.

Get good advice and look for partners, architects and designers with proven environmental credentials and/or who you feel can help to develop and share your environmental ambitions as part of the overall project.

Chichester Festival Theatre's key learnings from its capital project included the importance of investing time and effort as a client to keep the project progressing to your brief, and of challenging consultants to deliver the project to your brief.

"Don't leave everything to the consultants and make sure that you have understanding within the organisation of the benefits of what is being proposed. Financially you may have to make decisions about what to cut and this can only be done as part of a bigger picture."

3.1.4 Involving stakeholders

The underlying principles and assumptions about environmental sustainability in buildings can vary widely between the building owner/leaseholder, building users, architect/designer, engineers, local authority planners, funding organisations etc. Early dialogue is highly recommended. Different user needs, policy, regulation or budget responsibilities, perceptions of success and cost, motivations and vested interests can present challenges and, in some cases, weaken environmental ambitions. **Identify the different stakeholders for your project at the start**.

Stakeholder involvement can take different shapes and forms, depending on the size and complexity of your capital project. Once you have identified your stakeholders and their environmental concerns and motivations, plan appropriate stakeholder engagement activities, before, during and after the project.

CHICHESTER FESTIVAL THEATRE

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Five years ago, the **Chichester Festival Theatre** (CFT) was in urgent need of a 21st century upgrade. The Grade II* listed building had served the company well since it was built in 1962. However originally built on a budget to operate for an 11 week summer festival with 75,000 visitors, it was now operating year round with over 300,000 visitors annually. The theatre reopened in July 2014 following the capital project RENEW; a major restoration and renewal incorporating a remodelled auditorium, bigger foyer spaces, an improved parkland setting and a new back of house extension.

The project cost was **£22 million**. The award of a £12 million capital grant from Arts Council England in July 2012 immediately unlocked an additional £8 million in pledged local support from businesses, trusts and individuals, and, most notably, from West Sussex County Council and Chichester District Council who pledged £1.5 million and £500,000 respectively. Planning permission and listed building consent had already been granted in 2011. A further £1.2 million awarded by the Heritage Lottery Fund in December 2012 supported the restoration of the Grade II* listed features and implementation of a three-year **heritage engagement project**. CFT was proud to achieve a **BREEAM 'Very Good' rating** for its upgraded building.

Sustainability formed an integral part of the design process from early on. The aspiration was to achieve a **low-energy design through intelligent reuse of the existing building and a new build extension**; incorporating a ground source heat pump (GSHP), energy efficient technologies and low-water use sanitary facilities. The key aspects of the environmental strategy were proposed by the Mechanical & Electrical Services consultants and architects and developed during the design process.

The building uses a GSHP with a closed and open loop which **uses the stored heat of the earth and groundwater underneath Oakland's Park to support building heating and cooling**. Extra **insulation** of the auditorium roof regulates temperature and reduces the sound of rainfall during performances.

A **building management system** (BMS) has been installed to monitor heating and cooling systems and efficiently manage energy use. The BMS controls the major plant, including the GSHP, and is specified to minimise heating and cooling needs. Since July 2014, the installation engineers, CFT's Mechanical & Electrical consultant and the Building Services team have worked to ensure that the system is monitoring and reacting appropriately to the changing internal and external environment in public and backstage areas. CFT views the first 12 months and quarterly seasonal commissioning as an opportunity to fine-tune the technology and BMS monitoring to create benchmark figures for future years.

Energy efficient lighting and controls have been introduced. Where possible all backstage lights are now LED. PIR (movement) detectors have been fitted to lights in back of house rooms and all front of house toilets. CFT has also undertaken a programme of replacing inefficient bulbs in lighting rigs.

Recycled or sustainably sourced materials were used where possible. The theatre's original maple stage floor was restored and re-laid in the green room and meeting room. The existing auditorium seat frames were re-upholstered. Landscaping materials included paving made from clay drudged during the maintenance of Dutch flood defences and external paving with cockleshells collected during gravel extraction in southern England.

CFT employed an ecology consultant during the design stage who, having provided a survey of the site and surrounding areas, worked alongside the Landscape Designer to ensure that their **design both enhanced the site ecology and biodiversity in the long-term and mitigated short term impacts during construction**. Planting was done with reference to the Sussex Biodiversity Action Plan. The plants include a high proportion of species with known value to wildlife and include a substantial element of low maintenance, drought-tolerant species. Short-term measures included an agreement that no vegetation clearance take place between March and August to protect nesting birds. Additional nest boxes were also supplied. When dead wood was removed, it was retained on-site to be used as wood piles to protect invertebrates.

Since July 2014, additional works have been underway to complete the landscaping and rectify problems such as compacted sub-soil. Once the works have been completed, CFT will take over responsibility for landscape maintenance from the sub-contractor and a **more sensitive management system** will be adopted with plans to encourage woodpiles and wild areas, and plant a wildflower meadow. CFT continues to work closely with Transition Chichester which manages an organic community orchard on the boundary of the parkland. In due course, CFT will work with Chichester District Council and Transition Chichester to invite Sussex Wildlife Trust to carry out relevant studies.

3.2 Design

> "Good design delivers environmentally sustainable buildings"
>
> **Building Excellence in the Arts: A Guide for Clients, Commission for Architecture and the Built Environment and Arts Council England, 2009**

3.2.1 Best environmental practice

Environmental sustainability requires a systems-based approach to design and to see the interconnectedness of all elements. How does environmental sustainability relate to your purpose and long-term plans as an arts organisation? How do the spaces influence the cultural experience? What is the link between people and place, the building and the local climate and natural environment, resource efficiency and waste, materials and thermal comfort, green spaces and cooling? Understanding these links and getting the balance right between different systems is one of the key challenges of designing sustainable buildings.

Carry out a brainstorming exercise with your project team and/or other stakeholders to **understand sustainability in context and how your building might positively contribute to a sustainable society**. Horizons is a free online tool you can use to do this.

> The Horizons tool, developed by Forum for the Future, Innovate UK and Aviva Investors, defines the environmental limits and social conditions necessary for a sustainable economy, explains the planetary boundaries and associated risks and opportunities, and suggests actions organisations can take to be better prepared for the future.

Apply best environmental practice from the start, considering the following key principles:

Energy efficient, low or zero carbon:

- avoid using energy in the first place e.g. use natural ventilation and daylight;
- use less energy, e.g. with a well-insulated building fabric, energy efficient boilers, zoning heating and ventilation according to opening hours and use and;
- replace fossil fuels with low or zero carbon energy sources e.g. using solar photovoltaic panels to generate electricity, biomass boilers for hot water.

Zero waste – moving from the 'take, make, and dispose' model to a 'circular' model:

- using fewer materials in the first place;
- using reclaimed, recycled and secondary materials where possible;
- using materials specifically designed for reuse or recycling;
- using sustainably sourced materials;
- recovering products and materials for further reuse, repurposing and remanufacturing, either in your own project or by resale or donation.

Conserve water, e.g. through:

- using water efficient equipment;
- harvesting rainwater;
- using Sustainable Urban Drainage Systems, a means of managing surface water to reduce flooding, prevent water pollution and enhance biodiversity;
- planting drought resistant plants, which require less water.

Protect and make space for nature and biodiversity, e.g. through

- creating new green spaces such as living walls, green roofs or urban trees which can contribute to cooling and insulation, minimise surface run-off by soaking up water and provide a home for plant and animal life;
- creating new spaces for specific animal and plant species such as nesting areas, bat boxes and beehives.

Provide a healthy environment for people, e.g. through

- using non-toxic materials and natural ventilation for good indoor air quality;
- using natural daylight to provide good levels of visual comfort;
- using materials which ensure thermal comfort and good acoustics.

Prevent or minimise noise, light and air pollution, e.g. through

- using materials and insulation to minimise noise outside of the building;
- positioning external lighting to minimise nuisance to residents;
- providing sustainable transport solutions for building staff and visitors.

> To find out more about the latest thinking on approaches to sustainable buildings:
>
> - The International Living Future Institute's Living Building Challenge is a philosophy, certification and advocacy tool for projects to move beyond being less bad and to become truly regenerative.
> - Postcards 2050 - Future Solutions to Challenges in the Built Environment provides responses from CEOs in the buildings sector to a range of environmental challenges including energy security, resource scarcity and water risks.
> - Using Nature's Genius in Architecture a TedTalk by Michael Pawlyn.
> - Innovate UK's Design for Future Climate provides resources on designing, constructing, upgrading and using buildings to be more energy efficient and resilient to extreme weather.

3.2.2 Working with standards and codes

Standards and codes for sustainable buildings are by their nature a 'one size fits all' approach, which can sometimes impose constraints on organisations, e.g. requiring the use of specific environmental technologies which may not be the most appropriate for the building. **Use standards and codes wisely**. Complex technologies, unless maintained and controlled correctly, can actually increase energy use. In the education sector, for example, some schools created 'sustainable buildings' as defined though a narrow scope mainly influenced by building regulations, incentives for low and zero carbon technologies and trends in building design. In some cases this resulted in the buildings failing to live up to expectations, especially in terms of user satisfaction.

The Building Research Establishment Environmental Assessment Method (BREEAM) aims to set the standard for best practice in sustainable building design, construction and operation and encourages low carbon and low impact design at the early stages of building conception. The method can serve as a useful guide in itself. Buildings can also be assessed and rated according to the standard (there are five possible ratings, Pass, Good, Very Good, Excellent and Outstanding).

- BREEAM UK Non-Domestic Refurbishment and Fit-Out 2014 technical manual
- BREEAM UK New Construction 2014 technical manual

Whereas most of the new technologies introduced under the **National Theatre's Future** redevelopment programme were viable in terms of financial payback, some, such as the ground source heat pump did not have such good paybacks, but were deemed ultimately necessary to achieve BREEAM status for the new building as determined by Lambeth Council's planning guidelines.

3.2.3 Creativity and resourcefulness

Creativity is our most valuable resource. **Bring the creativity and resourcefulness of your organisation, building users, artists and other stakeholders into your building project**. Consider ways of doing things differently and more efficiently, for example avoiding material use, repurposing existing spaces, or relocating activities to make better use of natural lighting.

"We've found that embedding sustainability has bred ingenuity during the creative process. It is more of a challenge to create something within boundaries – something that can amaze an audience, but also save the environment and save money. This challenge is the motivation - to walk down that road and be resourceful rather than to create something with unlimited materials and money. It pushes you to be better and think about things with a different logic, one that we are finding to be ultimately more rewarding."

Crayg Ward, Pentabus Theatre Green Champion

While the **Almeida Theatre in London** was waiting to move into its new building, it created a temporary building in an old bus garage. They borrowed turf from the landscape contractor to insulate the roof as it was too cold and the rain too noisy and returned it at the end of the year.

BATTERSEA ARTS CENTRE

As an organisation dedicated to inventing the future of theatre which aims to be more environmentally sustainable, **Battersea Arts Centre** (BAC) has implemented a range of innovative and creative environmental solutions. One of its aims is to create a 'Building Forecast Tool' to actively monitor the building, so that they can more accurately predict the likely temperature and conditions of performance spaces, and therefore inform audiences in advance of a show how they might best dress for their comfort. In a first step to building such a tool, BAC tested the use of CubeSensors for their children's Christmas production 'Antartica' in 2014. CubeSensors measure air quality, temperature, humidity, noise, light and air pressure. Connected wirelessly to a base station they provide live information on a space. The CubeSensor allowed BAC to monitor the temperature of the Little Bulb Theatre and send messages to the audience before the show. Messages such as 'Having the polar bears over for dinner?' allowed audiences to dress appropriately for the show, so they could get to see and hear the wonder of the Antartica but not experience it through shivering. It is BAC's aim to have digital displays from the CubeSensor app placed around the building so visitors could get an idea of the temperature, air quality, noise and light of each of the spaces giving them an idea of the work BAC does to manage its energy use.

3.2.4 Identifying environmental options

The best environmental solutions do not necessarily have to be the most technological, expensive or high profile. **Consider a range of options, technologies, behavioural and procedural**, such as training and awareness-raising and setting up building controls and management systems.

Figure 1. shows the typical hierarchy of decisions and interventions made to reduce the energy impact of a building and Figure 2. the expected reduction in energy use associated with each of these types of interventions.

