ETC EUROPEAN THEATRE CONVENTION

Sustainable Buildings : Detailed Guidance

draft 240314

We would like to thank everyone who has supported the Green Book with their time, their commitment and ideas. Their names are in the acknowledgements. And special thanks to the funders of the Green Book, whose names you'll find in the inside back cover.

Renew Culture
The Theatre Green Book

BURO HAPPOLD

Foreword

The Theatre Green Book is an initiative by theatre-makers to move theatre towards sustainability.

Early in the initiative, we divided that challenge into three parts: making productions sustainably, making our theatre buildings sustainable, and reviewing theatres' other operations, from catering to offices, waste to travel. Those three challenges are the three areas of the ETC Theatre Green Book.

This volume, Sustainable Buildings, gives detailed guidance on how to make theatre buildings more sustainable, even though many of them are ageing and starved of investment. It's designed for executive directors and facilities managers, for boards, funders, local authorities and designers – for anyone who faces the challenge of taking a theatre building and making it fit for purpose in the context of the climate emergency.

Those theatres include some of our most valued, most loved and most prominent public buildings. If we want theatre to point society towards a sustainable future, then we urgently need to regenerate our theatres to suit a world of life-threatening temperature rise, over-exploited resources, and declining biodiversity.

That journey will never be easy – theatre owners know how hard it is to raise funds for investment. But it is essential. Sustainable Buildings gives theatre clear standards for assessing the challenge, selecting priorities – and setting out on the journey.

Lisa Burger and Paddy Dillon, Renew Culture

sustainable buildings

DETAILED GUIDANCE

1 Introduction

1 The ETC Theatre Green Book

The climate crisis is an immediate threat to our safety, equity and prosperity.

Theatre cannot solve the climate crisis, but it can play a role in addressing it, by creating new narratives, and reflecting the challenge of a world facing frightening change. To do that, theatre itself needs to become sustainable.

The European Theatre Convention has set a target for its members to achieve net zero by the end of 2030. The ETC Theatre Green Book provides a pathway to achieve this vital transition.

No theatre can become perfectly sustainable overnight. Reaching net zero – learning to make theatre without harming the planet – is a transition that will take place over a number of years.

The ETC Theatre Green Book provides its members with:

- A framework for planning the transition
- Standards for sustainability
- Guidance for each area
- Tools for measuring progress

2 The Framework

The ETC Theatre Green Book divides the challenge into three areas. Together, they give theatre clear, practical and detailed guidance towards sustainability:

1 Sustainable Productions

2 Sustainable Operations

3 Sustainable Buildings

3 The Standards

The ETC Theatre Green Book sets three standards for the transition to net zero. The standards apply to all three areas of running a theatre: Productions, Operations, and Buildings.

- Basic standard is the first step on the journey. It requires meaningful change, but it isn't too hard to achieve. Many theatres are already working at basic standard.
- Intermediate standard is the next step on the journey.
- Advanced standard is, effectively, net zero theatre.

4 The Guidance

The ETC Theatre Green Book (main volume) explains the basic principles of sustainable theatre in each area, productions, operations and buildings. To support each area, the ETC Theatre Green Book also gives detailed guidance. This volume is the detailed guidance for productions.

5 Measuring Tools

The ETC Theatre Green Book provides tools for measuring your progress in each area:

- A Production Calculator to assess productions
- An Operations Tracker to manage progress in operations
- A Building Survey Tool to help generate a Sustainability Plan for buildings.

The tools can be downloaded as Excel workbooks from the Resources area of the ETC website.

6 Self-Certification

To help track progress towards the target of 2030, the ETC Theatre Green Book helps theatres to self-certify the standard they've reached.

- Begin with a Preliminary certificate to demonstrate commitment, and to show that you've made preparations to begin the transition.
- Then progress through the three standards – Basic, Intermediate, Advanced – demonstrating that you've reached each standard for your productions, operations and building.