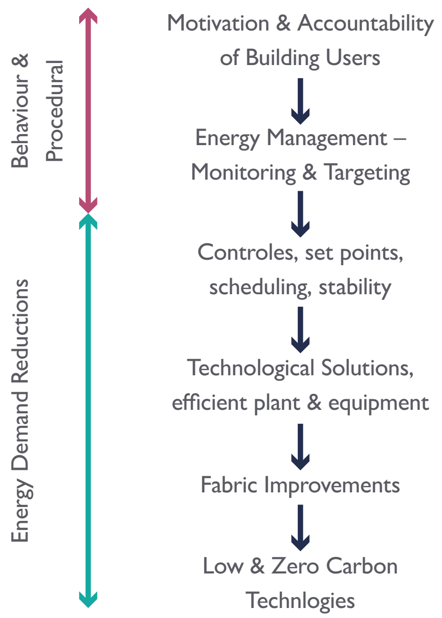


Figure 1. Hierarchy of energy reduction

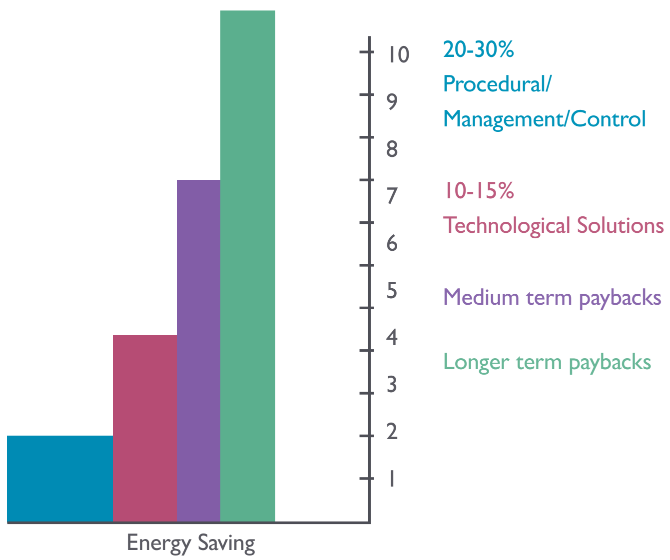


Figure 2. Energy solutions and their savings

Define a clear set of criteria for assessing different environmental options, such as cost, environmental benefits, technology risk, maintenance requirements, reputation and public profile. Figure 3. provides an example of an approach to assessing low carbon solutions.

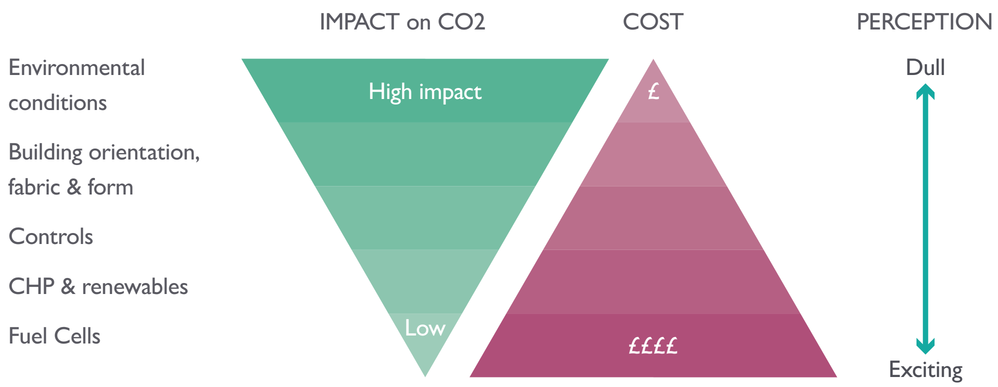


Figure 3. Carbon reduction, cost and perceptions of low carbon solutions

Courtesy of Max Fordham

Engineers can often be overly influenced by the idea that technological interventions will realise the biggest improvements. As a client you can **play your part in influencing this stage by ensuring that technological solutions are properly and objectively assessed**, asking the following questions:

- It a technological solution necessary?
- Will this intervention create an environmental performance improvement, such as a reduction in energy use? Can this be clearly demonstrated by the engineers?
- Have alternative options such as passive techniques (heating/cooling/ventilation) been properly assessed and considered?
- Have paybacks been calculated on the basis of the whole life cycle of a technology i.e. upfront costs, running, maintenance, and disposal costs?
- Are there adequate skills within the procurement team to ensure technology will be installed and commissioned to best practice standards?
- Are there adequate skills and resources within the organisation to ensure that this technology will function as planned?

Life cycle costing (LCC) involves evaluating the costs of an asset throughout its life cycle, such as construction, maintenance, operation, occupancy and end of life. Conventional LCC techniques most widely used are based on a purely financial valuation. Environmental LCC considers the external costs of environmental impacts, such as greenhouse gas emissions associated with energy use.

3.2.4 Identifying environmental options

Environmental technologies and options change over time, as do their associated costs and risks depending on how well established they are. **Plan for a robust, regular review of environmental solutions and options identified** against performance outcomes and targets, the design brief, user needs and technology developments.

For buildings, energy consumption for heating and cooling is almost always the largest direct source of environmental impact. **Define requirements for new heating, hot water, cooling and ventilation systems according to the predicted energy demand of a building post-investment, as opposed to current demand**. You can predict demand using the floor area of the building post-investment using benchmarks, see Section 4.3 Benchmarks.

Appendix 4. Environmental technologies and solutions, provides an overview of the main technologies and solutions. Appendix 5. Funding and financing sources provides a comprehensive listing of funding and financing for capital investment projects, energy efficiency and renewable energy, and other sustainable buildings work.

- Ashden low energy buildings – simple, clear information on sustainable technologies and low energy building principles and techniques.
- Autodesk Sustainability Workshop Building Design covers a range of topics from. building energy fundamentals and passive design strategies to energy efficient Heating Ventilation and Air Conditioning (HVAC) systems, building envelope and water.
- The Carbon Trust's Low Carbon Buildings Design and Construction resources
- Arup's Museums and Art Galleries Survival Strategies: A guide for Reducing Operating Costs and Improving Sustainability includes 205 possible upgrade measures.
- The Sustainable Traditional Buildings Alliance's Responsible Retrofit Knowledge Centre and Guidance Wheel depicts over 50 measures that can be used for the retrofitting or refurbishing of traditional buildings.
- The Fit for the Future Network is a carbon-cutting network established by the National Trust and sustainable energy charity Ashden with a focus on heritage buildings and sites.

Against a backdrop of fast developing renewable and low or zero carbon technologies and even faster reducing grants and incentives for adopting them, **Everyman Liverpool assessed different technologies based on cost effectiveness, carbon savings, marketing image and technology risk**. This approach ruled out biomass and ground source heat pumps and favoured solar thermal, photovoltaics, wind and Combined Heat and Power (CHP) fairly equally.

Biomass was rejected mainly due to poor availability of a fuel supply within 25 kilometres, higher emissions, lower efficiency and, crucially, the need for fuel storage space. Wind power was also rejected because of intermittent generation and noise and vibration issues. The high initial cost of ground source heat pumps, coupled with the Everyman being sat on a massive sandstone ridge with groundwater at an unknown depth, ruled out this technology.

A further evaluation confirmed the viability of a **small combined heat and power (CHP) plant** with the thermal load matched to the expected domestic hot water requirement and generating about 25kW of electricity, reducing site emissions by about 15 per cent. Projected carbon savings for solar thermal water heating were only 3 per cent and it was also found that it would work against the CHP and was therefore rejected. Solar photovoltaic was further evaluated, but ruled out as it was found to offer an even smaller carbon saving and there was insufficient unshaded roof area.

Natural ventilation systems were analysed using computer modelling based on air flow and temperature. At the time guidance on maximum temperature levels was only available for air conditioned auditoria – with an upper limit of 25°C. As there was no guidance for naturally ventilated auditoria, extensive monitoring was undertaken in the old Everyman auditorium to provide this information. This showed that at 22°C the audience are happy, at 24°C they start to comment about being warm, at 26°C they complain and at 29°C they pass out.

Air source heat pumps were initially rejected as the technology available was not efficient at low winter temperatures. However with improvements in the technology, a re-examination found them to be a viable method of heating the auditorium. As they could be run in reverse cycle they could also be used to reduce auditorium temperature if it exceeded 26°C. In spite of external air temperatures reaching in excess of 30°C, this cooling has only run for short periods on two days over the first two summers of operation.

3.2.5 Art-form and activity-specific solutions

Arts organisations generally have specific requirements relating to their art form and activities, from temperature and relative humidity conditions for the conservation and storage of cultural collections to heating and cooling requirements for artists, dancers and audiences. It is important to **find a balance between environmental performance requirements and art-form specific environmental conditions**.

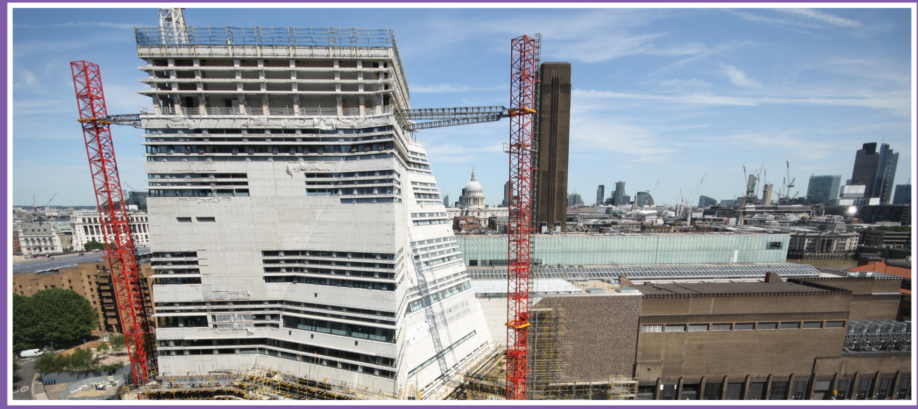
- The National Archives worked with leading experts in the fields of environmental management, cultural heritage and conservation to develop an environmental standard which addresses the challenge of long-term cultural collection care without excessive use of energy. PAS 198: 2012 Specification for managing environmental conditions for cultural collections was published in 2012 by the British Standards Institute (BSI).
- A European standard dealing with the protection of objects in all types of collections is under development by the European Committee for Standardisation - CEN TC 346 – Conservation of Cultural Heritage.
- Sustainable Exhibitions for Museums works towards sharing knowledge to improve the sustainability of the design, production and staging of exhibitions: V&A, Science Museum Group, Garden Museum, Royal Academy of the Arts.

IKON

The **Ikon Gallery** is a contemporary art venue in Birmingham. It is an educational charity that works to encourage public engagement with contemporary art through debate and participation. In 2013, Ikon received a small capital grant of £457,387 to replace, repair and modernize its 138 year old red brick neo-gothic building. Built in 1877 and refurbished from dereliction in the late 1990s into gallery, retail and café spaces, the aims of the capital project included **ensuring crucial equipment was reliable and safe, making the building more efficient, reducing energy consumption, environmental impacts and running costs.**

Ikon invested £56,222 in replacing light fittings throughout the building with **LED lighting** and presence detection technology. Ageing tungsten halogen track lighting in the gallery spaces was replaced with Designed Architectural Lighting's 'Baltic LED' spot lights. Lancashire-based manufacturer, Lamps & Lighting, supplied luminaires for public and back of house areas. On an annual basis Ikon estimates that the new lighting will reduce energy use by 45,000 kWh per year, saving circa £5,000 per year at their current tariff. A second phase of LED replacement works is expected 2015-16.

Ikon has also invested in a **reusable walling system for their exhibitions**. The new 'ReForm' system is a modular system comprising aluminium framework and profile-edged MDF cladding to create seamless walls and window infills. The only waste is the narrow joint filler strip that is removed during deconstruction. All boards and frames can be used again. They worked closely with the ReForm system supplier to develop semi-bespoke systems of varying scale made for specific gallery structures that are frequently erected and dismantled. This approach has significantly reduced landfill waste.



View of Site, Courtesy Lobster Pictures Ltd 2015 ® Tate

The Vision View from the South at Dusk, Hayes Davidson and Herzog & de Meuron

TATE

The extension of **Tate Modern** is due for completion in 2016, and will see a new building added at the south of the existing gallery. The vision of the new building is to redefine the museum for the 21st century, integrating learning, display and social functions and strengthening links between the museum, its community and the City.

The Tate's brief is for the building to be **agenda setting and take a leading role in sustainability**. It aims to challenge the perceived wisdom on the strict levels of environmental control associated with the display of art and **set new benchmarks for museums and galleries in the UK**. Other drivers for the design are: visitor and staff enjoyment – thermal and visual comfort; the conservation of art; the requirement for 20 per cent on-site renewable energy generation (from the Greater London Authority's 2008 Plan), and; the availability of UKPN's waste heat for use in the building.

To deliver a building that minimises energy use and carbon emissions, Tate's M&E engineers are focusing on a few key areas.

- Environmental zoning
  A passive approach to environmental control is possible within the parts of the building not used for the display of art. This means **selecting the most appropriate conditions (temperature and humidity) for each type of space, and minimising energy use** where possible, by using primarily passive means for non-art spaces where providing comfortable conditions for the occupants is paramount.
- Passive design
  This involves maximising the use of **natural ventilation** (a low tech, low energy solution to controlling internal pollutants and summertime temperatures), **thermal mass** (which absorbs heat during the day, releasing it during the cooler nights) and **natural lighting**.
- Efficient mechanical and electrical (M&E) systems
  Even after all the passive measures, the new building will still have significant energy needs: cooling will be required for the galleries, performance spaces, retail spaces, kitchens, IT rooms etc. and; heating in winter and hot water for WCs and kitchens. The new building aims to make use of **efficient M&E systems and low energy technologies** to reduce the energy demands of the building.
- Low carbon and renewable energy technologies
  The new building will draw the majority of heating and cooling energy needs from waste heat from UKPN's on-site transformers and by tapping into local groundwater resources. **Waste heat will be used for space heating, fresh air heating, hot water generation and desiccant dehumidification** within the galleries. Extracted from the River Terrace Gravels, **groundwater will be used to provide direct cooling** by pumping it around the building and running it through air handling units and embedded coils in offices, a much more energy efficient approach to cooling than conventional air conditioning. **Groundwater will also be used to supplement the heating and cooling by using heat pumps**, which either extract heat from the groundwater for heating or reject heat to the groundwater in cooling mode.

Through the use of these passive measures along with the efficient M&E services and renewable technologies, the **new building is expected to use 54 per cent less energy and generate 44 per cent less carbon** than current building regulations demand.

The energy and carbon savings elements of the project have been supported in part by the European Regional Development Fund (via the London Energy Efficiency Fund).

3.3 Construction

3.3.1 Materials

Building materials can have many adverse environmental impacts throughout their life cycle – from extraction, transportation and manufacturing of raw materials, to use and disposal: using energy and generating carbon; depleting natural resources; and negatively impacting natural systems and human health. Materials also create the physical space and aesthetics experienced by building occupants, hugely affecting the thermal, visual and acoustic performance of the building. The choice of materials also influences cost.

Focus first on minimising material use, repurposing existing materials or using reclaimed or recycled materials. When deciding on new or additional materials needed consider using:

- materials using recycled content
- sustainably sourced materials
- materials which can be easily reused or recycled
- durable materials
- locally available materials, although in some cases it may be better to source recycled materials shipped long-distance than to locally source virgin materials
- low or non-toxic materials
- materials that contribute to the thermal and acoustic performance of the building

For further information see **Appendix 4. Environmental technologies and solutions**.

- The Building Research Establishment's (BRE) provides a number of resources:
  - Green Guide Online - listings of building materials and components assessed in terms of their environmental impact across their life cycle.
  - Green Book Live - a free online database designed to help specifiers and end users identify products and services to help to reduce their environmental impacts.
  - BES 6001 for Responsible Sourcing of Construction Products is a framework that assesses responsible sourcing practices throughout the supply chain of construction products and allows manufacturers to prove their products have been responsibly sourced.
  - Autodesk's online resource Sustainability Workshop Building Design includes a Green Building Materials section.
  - Julie's Bicycle Forestry Stewardship Council Factsheet.

© Philip Vile

The Temporary Theatre (originally known as The Shed) was constructed as a temporary 225-seat auditorium to provide a third auditorium whilst the Cottesloe Theatre was closed during the National Theatre's (NT) redevelopment, at a cost of £1.2 million. The NT, architects Haworth Tompkins and theatre consultants Charcoalblue, initially explored the possibility of designing a building that could be fully reused. They decided the extra construction and transport costs for a moveable building, couldn't be justified. and chose instead to focus on making it out of recyclable components. It was designed and built in little more than a year, a collaborative process between the building designers, the theatre, and theatre-makers, more closely resembling a theatre show than a conventional construction project.

Wherever possible**, components from elsewhere were reused**, for example, the seating was taken from the original theatre; **reclaimed materials** were used, mainly reclaimed steel and plywood, and; **reusable or recyclable materials were used**. For example, the stage floor and galleries are made from reusable modular panels and steelwork was left unpainted so that it can easily be recycled.

The Temporary Theatre was designed to be as **low energy** as possible. Heat is provided by the NT's heating system supported by the Combined Heat and Power Plant and the four corner towers allow for natural ventilation, drawing air in naturally from under the seats to avoid mechanical ventilation.

3.3.2 Contractors

Integrate environmental sustainability requirements into procurement and contracting for construction contractors, including:

- materials sourcing and an obligation for the contractor to provide evidence on the origin and sourcing of the materials used, either directly or through their suppliers;
- a requirement for the contractor to establish an environmental plan for site construction, addressing site related impacts, notably: energy, waste, water, transport and noise and;
- a requirement for the contractor to monitor and report on the environmental impacts and carbon footprint of the construction project.

Under the Considerate Constructors Scheme construction sites, companies and suppliers voluntarily register with the scheme and agree to abide by the Code of Considerate Practice, designed to encourage best practice beyond statutory requirements. The main areas of concern are the general public, the workforce and the environment. On environmental issues, scheme participants commit to:

- identifying, managing and promoting environmental issues;
- seeking sustainable solutions, and minimising waste, carbon footprint and resources;
- minimising the impact of vibration, and air, light and noise pollution and;
- protecting the ecology, the landscape, wildlife, vegetation and water courses.

Chichester Festival Theatre's construction contractor, Osborne, achieved a Bronze Award in the Considerate Constructors Scheme (CCS) 2015 National Site Awards. Measures to reduce construction impacts included building the site roadway from the crushed aggregate from the demolition, and creating a bund in the park so that moved earth could be kept on site, reducing transport.

Steps taken by **Everyman Liverpool** to **reduce environmental impacts** during construction included:

- recycling98.6percentof demolition waste.
- recycling 89 per cent of construction waste.
- monitoring the sites energy and water use and impact of transport to site.
- a biodiversity champion on the site team to prevent harm to any flora and fauna.

3.4 Building in use

3.4.1 Handover and commissioning

Handover and commissioning have an essential role to play in the operational readiness of equipment, plant and buildings. **Define environmental sustainability standards and expectations as part of the handover and commissioning process.** The Soft Landings framework, introduced in Section 3.1 Project inception, includes a requirement for designers and contractors to support clients in ensuring the performance of a building in the crucial first months of the building occupation and in use.

Ensure new technologies, systems and controls are understood by the building users. If the people responsible for running a building don't understand newly installed technologies, controls and systems, it's unlikely the predicted levels of operational and environmental performance will be achieved. During commissioning and handover:

- systems and their control should be robustly tested, witnessed and understood by facilitates managers and building users;
- the process and appropriate methods for inspecting, identifying and rectifying defects should be agreed, and;
- facilities management and non-technical building users should be well briefed and, where appropriate, be given a non-technical building user guide and user/operator training timed appropriately around handover and proposed occupation.

- Soft Landings
- The Carbon Trust Making Buildings Work a guide on effective commissioning for achieving low carbon buildings

ARVON

Arvon is a charity that runs residential creative writing course and retreats in rural writing houses in Devon, Shropshire and Yorkshire. Arvon commissioned extensive sustainability assessments of its centres, looking at social, economic and environmental sustainability. In 2013 they redeveloped their Shropshire residential centre, The Hurst. This **£2.5 million project** included a full renovation, extension and accessibility improvements. 65 per cent of the funding was provided by Arts Council England and the remainder through fundraising, trusts and individual donations. For their heating and hot water solution, they worked alongside a Renewable Heat Incentive (RHI) consultant and installed a g**round source heat pump (GSHP) for heating** and **solar thermal panels for hot water** both eligible under the RHI. This has already reduced heating costs from £15,000 to £5,000 a year. A key learning for Arvon is that GSHP can be complex to run initially for a small organisation without specialist facilities staff, so **proper training in day-to-day maintenance is critical** at the outset.

3.4.2 Maintenance and operation

The maintenance and operation of a building is crucial to its long-term sustainability – environmental and financial. Many systems and controls installed in buildings do not take account of building operators and their ability to use them and equipment is often poorly installed and commissioned. There is also growing evidence that current legislation is not achieving expected reductions in the actual energy use of buildings and, if anything, can have unintended consequences, such as an increase in energy use for equipment which wasn't previously there.

Figures from Carbon Buzz[11], a RIBA-CIBSE (Royal Institute of British Architects and the Chartered Institute of Building Service Engineers) initiative show that on average, buildings consume between 1.5 and 2.5 times more energy than predicted values.

It is essential that a project or building is regularly appraised post-construction to ensure that the plant, technologies, controls and systems are operating as planned. This can be done in different ways from conducting a building performance evaluation (BPE), to building user surveys, walkthroughs and on-going performance monitoring. For further information see Chapter 4. Understanding, evaluating and monitoring environmental performance.

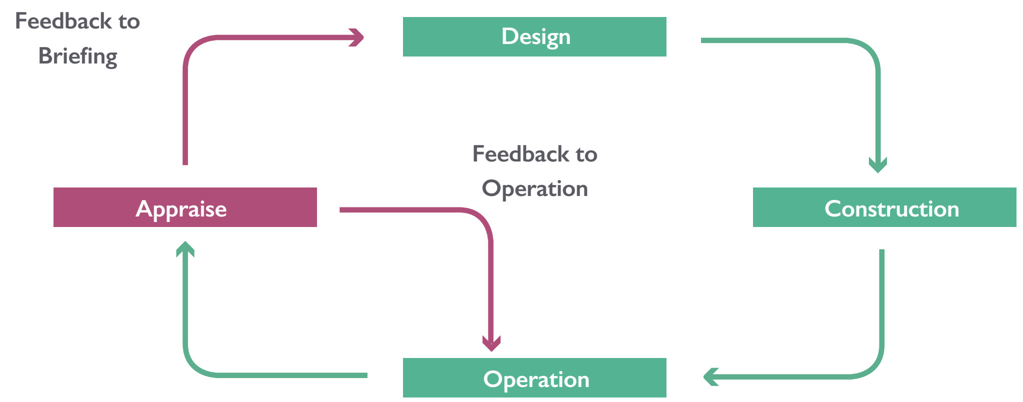
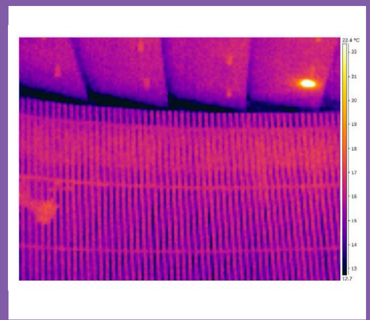


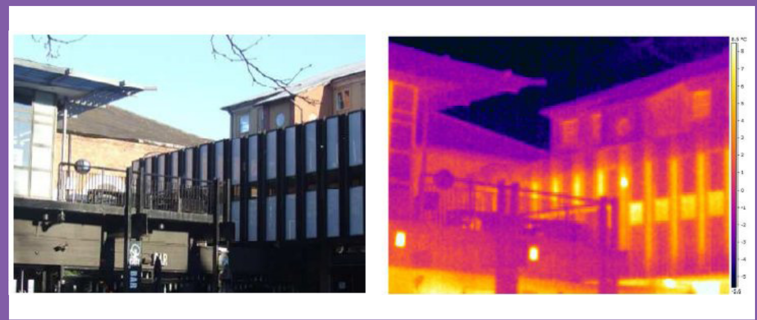
Figure 4. Post-construction appraisals in the building projects life cycle

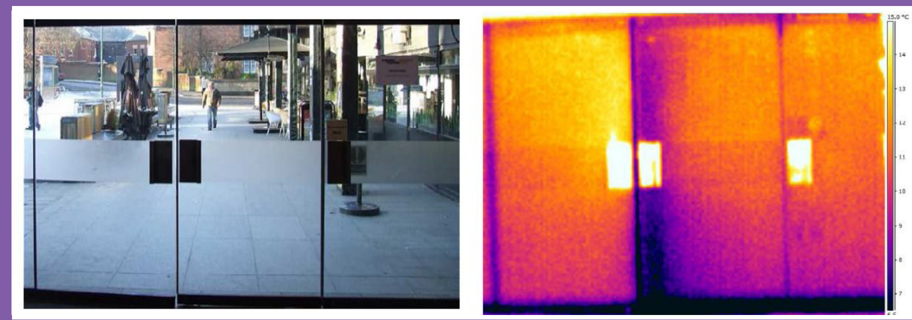
- Julie's Bicycle Practical Guide: Sustainable Procurement
- Julie's Bicycle Practical Guide: Waste Management in Buildings
- Julie's Bicycle Practical Guide: Productions and Exhibitions
- Sustainable Exhibitions for Museums
- Arup's Museums and Art Galleries Survival Strategies: A guide for Reducing Operating Costs and Improving Sustainability

11. http://www.carbonbuzz.org/

Nottingham Playhouse







Nottingham Playhouse is a Grade II* listed building, built in 1963. In 2013 the Playhouse received £1 million from Arts Council England's Large Capital Grants Programme for redevelopment work. To make up the remainder of the **£1.9 million cost**, it had planned to borrow money from commercial lenders with borrowing costs of £38,000. However the city council, which owns the building, provided a £230,000 loan towards improving energy efficiency, costing just £469 in interest and waived rent on the building for 13 years. The work was completed in summer 2015.