An Excel workbook for submitting your self-certification can be downloaded from the ETC website resources area. When it receives them, the ETC will issue certificates and logos to include in websites and communications.

Sustainable Buildings

There are some overlaps between Sustainable Operations and Sustainable Buildings.

Sustainable Operations covers the challenge of managing buildings sustainably, whereas Sustainable Buildings shows how to upgrade them to be more sustainable.

Whatever your role, it's worth looking at both volumes.

7 The European Theatre Convention

Theatre has an impact on the planet. Productions use energy and materials, require travel, create waste and employ harmful chemicals; while operations require travel and create waste, and buildings consume energy. The transition to net zero is vital and urgent.

It requires shared ideas and expertise, shared learning, and mutual support. It will only happen if we make the most of our networks.

The ETC is Europe's largest and most dynamic theatre network, uniting theatres of extraordinary creative energy. It has a unique role to play in achieving the transition to net zero by 2030.

8 Sustainable Buildings

Many ETC theatres are among the most important buildings in their town. They are flagships for the arts and culture. It is important, therefore, that they are fit-for-purpose in the climate emergency.

The challenge is hard because some member theatres have been starved of investment to upgrade fabric and services. Roofs may be uninsulated; many services systems are old, inefficient, poorly-controlled – and powered by fossil fuels. It is an urgent task to make theatres more sustainable.

The ETC Theatre Green Book provides a blueprint for this journey.

Fortunately, many ETC members have pioneered solutions, and have considerable expertise.

9 Scale

Theatres vary in type and scale, but the principles of sustainability are the same. This guidance is designed for all ETC members. The process of assessing priorities, developing a Sustainability Plan and delivering improvements is the same. The guidance also works for workshop, storage and rehearsal facilities.

4 Responsibility for the Building

Many ETC members operate buildings owned by government or local authorities, who are responsible for their upkeep and operation. They don't, themselves, have the power to raise money and upgrade their theatres.

In that case, upgrading the building depends on developing a good relationship with the building owner, and working together to:

- Agree 'easy wins' to reduce energy use quickly
- Plan a long-term programme of capital works to upgrade the building.

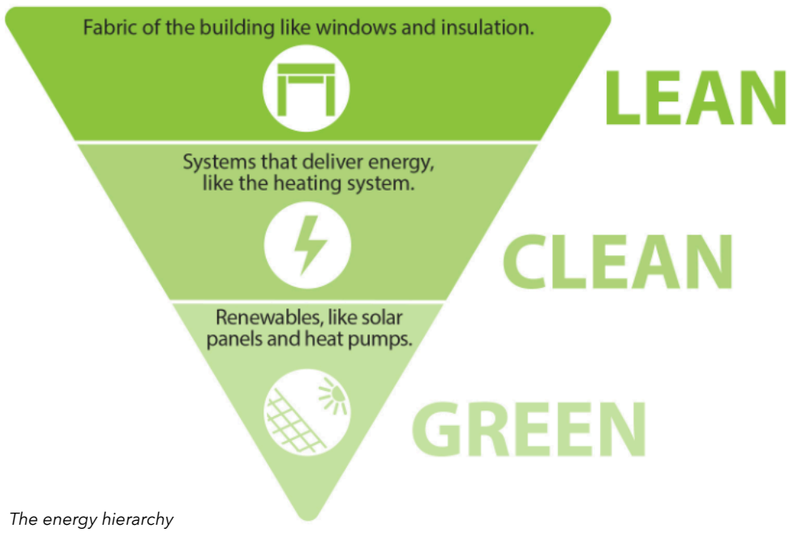
Net Zero Carbon

Ideally, all buildings would be 'zero carbon', causing no carbon emissions in the course of an average year. The aim of Sustainable Buildings is to help building owners map the journey to zero carbon.

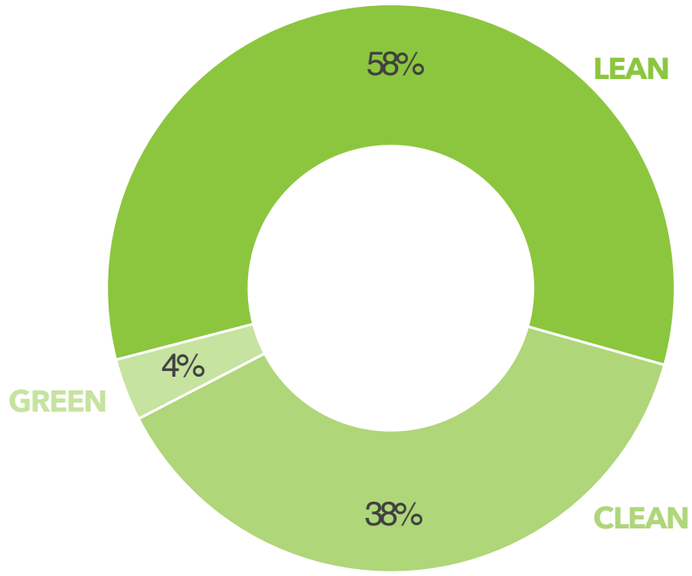
Most will still cause some carbon emissions, but might balance that, for example, by generating surplus energy from renewable sources. They'll be 'net zero'.

For many existing buildings, achieving net zero on site will be very difficult. In that case, 'net zero' can only be achieved by 'offsetting' carbon use through schemes that (for example) generate green electricity or plant trees elsewhere.

2 Key Principles



The energy hierarchy



The typical proportion of energy savings resulting from 'Lean', 'Clean' and 'Green' measures. 'Lean' measures have much the highest impact.

1 Insulation – Efficiency – Renewables

1) First, make your building *need* less energy, by improving its building fabric. That means **insulation** of roofs and walls, windows and doors.

2) Second, make it *use* less energy through more **efficient** equipment. That means, first, better equipment that takes less energy to deliver the same amount of heat, light, coolth or ventilation (etc); and second, better controls so you only deliver those services when and where they're needed.

3) Thirdly, *generate* your own energy by switching to **renewable** sources. That means photovoltaic cells, heat pumps etc.

Typically, the greatest carbon impact is achieved at the beginning of this energy hierarchy. Insulation savings account for 58% on average (66 kWh/m^2/annum), Efficiency for 38% (43 kWh/m^2/annum), and Renewables for 4% (5 kWh/m^2/annum).

For an average theatre size of 3,300m^2, these savings could amount to approximately 80 tonnes of CO2 – and generate important savings each year.

Sustainable Buildings is accompanied by a 'Building Survey Tool', which helps generate a Sustainability Plan for your building. It automatically prioritises green measures according to the energy hierarchy.

2 Small Steps

There is no easy answer to sustainability. No single intervention, from roof insulation to installing a wind turbine, will make a theatre 'green' overnight.

Achieving a sustainable building needs a lot of small gains. Bit by bit, each improvement takes the building closer to zero carbon.

Training and Learning

Theatre's shift towards sustainable working needs everyone to understand the principles on which green guidance is based.

More widespread Climate Literacy training can help the whole sector move forwards. Meanwhile theatre's own networks can help share theatre-owners' experiences and lessons learnt in working sustainably.

3 Go Electric?

Different countries across Europe have very different profiles for energy generation. For example, France (nuclear) and Norway (hydro-electricity) both offer sustainable electricity grids. ETC members in those countries, and others with a high percentage of renewable energy in their grids can become more sustainable by switching energy use from fossil fuels (like oil and gas) to electricity.

In some countries, you can choose an electricity supplier who offers electricity only from renewable sources.

What do We Mean by Green?

The ETC Theatre Green Book uses 'sustainability' and 'greener practices' as catch-alls to cover decarbonising theatre buildings, reducing waste and eliminating environmentally harmful practices. That keeps it simple and readable, regardless of anyone's prior knowledge.