The project's aim was to **make the building more sustainable for the future:** 'It will be more comfortable for our audiences, more efficient to heat and light, and therefore much cheaper to operate, so that all our energy, and all your support, goes into our work, not our bills'. **Finding the balance between comfort and environmental sustainability** was a key element of the project.

Nottingham Playhouse had a **strong understanding of the energy performance of the building at the start** and had identified key problem areas which included: the main entrances into the buildings (frameless glass windows), the roof and the single glazed windows. Their Environmental Working group had managed to improve its Display Energy Certificate (DEC) rating before the application for the development project.

Prior to its redevelopment, Nottingham Playhouse had been working with Nottingham Trent University's Future Factory to identify sustainable design options for the building. In 2012/13 with Marsh Grochowski, Focus Consultants and Price & Myers Sustainability they also conducted a **feasibility study which recommended exploring a variety of low carbon and energy options** including:

- photovoltaic panels
- use of grey water
- insulating the brick work
- thermal energy
- double glazing
- using wind energy for electricity generation
- using biomass for heating.

In the end, the study showed that it would be more cost effective to replace the windows as opposed to insulating the brick work. Biomass and wind were ruled out as unsuitable for the city centre location. The final solution was to go with **solar photovoltaic panels for electricity generation, secondary double glazing, aerogel insulation in the metal window frames and roof insulation**. Other options implemented included replacing 50 year old stage lighting with **energy efficient lighting**. They also established a **zoned Building Management System** to facilitate energy management.

The capital investment is **expected to reduce energy use by 30 per cent and generate annual cost savings of £55,000-£58,000**. As the work was only completed in summer 2015, it is too early to determine the extent to which these savings have been achieved. However even before the system is fully calibrated and electricity generation by the solar PV panels fully live, Nottingham Playhouse has already seen a 35 per cent reduction in gas use and a 19 per cent reduction in electricity. Initial electricity savings are projected at 5 per cent. The 19 per cent savings achieved so far are in part due to additional replacement of the theatre lanterns.

The **Building Management System** (BMS) is working well and, once a new IT installation is in place they have ambitions to place displays in the front of house areas communicating the energy saved. In addition to this they have four new usable spaces that can be used for corporate hire, workshops and events, generating additional income.

Nottingham Playhouse's **Environmental Working Group is currently looking at next steps to ensure the building is environmentally sustainable in use**.

4 Understanding, evaluating and monitoring environmental performance

4.1 Understanding and evaluating performance

Whether investing in new plant and equipment, or undertaking major refit and refurbishments or redevelopment, you need a good understanding of your building's environmental performance. This knowledge will enable you to define clear and explicit performance outcomes, targets and indicators and determine a baseline against which to measure environmental performance of the building in use. Evaluating building performance after project completion will enable you to assess the extent to which outcomes and targets have been realised and identify changes or fine-tuning needed.

There is a range of methods. Choose the ones that work best for you, for example:

- **A review of existing behavioural and procedural measures** can identify non-technology interventions.
- **Building user interviews and surveys** determine what people think and how they feel about a building and how it meets their needs.
- **Energy surveys** are a systematic review of how energy is used within a building, from a walk through to an investment grade level survey by an experienced professional.
- **Infrared thermographic surveys** identify key areas of the building fabric to be prioritised for improvement and provide a baseline for comparing performance post works.
- **Air leakage testing** assesses the value of including draught-proofing improvements as part of a retrofit and gives a baseline for comparing results afterwards.
- **A Building Performance evaluation (BPE)**, generally done after project completion, evaluates how well performance objectives have been realised and how well the built environment satisfies the needs of the users, owners and managers. It will include building user surveys and at least some of the other methods listed above. The BPE method can also be applied in project inception.

Post-occupancy **building performance evaluations** (BPE) are an integral part of the Soft Landings approach. They involve measuring and comparing a building's as-constructed or in-use performance with its intended designed performance or industry benchmarks. The real performance can turn out to be better or worse than the designer intended or compared to benchmarks. This difference is known as the '**performance gap**'. BPE unpicks the reasons why and how improvements can be made.

- Institute for Sustainability's online Guide to Building Performance Evaluation including questionnaires for user surveys and guidance on infrared thermography, U-value testing and air leakage testing
- Chartered Institute of Building Service Engineers TM22 Energy Assessment and Reporting Methodology
- CarbonBuzz tool for benchmarking and tracking energy use in projects from design to operation
- Carbon Trust Energy Survey Guide
- Arup's Museums and Art Galleries Survival Strategies: A guide for reducing operating costs and improving sustainability
- Building User Survey Methodology
- Soft Landings an initiative of BRSIA (Building Services Research and Information Association) and the Usable Buildings Trust

4.2 Environmental goals, targets and indicators

There is no 'one size fits all' approach for defining environmental ambitions, targets, goals etc. for buildings. In general though, they should cover environmental issues in design and construction and the building in use – notably energy, materials, water and waste. When setting targets and defining indicators refer to:

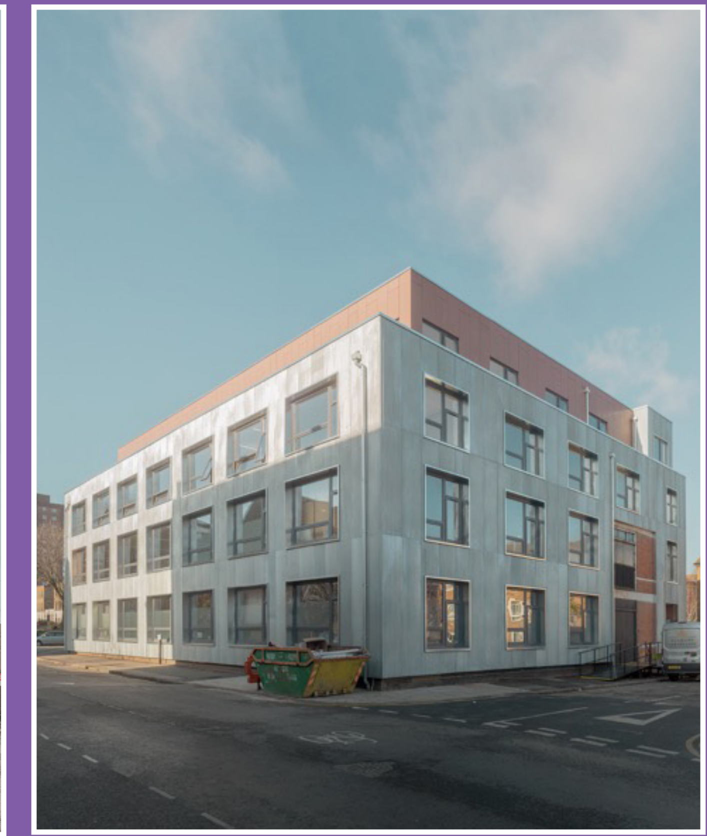
- **target emissions reductions** if they have been defined for your project under building regulations, see Section 2.2 Building policy and regulations;
- **regional or local environmental targets,** even if not mandatory, they can be a useful point of reference and;
- **sector benchmarks**, see Section 4.3 Benchmarks.

Targets:	**Indicators:**	**Implementation strategy**
Goal/ambition: to be a low carbon building and become more energy self-sufficient		
• to reduce the building carbon footprint by 10% (comparing the year preceding the capital project and the year after completion) • to source 25% of building energy from on-site renewable generation	• kg of carbon dioxide equivalent per m^2 floor area per year (based on electricity and gas use) • % of total energy use generated by on-site renewable sources per year	(developed over the design process) • introduce passive cooling via natural ventilation • install energy efficient boiler • install LED lighting and lighting controls • install solar thermal panels for hot water heating • energy management training for the facilities team
Goal/ambition: to maximise the use of sustainable construction materials		
• reuse as many of the original building materials as possible in the refurbishment • achieve 100% FSC certified timber	• % of construction materials which were reclaimed (tonnes of reclaimed construction materials / total tonnes of construction materials) • % of FSC timber used (tonnes FSC certified timber used / total tonnes of timber used)	• reclaim bricks from the demolished areas of the building • reuse timber flooring for desks • inclusion of sustainable sourcing requirements in the construction contract

Table 1. Examples of environmental goals, targets and indicators

Include ambitions, targets and indicators in the project brief and, where relevant, contractual obligations. Review them regularly throughout the project. Are they are still valid or do they need adjusting? Can new ones be set in light of new information on low or zero carbon technologies? Evaluate the extent to which they have been realised upon completion.

- Better Buildings Partnership's Sustainability Benchmarking Toolkit for Commercial Buildings
- The 2014 technical manuals for BREEAM UK Non-Domestic Refurbishment and Fit-Out and BREEAM UK New Construction including Key Performance Indicators In Use



[space]

SPACE runs 18 artist studio buildings across seven London boroughs, providing affordable creative workspace for over 700 artists and professional development support for a further 700. It is committed to environmental, economic and social sustainability. SPACE's Operations Director has overall responsibility for its environmental policy and each studio building has an environmental champion.

Measures undertaken before its capital project included installing solar photovoltaic panels at Haymerle Road, a measure which has already generated about £18,000 of new revenue.

Over the last few years, SPACE invested in a **refurbishment of four of its buildings** (two freeholds and two leaseholds) – Deborah House, The Triangle, Haymerle Road and Martello Street. The **total project cost was £3.24 million**. £1.26 million was provided through Arts Council England. The remaining £1.98 million came from a range of sources, including a private donation of £180,000 and loan funding from the ethical bank Triodos of £512,000.

The project's aims were to:

- **ensure the sustainability of artistic practice in London by improving working conditions for the artists**, in particular enabling artists to use studios through the winter which was previously very challenging.
- **increase the life of its buildings** in the long-term and;
- **reduce energy and running costs**.

In the course of the project, SPACE found a **significant overlap between environmental and artists' needs**, bringing environmental sustainability into the heart of the project. In addition, as the works took place while the buildings were occupied, good communication and planning in co-operation with the artists was essential.

SPACE was **supported throughout the project by professional advisors and experienced contractors** with whom it had an established working relationship, in particular: Sarah Wigglesworth Architects, an architectural practice with a proven environmental track record, and; Michael Pawlyn of Exploration Architecture, a proponent of learning from nature to transform architecture and society. Construction began in November 2013 and was completed in January 2015. The construction contractor had its own environmental policy and waste management plan.

One of the main aims of the redevelopment was to **improve the buildings' thermal performance and increase the buildings' life span**, which it did via **insulation, notably re-roofing, cladding and double glazing and the use of durable materials**.

At Deborah House the refurbishment included recladding, insulating external walls, double glazing and installing a **green roof. A gas central heating system** was installed at Deborah House and Haymerle Road, replacing the ad hoc use of inefficient electrical heaters. At The Triangle all **windows were draught-proofed and the heating pipes lagged** to reduce heating costs. Low wattage **LED lights on PIRS** (passive infrared sensors) were installed in communal areas and studio lights are low energy 46W T5 strip lights.

While it is early days yet, SPACE is confident that the refurbished workspaces will help to sustain its future and that of the artists it supports. It has already had positive informal feedback from the occupiers and will be doing a formal building user survey. They have seen **signi icant reductions in U-values, a measure of thermal performance** and will be collecting and analysing meter readings on a quarterly basis, comparing before and after the refurbishment to establish energy performance improvements and examine emerging trends. Gas heating systems will be regularly reviewed to ensure that they are working at optimum levels. It will also review settings for each building following a settling in period. Given the anticipated life spans of the materials used it **expects savings of about £50,000 a year in maintenance costs** over the next twenty years which will help compensate for increased rental costs.

4.3 Benchmarks

When setting performance targets and indicators, evaluating outcomes and monitoring the building in use, refer to existing industry benchmarks such as Julie's Bicycle energy and water benchmarks and the Chartered Institution of Building Engineers (CIBSE) TM46 Energy Benchmarks.