For a more precise vocabulary for green theatre, the Future Materials Banks keeps an excellent lexicon of terms at www.futurematerialsbank.com/lexicon.

3 Building Types

1 Different Theatres

All ETC member theatres are different, but they fall into distinct groups. Each has its own challenges for sustainability.

Historic Theatres

Historic theatres were mostly built in the late nineteenth and early twentieth century. They typically have ornate entrance facades. Internally, foyers are decorated with elaborate plaster and timber mouldings. Roofs are usually pitched, with lofts above the auditorium.

Most mechanical and electrical services were added later. They often occupy small plant spaces and voids, and have often been much altered. Some have only limited records of how they work. Heating is often through radiators driven by an ageing oil or gas boiler. Mechanical ventilation and air conditioning may have been fitted later onto plant spaces on the roofs.

Mid-Century Theatres

Many theatres and arts centres were built across Europe in the post-war reconstruction of the 1960s and 1970s.

Typically, these are much simpler buildings with plain walls and flat roofs. Many are built of concrete. They are often badly insulated. Foyers often have large areas of single glazing.

Services systems are often a combination of original systems, now old, with later upgrades and replacements. Air-conditioning (particularly to the auditorium) has often been upgraded, with new plant on the roof.

More Recent Theatres

Theatres built in the last thirty years have been designed and built to more modern standards, including higher standards for insulation. Services systems are newer. Some theatres have been built as exemplars of sustainability; others do not reach today's standards.

Some of these buildings now need to replace services systems, and this is an opportunity to improve sustainability. Others may not perform as well as their designers intend. The challenge is to make complex systems work as efficiently as possible.

2 Using the Theatre Green Book

Every theatre is different, but most will fall into one of the above categories.

Although theatres are different, the principles of sustainability are the same: to reduce energy consumption and carbon emissions through more effective building fabric (insulation), better services systems (efficiency) and – where possible – renewable energy sources (renewables), while reducing water use and maximising biodiversity.

4 Insulation : Building Fabric

1 Introduction

Design professionals talk about the 'building envelope', meaning everything – roof, walls, windows and doors – that separates the inside of a building from the rain, cold, heat and snow outside. In older buildings that 'envelope' does little to keep energy in. Roofs are often badly insulated. Walls are often plain brickwork or concrete. Windows are single-glazed. Therefore, energy put into the building to heat or cool it is quickly lost into the atmosphere.

The most important task in making any building more sustainable is to improve its 'envelope', so that it needs as little energy as possible.

2 Insulation

Insulation keeps heat in in winter, and keeps rooms cool in summer. Ideally, it is fitted on the outside of a building, protected by a final layer of render or roofing material. This often isn't possible for existing buildings, since it changes the building's appearance (flat roofs are an exception). Instead, it can be fitted as a lining on the inside face of roofs and walls. Or, if the wall is made of two "skins" of brickwork, the gap between them can be filled with insulation.

Roofs

Flat roofs can usually be insulated on the outside when you replace roof coverings. It's sometimes possible to insulate pitched roofs on the outside (immediately under the slates or tiles), but only if you're carrying out a major re-roofing – and even then it can be challenging to change eaves, ridges and gutters to include the extra thickness. More often, pitched roofs are insulated internally, by fixing insulation to the underside of rafters and covering it with plaster or timber linings. Where pitched roofs cover lofts, it's easiest to fit loft insulation directly to the loft floor.

There are some challenges to watch out to beware of. Check that old roof structures can support the weight of extra insulation. In historic theatres, the auditorium ceiling must not be covered with loft insulation if you need to inspect a ceiling below.

Walls

It may be possible to insulate walls from the outside, by applying insulation to the wall and finishing it with a coat of render. That is impossible if the facade has historic mouldings and cornices. But it may be possible in technical areas, or on plainer, Modern buildings. Even then, windows, doors and eaves will need modifying to suit the extra thickness.