- Julie's Bicycle energy and water benchmarks
- CIBSE TM46 energy benchmarks

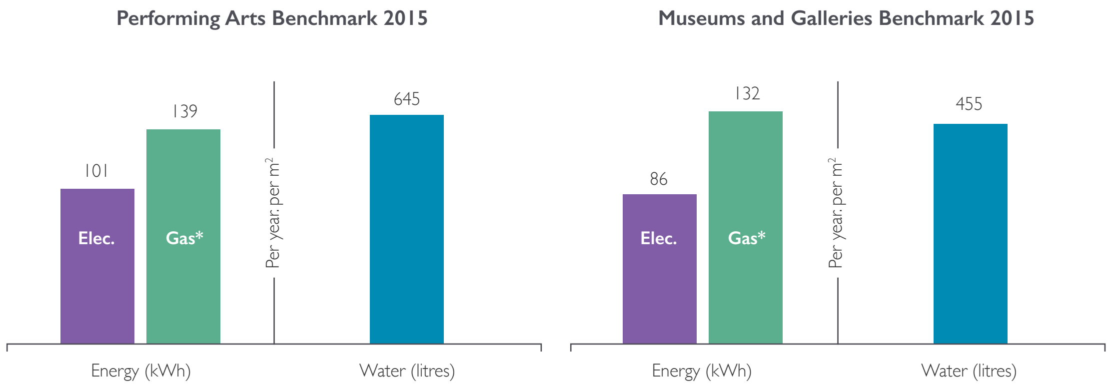


Figure 5. Julie's Bicycle Energy and Water Benchmarks

Building type	Entertainment Halls CIBSE TM46 (kWh/m2/year)		Performing Arts Buildings Julie's Bicycle 2013/14 (kWh/m2/year)		Cultural Activities CIBSE TM46 (kWh/m2/year)		Museums & Gallery Buildings Julie's Bicycle 2013/14 (kWh/m2/year)	
Energy type	Electricity	Gas	Electricity	Gas	Electricity	Gas	Electricity	Gas
Median kWh/m2/ year	Na	Na	100	131	Na	Na	81	134

Table 2. Comparison of CIBSE and Julie's Bicycle Energy Performance Benchmarks

4.4 Monitoring environmental performance in use

Define clear responsibilities for monitoring the environmental performance and impacts of your building in use. Make sure the people responsible understand why this is being done and have the necessary knowledge and training.

Monitoring in itself will not generate improvements. The information it generates should be used in a timely way by the right people (discovering a major peak in energy use a year after the event may not be helpful). On-going and regular monitoring will enable you to see how you are doing over time and make the link between your actions and performance and also better communicate with your staff, audience etc.

- Arup's Museums and Art Galleries Survival Strategies: A guide for Reducing Operating Costs and Improving Sustainability
- Carbon Trust Monitoring and Targeting guide
- Julie's Bicycle Industry Green Tool - carbon calculator for venues

ARTS ADMIN.

Artsadmin is a unique producing and presenting organisation for contemporary artists working in theatre, dance, live art, visual arts and mixed media. In 2014, Artsadmin installed 40 **solar photovoltaic panels** onto the roof of Toynbee Studios in London. This was a self-funded project with an estimated ten-year payback period. The panels have generated 9.4 MWh of energy since 2014, saving 5.4 tonnes of carbon and £1,184 so far. **Energy use is communicated to visitors through digital displays** in the foyers of the building. **Power and water are measured on a monthly basis** and building users are actively encouraged to switch off energy and water using devices and equipment. Between 2013 and 2015, Artsadmin have seen a **50 per cent** reduction in water use based entirely on staff efforts.

Appendix 1. Case study listing overview

Artsadmin in London self-financed the installation of solar photovoltaic panels to generate electricity and engages staff and visitors reducing the impacts of its building.

Arvon's residential writing centre in Shropshire redeveloped at a cost of £2.5 million, uses renewable energy sources for heating and hot water.

Battersea Art Centre's innovative environmental measures include testing CubeSensors as a means of monitoring and communicating performance space conditions to engage with audiences.

Chichester Festival Theatre in West Sussex undertook a major restoration of its Grade II listed building and parkland at a cost of £22 million, creating a low energy building, using sustainable materials, with a sensitive development of its landscaping to enhance the site ecology and biodiversity of its parkland..

Everyman Liverpool's £27.1 million award-winning new building, an exemplar of best sustainability practice, is enabling the Everyman to realise its artistic, accessibility and environmental vision.

Ikon Gallery in Birmingham used a capital grant of £457,387 to upgrade its 138 year old building to make it more efficient and cost effective to run, including a focus on lighting and resource efficiency and waste prevention for its exhibitions.

The **Lyric Hammersmith** in London redeveloped its existing building and built a new extension at a cost of £20 million, using low and zero carbon technologies and reclaimed and recycled materials, with energy efficient lighting, water efficient equipment and a green roof.

Nottingham Playhouse invested £1.9 million to make its building more comfortable, more efficient and cheaper to operate, installing insulated double glazed windows, roof insulation, energy efficient lighting, solar photovoltaic panels and a new Building Management System.

National Theatre's £83 million Future redevelopment programme (NT Future) targets a 30 per cent reduction in energy use using a range of low carbon technologies and energy efficient equipment.

The **Temporary Theatre (originally known as The Shed),** which gave the NT a third auditorium while the Cottesloe was closed during redevelopment, is an innovative low energy construction made mainly from reclaimed, recycled and reusable components.

SPACE provides affordable creative workspace for artists in 18 studio buildings across London. It invested £3.24 million in refurbishing four of its buildings, including re-roofing, cladding, double glazing, draught-proofing, and the use of durable materials to improve thermal performance and increase the buildings' life span.

The **extension of Tate Modern**, due for completion in 2016, aims to lead on best sustainability practice and set new benchmarks for museums and galleries in the UK. Using a range of passive measures such as natural ventilation, temperature and humidity settings, combined with energy efficient heating and cooling systems and renewable technologies, the new building is expected to use 54 per cent less energy and generate 44 per cent less carbon than current building regulations demand and aims to generate 20 per cent on-site renewable energy.

The award-winning **Whitworth**, part of the University of Manchester, invested £15 million to extend and refurbish its historic building. The extended building uses a range of low carbon solutions, including solar thermal panels, natural ventilation and daylighting, insulation, and a reconfiguration of collection storage, temperature and humidity settings, with sensitive landscaping to protect and enhance biodiversity in its parkland.

Appendix 2. Glossary

BAC – Battersea Arts Centre
BMS – Building Management System
BPE – Building Performance Evaluation
BRE – Building Research Establishment
BREEAM – Building Research Establishment Environmental Assessment Method
CCS – Considerate Constructors Scheme
CFT – Chichester Festival Theatre
CHP – Combined Heat and Power
CIBSE – Chartered Institute of Building Service Engineers
CO2 – Carbon Dioxide
CO2e – Carbon Dioxide Equivalent
CRC – Carbon Reduction Commitment
DEC – Display Energy Certificate
EPC – Energy Performance Certificate
FIT – Feed-in-Tariff
GGBFS – Ground Granulated Blast Furnace Slag
GHG – Greenhouse Gas
GSHP – Ground Source Heat Pump
GWP – Global Warming Potential
HFC – Hydrofluorocarbon
HVAC – Heating, Ventilation, Air-Conditioning
LED – Light-emitting diodes
LLC – Life Cycle Costing
M&E – Mechanical and Electrical
NT – National Theatre
N20 – Nitrous Oxide
ODS – Ozone Depleting Substance
OJEU – Official Journal of the European Union
PAS – Publicly Available Specification
PIRS – Passive Infrared Sensors
PV – Photovoltaic
PVC – Polyvinyl Chloride
RH – Relative Humidity
RHI – Renewable Heat Incentive
RIBA – Royal Institute of British Architects
U-values – a measure of thermal performance
VOC – Volatile Organic Compound

Appendix 3. Further information

Standards, codes and benchmarks

BES 6001 for Responsible Sourcing of Construction Products, Building Research Establishment (BRE)

Building Research Establishment Environmental Assessment Method (BREEAM) including:

- BREEAM UK Non-Domestic Refurbishment and Fit-Out Technical Manual 2014
- BREEAM UK New Construction Technical Manual 2014

Building User Survey Methodology

CEN TC 346: Conservation of Cultural Heritage, European Committee for Standardisation

Considerate Constructors Scheme

Energy and water benchmarks, Julie's Bicycle:

- Performing Arts
- Museums and Galleries

PAS 198: 2012 Specification for managing environmental conditions for cultural collections, British Standards Institute

Soft Landings, BRSIA and Usable Buildings Trust

TM22 Energy Assessment and Reporting Methodology, Chartered Institute of Building Service Engineers

TM46 Energy Benchmarks, Chartered Institute of Building Service Engineers

Policy and regulations

Display Energy Certificates, Department for Communities and Local Government

Carbon Reduction Commitment Energy Efficiency Scheme, The Environment Agency

Energy Performance Certificates, Department for Communities and Local Government

Feed-in Tariff, Ofgem

Non-domestic Renewable Heat Incentive, Ofgem

Designing Buildings Wiki, a comprehensive source of information on environmental legislation for buildings, you should always check the latest on policy and regulation requirements with the official national, regional or local government body

Guides

Building Excellence in the Arts: A Guide for Clients, Commission for Architecture and the Built Environment and Arts Council England, 2009

Design Handbook for Cultural Centres, Truc sphérique 2014

Energy Survey Guide, Carbon Trust

Forestry Stewardship Council Factsheet, Julie's Bicycle

Practical Guide to Sustainable Procurement, Julie's Bicycle

Practical Guide to Waste Management in Buildings, Julie's Bicycle

Practical Guide to Productions and Exhibitions, Julie's Bicycle

Living Building Challenge 3.0 – A Visionary Path to a Regenerative Future, International Living Future Institute, 2014

Making Buildings Work, Carbon Trust

Monitoring and Targeting, Carbon Trust

Museums and Art Galleries Survival Strategies: A Guide for Reducing Operating Costs and Improving Sustainability, Arup 2010

Sustainability Benchmarking Toolkit for Commercial Buildings, Better Building's Partnership 2010

Online resources

Carbon Buzz, a tool for benchmarking and tracking energy use in building projects from design to operation, Chartered Institute of Building Service Engineers and Royal Institute of British Architects

Design for Future Climate, Innovate UK

Designing Buildings Wiki

Green Business Directory, listing of accredited suppliers and installers of energy efficiency and renewable energy technologies The Carbon Trust

Green Book Live, a free online database of environmental products and services for the buildings sector, Building Research Establishment

Green Guide Online, listings of building materials and components with environmental assessments, Building Research Establishment

Guide to Building Performance Evaluation, Institute for Sustainability

Horizons – a free online tool for exploring environmental sustainability issues and how they relate to business and communities, Innovate UK, Forum for the Future and Aviva Investors

Industry Green Tool – carbon calculator for venues, Julie's Bicycle

Low carbon buildings design and construction resources, Carbon Trust

Low energy buildings and sustainable technologies, Ashden sustainable energy charity

Responsible Retrofit Knowledge Centre and Guidance Wheel, Sustainable Traditional Buildings Alliance

Sustainability Workshop – Building Design, Autodesk

Other resources

Postcards 2050 – Future Solutions to Challenges in the Built Environment, UK Green Building Council

Sustaining Creativity Survey: Actions and attitudes from the creative community: environmental sustainability 2014, Julie's Bicycle and BOP Consulting Using Nature's Genius in Architecture, a TedTalk by Michael Pawlyn

Chartered Institute of Building Service Engineers

UK Green Building Council

Organisations

Better Buildings Partnership

Building Services Research and Information Association (BRSIA)

Building Research Establishment

Fit for the Future Network, established by The National Trust and Ashden

Forest Stewardship Council

The Happy Museum Project

Institute for Sustainability

International Living Future Institute

London Climate Change Partnership

London Energy Efficient Fund

London Theatre Consortium

Manchester A Certain Future

Sustainable Exhibitions for Museums

Sustainable Traditional Buildings Alliance

UK Green Building Council

Usable Buildings Trust

Appendix 4.
Environmental technologies and solutions

4.1 Energy

Passive techniques

Passive cooling: includes technologies to prevent heat gain within a building and to cool spaces through mostly non-mechanical means (as opposed to cooling which requires equipment such as chillers). Passive cooling often uses natural ventilation to remove excess heat from a space and to introduce cooler fresh air. At its simplest, passive cooling can be opening a window. For higher cooling demands in larger or enclosed spaces, some passive systems require mechanical ventilation, such as fans to extract heat. Passive cooling systems often take advantage of the thermal mass within a building, using materials such as exposed concrete, which absorb heat from the air during the day. The heat gained in the thermal mass material is purged during the night when outside air temperatures are cooler. Passive cooling can also involve measures to minimise heat gains, such as the use of panelling, louvres on the external walls to minimise solar gain and outdoor plants, green walls or roofs.