Internal cornices, dados and skirtings in historic theatres can also make it difficult to line walls internally. Mouldings need to be removed and replaced if the walls are thickened by a layer of insulation and plaster. That disturbs historic fabric, and is expensive.

Plain walls – either in more modern buildings, or in backstage areas – can be lined with insulation and plasterboard. Even so, windows and doors need to be changed, and skirtings replaced. In corridors, check the insulation doesn't reduce the width of escape routes or limit access for wheelchairs.

3 Windows and Doors

Windows and doors are weak points in the building envelope. They are often thin and uninsulated. Many have gaps in the junction between window / door and wall.

Where does your building leak?

Thermographic images of your façade highlight warm areas in red and cold spots in blue, identifying where heat leaks out. That helps target sustainability works.

Windows are often the key area for focus, followed by walls, then doors.

Windows

Draughty, single-glazed windows can be replaced with modern windows that are double or triple-glazed. That's expensive and disruptive, but will improve comfort as well as reducing energy loss. For historic windows, where double-glazed replacement isn't possible, an alternative is secondary glazing, where an inner window (usually with a thin aluminium frame) is added. Secondary glazing also avoids the embodied carbon of new replacement windows.

Large areas of glazing in the foyers of more modern buildings present a difficult challenge, which can usually only be solved by replacing them in a major building project.

Doors

Doors are also a weak spot. Main entrance doors are often open as audiences arrive, allowing heat to leak out.

Draught lobbies are the best way to prevent heat loss. Revolving doors are next best (although they are not possible everywhere, and alternative options are needed for wheelchair-users). Air curtains blast room temperature air down to minimise incoming draughts. As a 'cheap and cheerful' solution, a wintertime draught lobby can be created simply by hanging a heavy curtain inside the door.

4 Some Challenges

Airtightness

Old buildings are leaky. That means they have constant natural ventilation through ill-fitting windows and doors. It wastes energy but provides fresh air to replenish oxygen and prevent mould and condensation.

To reduce energy loss, you must make a building airtight. But that can create a problem of insufficient ventilation – except in areas with mechanical ventilation. Elsewhere, you must introduce controlled ventilation through 'trickle vents' (openable ventilation slots in new windows) or by 'hit-and-miss' vents in walls. Seek professional advice if needed.

Condensation

To prevent energy loss, you need a building envelope that separates inside from outside to keep energy in. There's a risk that the warm, moist air inside the building will condense into water when it meets a cold surface. If that happens within the building fabric, it causes rot and decay. Building professionals refer to this as 'interstitial condensation', and the point at which moisture in the air condenses into water as the 'dew point'.

To avoid problems, get professional help. A combination of good ventilation and 'vapour control layers' (to prevent moisture reaching the cold surfaces) stops insulation from causing problems.

In historic buildings it's important to use 'breathable' materials to prevent condensation within the structure. Seek professional advice to make sure the works are well designed.

Cold Bridging

A third challenge is 'cold bridging'. Effective insulation needs a continuous layer of insulating material. Fixings and brackets which pierce it, or structural beams which run through its, act as 'cold bridges' to allow energy out and cold in.

Careful detailing is needed to eliminate or minimise cold bridging and make sure insulation works as effectively as possible.

5 Hazardous Materials

All works to older buildings may involve asbestos and other hazardous materials. Some asbestos was still being incorporated in buildings as late as 2001. Seek guidance from local experts.