Key considerations:

- In the UK, relatively low summer temperatures mean that passive cooling can generally meet cooling demand all year round, except in buildings with high internal heat gains.
- Cooling using thermal mass often requires air to be drawn across specific materials such as exposed concrete or brickwork. Having both adequate thermal mass and good night-time ventilation is essential.
- Thermal mass must also be thermally connected for it to work effectively. For example, concrete or brick must be exposed internally in a room, not hidden behind plasterboard or ceiling tiles.

Key resources:

Autodesk Building Design Sustainability Workshop
Passive cooling guide

Natural lighting: window placement and sizing can be used to maximise natural lighting in a building, reducing reliance on electric lighting, improving the light quality in a building, and providing a better environment for building users. It also allows a building to take advantage of heat from the sun to heat spaces (but carefully optimised to prevent overheating in the summer).

Key resources:

Autodesk Building Design Sustainability Workshop
Lighting and daylighting design

Renewables

Biomass boilers: generate heat energy from burning plant-based material. As long as the biomass material used is legally and sustainably sourced, and the boilers run efficiently, biomass boilers will be a much lower carbon alternative to gas boilers. Biomass boilers currently attract payments through the the non-domestic Renewable Heat Incentive.

Key considerations:

- Woodchips or pellets which are a by-product of forestry or wood processing in the UK are the most sustainable source of biomass.
- Biomass boilers work best with a relatively consistent heating load.
- They require a larger amount of space than a conventional boiler: room is needed to store the biomass fuel.
- Appropriate storage should be provided as damp fuel can reduce reliability.
- Biomass boilers can often make heating systems more complex and care should be taken when integrating them with other heating sources such as gas boilers.

Key resources:

The Carbon Trust
Biomass heating tools and guidance

Ground source heat pumps: extract heat from the ground via vertical bore holes or a horizontal network of underground trenches. Temperatures are much less variable underground and generally in the UK these temperatures can be used to service heating and cooling demand. Ground source heat pumps are very efficient at extracting or rejecting heat, but do require electricity to run. They are eligible for the Renewable Heat Incentive.

Key considerations:

- A horizontal network is cheaper to install, but requires more space than vertical boreholes. Vertical boreholes are more expensive to install as they can be up to 200 metres deep, requiring special machinery and good access on-site.
- Understanding heating demand is essential. The heat pumps may need to be supplemented with other types of heat generation.
- They provide 'low-grade' heat, i.e. lower temperatures than conventional boilers, meaning that the system may have to operate for longer periods of time to heat a space. It will also react more slowly to sudden increases in heating demand.
- A well-insulated building will contribute to the efficient use of heat.
- It is essential that they are used with a low-temperature heat delivery system, such as underfloor heating, to realise their efficiency potential.
- If not well-installed, maintained and monitored, lower operational efficiencies can lead to high electricity bills.

Key resources:

Carbon Trust Down to earth: ground source heat pumps

4.1

Energy

Renewables

Air source heat pumps: work in the same way as ground source heat pumps, but extract heat from outside air. Air source heat pumps are relatively easy to install (usually on a flat roof space of a building), so installation costs are lower than for ground and water source heat pumps. However, because air temperatures are more variable than ground or water on average, air source heat pumps are less efficient. They are eligible for the Renewable Heat Incentive.

Key considerations:

- Depending on heating demand, heat pumps may need to be supplemented with other types of heat generation.
- They provide 'low-grade' heat, i.e. lower temperatures than conventional boilers, so the system may have to operate for longer periods of time to heat a space. It will also react more slowly to sudden increases to heating demand.
- A well-insulated building will contribute to the efficient use of heat.
- They can be noisy.
- It is essential that they are used with a low-temperature heat delivery system, such as underfloor heating, to realise their efficiency potential.
- If not installed, maintained and monitored, or controlled to best practice, lower operational efficiencies can lead to high electricity bills.

Key resources:

Carbon Trust How to implement air source heat pumps

Water source heat pumps: work in the same way as ground source heat pumps, but source heat from a nearby water source. It is essential to be in close proximity to a body of water with a consistent depth all year round (minimum 3 metres). Generally, water source heat pumps are cheaper to install and more efficient than ground source heat pumps. They are also eligible for the Renewable Heat Incentive.

Key resources:

Designing Buildings Wiki Water Source Heat Pumps

Solar thermal and photovoltaic thermal panels: solar thermal panels produce hot water using the heat of the sun and are usually placed on the roof of a building. The hot water generated is usually used in combination with a high efficiency boiler. Because water enters the boiler at a pre-heated temperature, gas consumption in the boiler is reduced. They can also be used to service relatively low heating demand such as hot water for taps. Photovoltaic thermal panels (PVT) combine both electricity and heat generation in one panel, which can be more space efficient. Solar thermal panels and PVT panels for non-domestic buildings are covered under the Renewable Heat Incentive. Electricity generated by PVT panels is eligible for feed-in tariffs.

Key considerations:

- The potential for heat production should be considered in relation to a building's seasonal heating demand. In the UK, solar thermal panels will produce most heat when it's typically least needed. However, there will always be a minimum heating requirement for hot water taps and showers.
- They tend to be more suited for domestic hot water heating.
- The pumps will consume some electricity.
- Because solar thermal panels are often linked to boiler systems it's crucial that they are properly commissioned and controlled. Invest in expert advice at an early stage to ensure systems work effectively.

Key resources:

- The Ashden Trust Solar Thermal guide
- Carbon Trust Solar Thermal Technology

Solar photovoltaic (PV) panels: convert solar energy into electrical energy, which can then be used instantaneously in a building, or supplied (and sold) back into the national grid system. Photovoltaic generation is eligible for feed-in tariffs.

Key considerations:

- Solar PV panels should be carefully assessed in relation to the electricity requirements of a building. Generally speaking for cultural buildings, they will only be able to meet a proportion of overall electricity requirements.
- Some panels are less efficient, but cheaper, so estimates can often be made in terms of the cost per kilowatt of installed panels.

Key resources:

Energy Saving Trust Solar Panels

Wind power: turbines convert wind energy into electrical energy, which can then be used instantaneously in a building, or supplied (and sold) back into the national grid system. Wind generation is eligible for feed-in tariffs. However, due to the size of wind turbines and the associated planning consent, it's unlikely that wind power will be an option unless a building is located in an open, rural environment.

Key resources:

Energy Saving Trust Wind Turbines

Energy efficient active systems

Heat recovery ventilation: this involves the recovery of heat from outgoing/exhaust air to warm incoming air when outside temperatures are lower than inside. Heat recovery ventilation is worth considering for spaces which are mechanically ventilated. The exhaust and incoming air are often not actually mixed, meaning the ventilation system still provides 100 per cent fresh air. Overall this reduces demand for heating the ventilated air.

Key considerations:

- Heat recovery ventilation will reduce the loads on an existing heating system (such as a boiler) but will not mean that a heating system is not required.
- It will always work best in air-tight spaces where air input and output are closely controlled.
- Heat recovery is not always needed during the summer. In some cases, bringing in fresh air that is at a lower temperature from the outside, bypassing the heat exchanger, is desirable. This is known as "free-cooling".

Key resources:

The Carbon Trust Guide to heat recovery

High efficiency boilers: choosing a high efficiency boiler will help realise significant cost and carbon savings, especially if upgrading from a boiler which is more than ten years old. Invest time in fully assessing heating demand to ensure that the boiler is specified for the predicted heating demand after a building has been refurbished. Condensing boilers are the most efficient type of boiler. Ensure automated boiler controls are installed and commissioned to maintain optimum boiler efficiency throughout its use.

Key resources:

- Database of boilers and their respective efficiency ratings
- The Carbon Trust How to implement condensing boilers

4.1 Energy

Energy efficient active systems

Energy efficient active cooling: an active cooling system should be specified according to the predicted cooling demand of a building. Air-tightness and insulation of the spaces which require cooling will ensure that the cool air produced isn't wasted through leaks or open doors. Other options for cooling, for example in collection storage rooms with stricter environmental conditions, include using what is known as a 'phase change material', which is cooled down at night using cold air from outside, allowing it to cool indoor air the following day. Active cooling measures should only be considered after options for passive cooling, preventing solar gains and internal heat gains and increasing air movement.

Combined heat and power (CHP) systems: generate electricity on-site and use the waste heat generated by the electricity generation for space and water heating. This makes them more efficient than typical electricity generation systems which do not utilise the heat generated. They are appropriate for buildings where a lot of heat is needed year round. CHP systems often use gas, but can use other fuels such as biomass. If biomass is used then the plant should be eligible for the Renewable Heat Incentive.

Key considerations:

- A relatively high and consistent heating demand is required all year round, as CHP systems operate for long periods of the day in order to meet its electricity demand.
- If only a small proportion of the heat produced is used, then it's probably more carbon intensive than conventional heating and grid electricity.

Key resources:

Carbon Trust Introducing combined heat and power

Energy efficient lighting

Already standard practice, the installation of LED (light emitting diodes) or high efficiency fluorescent tube lighting such as T5 or T8 bulbs can significantly reduce the electricity demand from lighting. Lighting should be used in combination with adequate controls, such as PIR (passive infrared) occupancy sensors, which are triggered by movement and/or timers.

Key resources:

Carbon Trust Lighting

Energy efficient plant

The plant in a building (i.e. the equipment for heating, cooling and ventilation) will use a significant amount of energy so ensuring that it is operated efficiently and is well-maintained will contribute to energy efficiency.

Key considerations:

- Plant should be specified according to energy demand. For example, the energy efficiency benefits of an efficient chiller will be lost if it has been specified for a cooling demand double what is actually required.
- Plant should be designed to adjust output according to the demand. For example, demand for cooling and ventilation changes throughout the day. Modulating the pumps and fans used by the system to adjust to lower demand will reduce overall energy consumption. Variable speed drives allow pumps and fans to modulate their power according to demand. A pump running at an 80 per cent load uses 50 per cent less energy than one running at 100 per cent.
- A range of building plant and equipment is eligible for Enhanced Capital Allowances, which effectively reduces the purchase cost.

Key resources:

The Energy Technology List

Controls and Building Management Systems

Metering and monitoring: enables better understanding of where and when energy is being used in a building. Automatic meter reading (AMR) of electricity and gas supply can provide a rich insight into energy use across each day, helping to pro-actively manage energy consumption. Sub-metering specific areas of a building, for example an auditorium or office space, can provide further insights into electricity consumption.

Key considerations:

- If using AMRs and/or sub-meters, ensure that they are being used to monitor the most important areas of energy consumption.
- Ensure that the people responsible for running the building can use and interpret the information provided by metering, through training, demonstration and support from suppliers.
- The information generated by metering and monitoring must be used appropriately and in a timely way, so that peaks or unusual increases or decreases in energy use can be identified, as well as the reasons for these changes, and measures to address them, for example adjusting controls and settings of plant and equipment.

Key resource:

The Carbon Trust Green Gauges shares lessons learned from installing metering and monitoring systems in low carbon buildings.

Building controls and Building Management Systems (BMS): are a key element in operating buildings efficiently. Zoning involves setting controls and BMS according to the different heating requirements of different spaces at different points in the day. It can also be used for cooling and lighting. Being able to understand and control heating demand in separate spaces will reduce overall energy consumption. Many heating systems are controlled by simple internal thermostats. Compensation control can be used in addition to thermostats to adjust boiler operation based on real demand requirements, increasing system efficiency and improving comfort.

Key considerations:

- Controls and BMS which aren't set up correctly or are not understood by the users can lead to wasted energy. It is important to provide training for the people responsible for running the building and to spend some time selecting control systems, observing their operation before building handover.
- BMS operation can be very opaque. It is often difficult to tell how the BMS is actually operating the plant in a building. Products that help visualise BMS operation and data can identify energy savings, improve comfort and optimise control, and are often key to successful BMS operation and management.

Key resources:

- The Carbon Trust Taking control shares insights from case studies on building controls.
- Demand Logic is software that analyses current BMS operation to identify inefficiencies.

4.2 Building envelope

Insulation and draught proofing: contribute to efficient heating and cooling. Wall and roof insulation are relatively high cost investments in terms of the energy saved from reduced heating and cooling demand. When improving the air tightness of a building, moisture dispersal and adequate ventilation must be considered to prevent condensation and mould growth.

Key resources:

Autodesk Building Design Sustainability Workshop Insulation

Windows: bring solar thermal energy into a building, lose heat energy and provide ventilation. The use of air-tight windows with high thermal properties and the placement of windows can contribute to energy performance and building user comfort. South facing windows help with direct solar gain reducing heating requirements, but should be used with shading to minimise solar gain in the summer months. If windows can be opened manually ensure that mechanical cooling and ventilation is not being used at the same time as the windows are open.