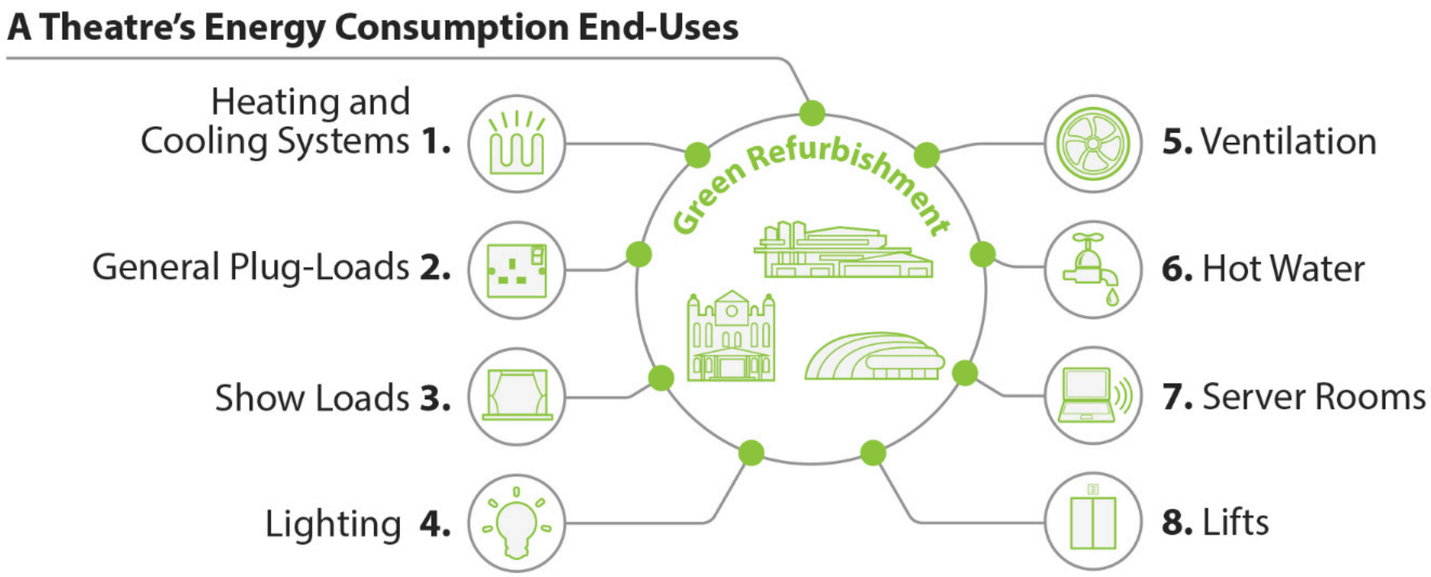
6 Climate Resilience

Because of climate change, temperatures and rainfall patterns are changing. Extreme weather is more frequent. We need to change buildings so they survive a changing climate.

Buildings need to be adapted for heat waves and increased rainfall (and hence flooding). That means larger rainwater pipes and gutters. Public drainage is often overwhelmed by intense rainfall, so buildings need to absorb and hold more rainwater on site. Cooling systems may be too weak for extreme heatwaves.

It is important that those responsible for theatre buildings take account of what the future holds.

5 Efficiency : Building Services



1 Introduction

Theatres consume energy through: heating and cooling systems, ventilation, hot water, lighting, general electricity, show lighting, server rooms, and lifts.

Each category can be reviewed in turn. They can be improved in two ways:

- Upgrading to more efficient equipment (for example, LED lighting uses less energy to make the same amount of light; modern boilers use less gas to produce the same amount of heat).
- Upgrading controls, so you only deliver services where and when they're needed (for example, timers, thermostats and movement detectors can save you from lighting and heating empty spaces).

2 Knowing Where You Are

To make your systems more sustainable, you must first understand how they work. Some theatres have professional Facilities teams, and good records of services systems, maintenance, and replacement. Others know less about their buildings systems, how old they are and how they work. In that case, talk with the companies that inspect and maintain your systems.

Utilities bills show how much energy you're using. Sub-meter different areas to learn more about how your energy use is distributed.

Section 8 gives more detail on gathering information.

3 Heating and cooling systems

Heating systems distribute heat from boilers either through radiators filled with hot water, or by blowing warm air around the theatre. Most auditoriums have air systems, while dressing rooms and offices often use radiators.

Systems are more sustainable when they work at lower temperatures. Low temperature systems waste less energy in distribution, and make it easier to work with electric heat sources. If possible, switch to underfloor heating, larger radiators and fan-coil units in the ceiling (which draw in air from the room, heat or cool it, and blow it out again).

Theatres can reduce energy use a lot by accepting cooler temperatures in winter and hotter temperatures in summer. Audiences may accept this, as they accept the realities of the climate emergency.

Heating

Boilers, fired either by oil or gas, are a common heat source for both heating and hot water systems.

Old boilers should be replaced. Modern 'condensing' boilers are more efficient and use less fuel. But don't change them until they reach the end of their lives. Once it's time to replace them, the most common green alternative is a heat pump (see section 6). However, a switch to heat pumps is complicated. They don't work in all buildings.

Sometimes, the only option is replacement with a new fossil fuel boiler. In that case, find the most efficient model you can.

Cooling

Mechanical cooling, commonly referred to as "air conditioning", is often provided in auditoriums and foyers to maintain comfort in summer. Reduce your need for mechanical cooling by improving

insulation, and shading windows. Temperature sensors, timers and occupancy detection minimise the use of energy.

To reduce energy, consider natural cooling methods; for example, circulating cool night-time air to reduce auditorium temperatures before a show.

District Heating

One of the most efficient heat sources is a low-carbon 'district heat network', if there's one in your area.

These are pipes in the ground carrying hot water that you can use to heat your building, instead of a boiler. District heat networks save carbon, cost and space.

3 Hot Water Systems

Hot water systems are often fed from the main boiler plant. Some have their own local ("point of use") electric source – which is usually a more sustainable option. "Point of use" heaters remove demand from the main boiler, reduce reliance on fossil fuels, and reduce the energy wasted when hot water is pumped around the building. They can be installed either during maintenance, or as part of refurbishment projects.

They may not be appropriate for large theatres which need a lot of hot water, and might not have electrical capacity for multiple electric heaters. If you have a centralised hot water system, make sure all distribution pipes are lagged.

4 Ventilation

Mechanical ventilation is needed in windowless rooms (like toilets and basements) to give people enough air to breathe. It's needed in most auditoriums, and in toilets and kitchens (to remove smells). In new buildings, most foyers and offices are mechanically ventilated.

Mechanical ventilation needs two elements: fresh air is pumped into the space, and exhaust air is pumped out of it.

Mechanical ventilation is often used to spread coolth and warmth as part of the heating and air conditioning systems, by heating or chilling the air before it's pumped into each room. Older systems waste energy by exhausting heated air without 'reclaiming' the heat. To avoid energy loss, heat can be 'reclaimed' from the exhaust air and reused to warm the fresh input air.

CO_2 sensors can be installed to ensure the right amount of fresh air is pumped in to suit the current occupancy levels, and to avoid running ventilation systems when they're not needed.

5 Lighting

Lighting is often a high proportion of a theatre's energy consumption. Moving to LED lighting is relatively simple. Improving lighting controls is equally important. Automatic switches with sensors for movement and daylight levels deliver significant energy savings, particularly in little-used areas.

6 General "plug loads"

Anything that gets plugged in draws energy, and adds to your theatre's carbon footprint. That includes computers, fridges, electric heaters, communication devices (radio and mobile phones), workshop tools, vending machines – and much else. When purchasing new products, choose efficient ones. Replacing old fridges (for example) can makes important savings – but only replace them if they're near the end of their lives.

7 "Show Loads"

Show loads include lighting rigs, audio-visual systems, special effects, and communications. Managing them sustainably is covered in the ETC Theatre Green Book, Sustainable Productions.

8 Controls

No matter how efficient your equipment, it wastes energy if it's on unnecessarily – for example, if lighting is switched on all night or radiators heat up empty rooms. Controls are essential to ensure systems only operate when needed.