Key resources:

- Energy Savings Trust Energy Efficient windows
- Glass and Glazing Federation Window Energy Rating
- Sustainable Traditional Building Alliance Responsible Retrofit

4.3 Materials

Key types of materials to consider:

- **Reclaimed or repurposed materials** such as bricks or wooden flooring
- **Materials using recycled content** not only require less virgin resources: they also use less energy and chemicals to process. For example, recycled or secondary aluminium is about 90 per cent less energy intensive than virgin or primary aluminium; likewise concrete made with Ground Granular Blast Furnace Slag (GGBFS) or pulverised fuel ash (PFA) are lower impact alternatives. Both are widely available as industrial products. Other lower impact alternatives to concrete and cement include rammed earth, Limecrete, and eco-cement. Make sure the alternatives you consider can meet the strength performance requirements for your particular project.
- **Sustainably sourced, natural, plentiful, renewable or rapidly renewable materials** for example Forestry Stewardship Council (FSC) certified timber, and rapidly-renewable materials which allow many harvests from the same plant such as bamboo and cork.
- **Reusable or recyclable materials** that can be easily dismantled and reused or recycled at the end of their useful life.
- **Durable materials** that help increase a building's lifetime and use.
- **Locally available materials**: locally or regionally available materials save energy and resources in transportation to the project site. They also benefit local economies. For most materials, transportation is a much smaller impact than resource extraction and manufacturing, so in some cases it may be better to source recycled materials shipped long-distance than to locally source virgin materials.
- **Low or non-toxic materials which contribute to indoor air quality.** Materials containing toxic substances, persistent organic pollutants, carcinogens, or irritants such as halogenated flame retardants (HFRs) in fire retardants, hydrochlorofluorocarbons (HCFCs) in refrigerant gases and Volatile Organic Compounds (VOCs) in adhesives should be avoided. They're not always advertised in products so double-check with contractors or manufacturers.
- **Materials that help reduce energy** consumption in buildings and facilities, for example insulation materials which contribute to the **thermal performance** of the building envelope or high thermal mass materials.
- **Materials which contribute to acoustic performance**, absorbing or blocking sound for better occupant comfort.

Key resources:

- The Building Research Establishment (BRE) provides a number of resources:
  - Green Guide Online – listings of building materials and components assessed in terms of their environmental impact across their life cycle, which aims to help those involved in the design, construction and management of buildings to reduce the environmental impact of their properties.
  - Green Book Live – a free online database designed to help specifiers and end users identify products and services that can help to reduce their impact on the environment.
  - BES 6001 for Responsible Sourcing a framework that assesses responsible sourcing practices throughout the supply chain of construction products and allows manufacturers to prove that their products have been responsibly sourced.
- Autodesk's online resource Sustainability Workshop Building Design includes a Green Building Materials section

4.4 Water

Water-efficient fixtures and equipment: include waterless urinals, low-flush or dual-flush toilets, low-flow taps and shower heads and timer-taps on sinks.

Water efficient irrigation and landscaping: if a building's location and surrounding land includes green spaces and landscaping, water-wise planting can be used and water efficient irrigation measures, e.g. drip irrigation hoses, using rainwater collection.

Grey water recycling: water that has been used in sinks, showers or even washing machines is still relatively clean and can be recycled for non-drinking water purposes, e.g. toilet cisterns or irrigation. It may require some treatment depending on its secondary use.

Rainwater harvesting: rain water collection (usually on the roof of a building) can be used for irrigating plants and green spaces on and around the building site, and for toilet flushing. It can also be used for drinking water if adequately treated.

Key consideration for grey water recycling and rainwater harvesting:

- Both require careful commissioning to avoid unnecessary maintenance costs, and require careful integration with existing or traditional cold water systems.
- The systems also use electricity to power pumps and for purification.
- Legionella's disease is a key health and safety consideration for water systems, so make sure the system has a regular flushing regime and that you work with a supplier that has a good track record at delivering these projects.

Key resources:

- Autodesk Sustainability Workshop Building Design Water resources
- UK Rainwater Management Association

4.5 Landscape and ecology

Green roofs: can provide a space which contributes to the local biodiversity, especially in urban environments. Because they absorb rainwater and slowly release it, they can also reduce over-ground water flow in urban areas during and after rainfall events, reducing peak water flow to the local drainage systems. They can also provide added insulation.

Key considerations:

- They are more expensive to install than conventional roofs.
- A roof may need to be strengthened in order to cope with the increased weight.
- They will require some maintenance.

Key resources:

Green roof guide

Green walls: are created by growing vegetation within a frame which is attached to an exterior or internal wall. Green walls help regulate the temperature of a building as the plants can shade a building from direct solar gain. They can also help reduce temperatures because plants lose heat through evapotranspiration. In urban environments, green walls have also been shown to reduce levels of local air pollution.

Key resources:

Living Roofs and Walls, Mayor of London.

Sustainable urban drainage systems (SUDS): is a natural approach to managing drainage in and around buildings. It involves designing the land around a building to reduce over-ground water flows and filter pollutants from water before the water enters the groundwater system.

Key resources:

Susdrain

Appendix 5.
Funding and financing sources

This appendix provides an overview of the key sources of funding and finance for capital investment projects, energy efficiency and renewable energy installations, and other sustainable construction, refurbishment, or refit projects.

5.1 Government funding

Name	Description	Eligibility	Amount
Non-domestic Renewable Heat Incentive (RHI)	The non-domestic RHI provides a subsidy, payable for 20 years, to eligible, non-domestic renewable heat generators. Eligible technologies include solar collectors, ground, water and air source heat pumps, combined heat and power (CHP), and solid biomass installations such as woodchip boilers.	Public and private sector organisations.	Once an installation is approved, RHI tariffs are paid. The tariff rate depends on the type of installation and installation date and is generally updated quarterly.
Feed-in tariffs	Tariffs paid on the basis of the electricity generated by on-site renewable energy installations such as solar photovoltaics, wind, and small-scale hydro. **Export tariffs** are additional payments if your installation is hooked up to the grid for any surplus energy you generate and feed/sell back into the grid.	Public and private sector organisations.	The tariff per kWh is determined based on the size of the installation, the Energy Performance Certificate (EPC) rating of the building, and installation date. Tariffs are generally updated quarterly. Payments are made for 20 years.
Enhanced Capital Allowances (ECAs)	ECAs allow a business to claim 100 per cent first-year capital allowances on qualifying plant and machinery (e.g. energy-saving plant and machinery and water conservation plan and machinery). It can write off the whole of the capital cost of the investment against the taxable profits of the period in which the investment is made.	Public and private sector organisations. A list of eligible equipment and technologies is published and regularly updated by the government.	Variable: claims are based on the invoice value of the eligible product.
Urban Community Energy Fund	A £10 million DECC programme supporting urban communities to develop renewable energy projects (including solar photovoltaics, solar thermal, wind turbines, combined heat and power, ground and airsource heat pumps). The fund provides funding to community groups for feasibility and pre-planning development work to help projects become investment- ready, generally in two stages: 1) a grant of up to approximately £20,000 to pay for an initial investigation into the feasibility of a renewable energy project; 2) a contingent loan of up to approximately £130,000 to support planning applications and develop a robust business case to attract further investment.	Communities with over 10,000 residents that do not lie in a predominantly rural local authority area. The community must form a legal entity in order to receive the funds, and be able to demonstrate the support of the wider community. Note that the fund is not designed for single building installations (even if these are community buildings). The scale of the project should be such that it requires planning permission – i.e. this is suitable for arts organisations looking to be involved with a larger community energy project.	Generally up to **£150,000**
Rural Community Energy Fund	A £15 million programme funded by Defra and DECC supporting rural communities to develop renewable energy projects (including solar photovoltaics, solar thermal, wind turbines, combined heat and power, ground and airsource heat pumps). The fund provides funding for feasibility and pre-planning development work to help projects become investment-ready, generally in two stages: 1) a grant of up to approximately £20,000 to pay for an initial investigation into the feasibility of a renewable energy project; 2) an unsecured loan of up to approximately £130,000 to support planning applications and develop a robust business case to attract further investment.	Communities with fewer than 10,000 residents, or more than 10,000 residents but in a local authority area defined as 'predominantly rural' by the Office for National Statistics. The community must form a legal entity in order to receive the funds, and be able to demonstrate the support of the wider community. Note that the fund is not designed for single building installations (even if these are community buildings). The scale of the project should be such that it requires planning permission – i.e. this is suitable for arts organisations looking to be involved with a larger community energy project.	Generally up to **£150,000**
Local Authority Loans and Grants	Individual local authorities may have loans or grants available for environmentally sustainable development or energy efficiency upgrades of equipment.	Check with your local authority.	Variable
Central Energy Efficiency Fund **(ceef)**	Loans for energy efficiency measures and small-scale renewable energy installations for the public sector in Scotland.	Public sector organisations (local authorities) in Scotland only.	Variable Payback periods of 7 years for energy efficiency or 10 years for renewables

5.2 Grant programmes

Name	Description	Eligibility	Amount
Arts Council England Large Capital Grants **2015-18**	£88 million of National Lottery funding available for significant capital expenditure projects, including improving buildings' environmental and energy performance. Prioritise consolidation and improvement of existing buildings and equipment vs. new.	Arts sector organisations undertaking capital investment projects over £500,000.	Projects over **£500,000** Grants of more than £5 million likely to be exceptional. Do not fund 100% of project costs – some partnership funding necessary.
Arts Council England Small Capital Grants **2015-18**	Smaller capital expenditure projects that could include improving a building's environmental and energy performance; predominantly intended for equipment.	Arts sector organisations.	Projects from **£100,000** to **£499,999**
British Gas Energy Efficiency Fund	Eligible micro-businesses can apply for a free on-site energy survey and fully-funded installations of energy saving measures valued up to £6,000.	Micro-businesses with an annual electricity consumption of less than 100,000 kWh (ca. £10,000 electricity spend) or micro-businesses with an annual gas consumption of less than 293,000 kWh (ca. £9,000 gas spend) or micro-businesses with fewer than 10 employees (or their FT equivalent) AND an annual turnover or annual balance sheet not exceeding £2 million.	Up to **£6,000**
Landfill Communities Fund	Landfill tax is charged on each tonne of landfill. To encourage more efficient use of resources, landfill operators can redirect some of their tax liability to support community and environmental projects near their landfill sites. Funds are distributed through registered Environmental Bodies.	Variable, but generally geographically determined. Search through the Environmental Bodies on the ENTRUST website to find any funders in your area.	Variable
Biffa Award – Main Grant Scheme **(MGS)**	Provides funding through the Landfill Communities Fund to community projects under four different themes: rebuilding biodiversity, community buildings, cultural facilities, and recreation. The facility must be open to the public for a minimum of 104 days a year.	Not-for-profit organisations only (local authorities not eligible). Biodiversity: project must be based within 15 miles of a Biffa operation and 10 miles of a licensed landfill site. Cultural facilities, community buildings, recreation: project must be within 7 miles of a Biffa operation and 10 miles of a licensed landfill site.	**£10,000** to **£50,000** Need a third party contributor(s) to provide 10 per cent of the grant. Total cost of the project must be less than £200,000.

Name	Description	Eligibility	Amount
Biffa Award – Small Grant Scheme (SGS)	Provides small grants through the Landfill Communities Fund to make a difference to a local facility, be it a community building, nature reserve, cultural facility or outdoor space. Site-based improvements only, no equipment or running costs. The facility must be open to the public at least 104 days a year.	Not-for-profit organisations only Project must be within 7 miles of a Biffa operation and 10 miles of a licensed landfill site.	**£250** to **£10,000** Need a third party contributor(s) to provide 3 per cent of the grant. The total cost of the project must be less than £15,000.
SITA Trust Primary Fund	Provides funding through the Landfill Communities Fund to make physical improvements (refurbishment, equipment upgrades, etc.) to community leisure amenities and historic buildings/structures for community benefit. The facility must be open to the public at least 104 days a year.	Not-for-profit organisations including charities, local authorities, and councils within qualifying distance (generally 3 miles) of a SITA waste site. Projects must be complete within 12 months of funds being awarded.	Up to **£50,000** for projects with an overall cost of no more than £250,000. Need a third party contributor(s) to provide 11.5 per cent of the grant for.
SITA Trust Smaller Project Fund	Provides funding through the Landfill Communities Fund to make physical improvements (refurbishment, equipment upgrades, etc.) to community leisure amenities and historic buildings/structures for community benefit. The facility must be open to the public at least 104 days a year.	Not-for-profit organisations including charities, local authorities, and councils within qualifying distance (generally 3 miles) of a SITA waste site. Projects should take no longer than a few weeks or months to complete and must be complete within 12 months of funds being awarded.	Up to **£20,000** for projects with an overall cost of no more than £40,000. Need a third party contributor(s) to provide 11.5 per cent of the grant.
CEMEX Community Fund	Provides funding through the Landfill Communities Fund to improve (refurbishment, equipment upgrades, etc.) local community facilities that are open to the public.	Within 10 miles of a landfill site and within 3 miles of a CEMEX operational site.	**£1,000 - £15,000**
WREN FCC Community Action Fund	Provides funding through the Landfill Communities Fund to improve (refurbishment, etc.) local community facilities that are open to the public.	Within 10 miles of a WREN/FCC Environment landfill site.	**£2,000 - £50,000**

Name	Description	Eligibility	Amount
Awards for All – Big Lottery Fund	Grants to cover the purchase of equipment and carrying out special repairs or conservation work. Note that A4A will not cover projects whose main scope falls within the scope of Arts Council funding – projects related to arts or heritage funding will only be supported if their main purpose meets A4A target outcomes around improving communities, health, or the environment.	Voluntary or community organisations (e.g. charities, co-operatives, not-for-profit organisations), schools, parish or town councils. Projects must be complete within 12 months	**£300 - £10,000** where the total cost of a building or refurbishment project is not over £25,000 including VAT.
Power to Change – Initial Grants Programme	A lottery funded grant-making programme looking to support community businesses. The initial grants programme is aimed at supporting new and existing community businesses that are in a position to make a step change towards long-term sustainability within the next 6 months, and may support e.g. the purchase of permanent premises, or refurbishment/renovation work.	Community businesses: businesses that are controlled by the community, place-based, operated for the community's social, economic or environmental benefit, and not operate as solely for private benefit. If relevant, planning permission must already be in place. Any funds awarded must be drawn down and spent within 6 months. Any additional funding required must already be in place.	**£50,000** to **£500,000**
Arts Council Wales – Lottery Capital Programme	Capital grants for the purchase of equipment, public art, minor capital projects, and major capital projects.	Arts organisations based in Wales.	Equipment purchase, public art, and minor capital projects: maximum **£100,000**. Major capital projects: over **£100,000** at 50 per cent-75 per cent of eligible costs, depending on the type of project.
Creative Scotland – Open Project Funding	The Open Project Funding programme also covers small scale capital projects such as the installation of new equipment or fixed assets such as lighting.	Arts organisations, local authorities, and creative businesses based in Scotland. Costs related to large-scale capital development work such as major renovations or building works (including feasibility studies) are NOT eligible.	Up to **£150,000** (prior approval must be given for applications over £100,000).
Other Trusts and Foundations	Particularly for arts organisations that are registered charities, further funding opportunities may be available via trusts and grants. For listed buildings and venues, further funds and grants may be available that support heritage protection and repair projects specifically. See in particular the National Trust's Fit for the Future Network for further support.		

5.3 Loans

Name	Description	Eligibility	Amount
Carbon Trust and Siemens Energy Efficiency Financing Scheme (EEF)	Financing available for a large variety of renewable energy and energy efficiency interventions, from solar panels to voltage optimisation to refrigeration and lighting. Usually one or a combination of a finance lease, lease purchase, loan finance, or sometimes an operating lease.	Any organisation trading for at least 36 months and able to provide latest full company financials. Operating lease only available to schools and academies.	Minimum value of financing is **£1,000**; no maximum. Energy efficiency assets can be funded over maximum 5 years, energy generation assets over maximum 7 years. No deposits are usually required.
Salix Finance	Provide interest-free loans for proven energy efficiency measures such as insulation, heating and lighting upgrades.	Public sector organisations only. Projects must be completed within 9 months. Projects must pay for themselves from energy savings within a maximum of 5 years, and the cost must be less than £100 per tonne of CO2 over the lifetime of the project.	Minimum loan value **£5,000**, no maximum Loans may finance up to 100 per cent of the cost of energy saving projects, to be repaid by direct debit on a 6 monthly basis over 4 years.
Creative Industry Finance	Business development support and loan match-making for creative and cultural enterprises for loans that can be used for capital expenditure, new premises or purchase of equipment. Creative United will charge a commission of 1per cent of the loan value for any loan that is successfully secured through its business support programme.	Charities, social enterprises and commercial businesses of any size in the cultural or creative sector that have been trading for at least 18 months.	**£2,500** to **£15 million**. Types of loans are variable but usually repayable within 1-7 years at interest rates of 10 pec cent to 14 per cent.
Ecology Building Society	Commercial mortgages for any form of business, community or charitable organisation that benefits the environment or contributes to the sustainability of a local community.	Registered charities, voluntary organisations and community owned enterprises. A minimum of 3 years of business accounts. are required	Up to 70 per cent of the value of the property, or 80 per cent for charities. Further funds can be released if the value of the property is increased through building or renovation work.
Triodos Bank	Triodos is a bank aiming to operate according to ethical principles. Business loans are available for a wide range of purposes that benefit people and the environment, including specific projects, refurbishment, and the purchase of property.	Businesses or charities with clear social, cultural, or environmental aims that meet Triodos Bank's financing requirements.	Generally **£25,000** to **£15 million**. Interest may be base-rate linked or fixed rate, and Triodos will generally charge 1per cent to 1.5 per cent of the value of the loan to cover for the cost of arranging it.

Name	Description	Eligibility	Amount
ReEnergise Finance	Provides loans or leases predominantly to SMEs for up to 100% of equipment and installation costs for energy efficiency and renewable energy measures.	SMEs	**£25,000** to **£500,000** repayable over up to 10 years.
Big Issue Investment	Loans, participation loans, and equity for socially-driven organisations that can be used for a variety of purposes including property renovation, equipment, and other capital expenditure. Note that there is a focus on social impact, so not all arts organisations will be eligible, but e.g. community-driven environmental projects could be funded.	Social enterprises, community organisations, charities, and businesses that are socially-driven, that have been operating for a minimum of 24 months and have a history of positive cash generation (or a clear near-term path to surplus cash generation).	**£50,000** to **£1.5 million**
Scottish Partnership for Regeneration in Urban Centres (SPRUCE) Fund	The fund provides affordable, flexible, repayable loans for regeneration and energy efficiency projects (including renewable energy, energy efficiency retrofits, low carbon technologies) in Scotland.	Public and private sector organisations located within the 13 local authority areas in the Lowlands and the Uplands of Scotland as determined by the Scottish Index of Multiple Deprivation. Projects must also be linked to an integrated plan for sustainable urban development.	Generally £1 million -10 million , although smaller or larger projects will be considered on a case-by-case basis. No set payback period, although generally short term or 5-10 year mid-term.
The FSE Group Community Generation Fund	The CGF provides commercial loan funding for communities both at the pre-planning/development and at the post-development/construction stages of renewable energy projects: 1) Development loans are contingently-repayable loans to achieve planning and other consents and licenses. 2) Construction loans are long-term loans for equipment and construction costs.	Generally projects from 25 kWp upwards for community energy projects seeking to create an environmental, social, and financial legacy.	Typically, projects are likely to involve total feasibility/pre-planning costs of £20,000-£150,000 (depending on technology and scale) and construction costs of £250,000-£2,000,000.
HEFCE Revolving Green Fund – Small Scale Energy Efficiency Programmes	Recoverable grants for projects that achieve cost savings and carbon emissions reductions. Institutions may also apply for a grant to be recycled within the institution for other appropriate projects that meet the same criteria – these grants are to be returned to the fund at the point at which an institution can find no further appropriate projects.	Any arts organisation attached to a Higher Education Institute (HEI) receiving HEFCE funding. Projects must have a maximum 8 year pay-back period and a cost per tonne of carbon saved of £200 or less.	**£50,000** to **£750,000** Repayments will be made over an agreed fixed period through reductions in the HEFCE grant to the institution.

Name	Description	Eligibility	Amount
HEFCE Revolving Green Fund – Large-scale **retrofit, new technology, renewables or other projects with a specific intervention to reduce carbon emissions**	Recoverable grants for whole-building or campus-wide large-scale projects that achieve cost savings and carbon emissions reductions. Projects should act as an exemplar, producing learning that can be shared and disseminated among broader HEI networks.	Projects that benefit from Feed-In-Tariffs or the Renewable Heat Incentive cannot be funded. No maximum payback period.	**£750,000** to **£2 million** Repayments will be made over an agreed fixed period through reductions in the HEFCE grant to the institution.
Carbon Trust 0% Loans for SMEs in Wales	Loans to support sustainable development across Wales. Projects should be commercial developments with regeneration credentials in urban areas on sites that are included in an Integrated Plan for Sustainable Urban Development and include the provision of renewable energy.	SMEs located in Wales that have been trading for at least 12 months. Public sector organisations are NOT eligible.	**£3,000** to **£200,000** The size of the loan will depend on the projected CO_2 savings – loans are offered of up to £1,000 per 1.5 tonnes CO_2 saved per year. The repayment period is based on projected energy cost savings so that the monthly repayment amount is covered by the reductions in the energy bills, up to a maximum of 4 years.
Regeneration Investment Fund for Wales **RIFW**	Loans to support a wide range of energy efficiency and energy conservation measures such as boiler replacement or low-energy lighting, as well as larger installations such as CHP, district heating, or renewables. Projects should deliver at least 20 per cent energy savings.	Further details to be published.	**£3 million** to **£10 million**
London Energy Efficiency Fund **LEEF**	LEEF has £112m to be lent to public or private sector borrowers on projects that promote energy efficiency.	Public and private sector organisations undertaking a refurbishment/retrofit project in London that will lead to improved energy efficiency.	**£1 million** to **£20 million** Smaller projects may be considered on a case-by-case basis. Maximum loan term of 10 years. The pricing will be linked to risk and credit rating.
Birmingham Energy Savers	A local authority led Green Deal programme that offers Green Deal assessments to SMEs based in Birmingham.	SMEs located in Birmingham.	Variable: the amount of financing available for work and technology will be no more than the expected energy bill savings.

5.4 Other

Examples of European funding:

Certain capital projects may also be eligible for funding under European Union programmes e.g. European Regional Development Fund (ERDF) and URBACT, which can be worth several million euro (generally at a rate covering 50 – 75 per cent of a budget), particularly if they are part of a wider environmental or regeneration/development project.

Some ERDF funding is also distributed via loans through geographically specific funds – such as the London Energy Efficiency Fund or The North West Evergreen Fund covering Manchester and NW England.

Arts and cultural projects that have benefited from this kind of funding in recent years include the new Everyman Liverpool and the Royal Opera House's Bob and Tamar Manoukian Costume Centre at the High House Production Park in Thurrock.

Power purchase agreements

There are a number of companies in the UK that offer zero upfront cost solar photovoltaic installation for commercial buildings – in return, you enter into a 20-25 year power purchase agreement. Costs such as maintenance are included in these contracts: effectively, the seller owns and operates the installation and you agree to purchase the generated energy from them at a pre-determined locked-in price.

Community Shares

Community shares are for investment through the sale of shares in enterprises serving a community purpose. They have been used to finance community buildings, renewable energy initiatives, and other community-based ventures. Shares must be issued by co-operatives or community benefit societies, industrial or provident societies.

Crowdfunding

Raising money or loans from a large number of people (i.e. the public), often in return for rewards or sometimes equity, generally via the internet through well-established portals such as DONATE/National Funding Scheme (a digital portal specialising in allowing cultural and arts charities to collect online donations), Kickstarter, Crowdfunder, Buzzbnk (which specialises in social and environmental projects), WeFund (which specialises in creative projects), and Funding Circle (peer-to-peer loans).

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About Julie's Bicycle

Julie's Bicycle is the leading global charity bridging the gap between environmental sustainability and the creative industries. Our aim is a creative community with sustainability at its heart and our goal is to provide the inspiration, expertise and resources to make that happen.

Julie's Bicycle has an unmatched track record of research specific to arts and cultural activity, which underpins everything we do. Our team brings together environmental expertise, and experience of the arts and cultural sectors and our website constitutes the most comprehensive resource library developed specifically for the arts and culture anywhere in the world.

We work with over 1,000 cultural organisations across the UK and internationally, to help them measure, manage and reduce their environmental impacts. Over 2,000 companies, large and small use the Creative IG Tools, our suite of carbon calculators and our certification scheme is the recognised benchmark for sustainability achievement within the creative industries.

We believe the creative community are uniquely placed to lead and transform conversation around environmental sustainability and translate it into action.

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Julie's Bicycle
SUSTAINING CREATIVITY

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