The right controls also generate important cost savings:

- Timers switch on systems for hours of operation, and make sure they're switched off afterwards.
- Thermostats efficiently control temperatures during hours of operation.
- Movement detectors switch off lighting in unoccupied rooms and corridors.
- CO2 detectors make sure ventilation only runs when the air quality is bad.

Once good controls are installed, it's important to manage them well. You'll find more information on building management in the ETC Theatre Green Book, Sustainable Operations.

Building Management Systems

Building Management Systems (BMS) control services automatically. A good system should be simple to use, with good user guides so that knowledge is not lost when people leave. Well-designed, and operated by well-trained managers, a good BMS can make sure a theatre runs as efficiently as possible.

However, BMSs can be complicated, and require technical knowledge to run them efficiently. Training staff and simplifying controls helps manage your building sustainably.

6 Renewables

1 Introduction

Theatres can generate their own electricity on site from renewable sources. Solar Photovoltaics (PVs) create electricity from light. Turbines generate it from wind. Generating renewable electricity reduces the need to take energy from the fossil fuel sources that power the electricity grid in many countries. In some countries, they allow theatres to put spare power back into the grid.

Theatres can also install heat pumps that draw energy from the air or ground to power heating or cooling systems directly.

This section describes the main ways theatres can turn to sources of renewable energy.

2 Solar PV Panels

Solar photovoltaic ('PV') panels are usually installed on roofs, and generate electricity which can both power systems within the theatre, and sometimes be fed back into the National Grid. PVs are installed in arrays either on pitched roofs, or on flat roofs, with frames to angle them towards the sun. They don't need direct sunlight, but operate most efficiently when facing as close to south as possible at an angle of about 30 to 40 degrees.

Like anything installed on a roof, they make it hard to maintain or replace the roof afterwards, so make sure the roof is repaired or replaced before installing them (and that it's strong enough to carry the weight). However, they are the most common form of renewable energy.

3 Solar Thermal Panels

Solar thermal panels use the sun's heat directly to heat water either for showers and taps, or to pre-heat water for radiators.

They come in several varieties: tubular or flat plated (these look similar to Solar PV panels). They usually work less well for theatres than PVs – particularly if the theatre is quite small, and doesn't have a constant need for hot water.

4 Wind Turbines

Wind turbines use the wind's power to generate electricity. They don't often apply to theatres, apart from some rural theatres.

5 Heat Pumps

Heat pumps are water-source, air-source or ground-source, depending on where they draw energy from. Air-source heat pumps are most likely to be the best option for theatres. But changing a gas boiler for a heat-pump isn't a direct replacement, so professional advice is needed. Your building needs to be well-insulated for a heat pump to work.

Air-source Heat Pumps

These are usually external units with fans that extract heat from the air and use it to warm up water which is pumped into the building. They are commonly specified for new buildings and theatres, but work best at low flow temperatures so they need the building fabric to be insulated; otherwise they become very large and don't work efficiently. Air-source heat pumps are a good alternative to fossil fuels, but may need large alterations to the building.

Ground-source Heat Pumps

These are typically a unit that sits within the building. Pipework extends outside the building, either around a large area of ground, not far below the surface, or drilled vertically into the ground. They're common in new buildings but less in existing theatres.

Water-source Heat Pumps

Water-source Heat Pumps require a local source of water to provide the heat. This might be a nearby river or canal, or an aquifer below ground. Liaison with the authorities is required to avoid environmental harm. These are the least common version of heat pump.

Biomass Boilers

Biomass boilers are similar in size to gas or oil- boilers. They are only renewable if the timber they burn (often in pellets) comes from a sustainable source. However, they need a lot of fuel storage, and large vehicle access for deliveries. They can cause bad air quality in urban areas. They are not common in theatres.

6 Storing Energy

Energy demand isn't constant. Theatres need a lot of power before and during shows. Hot water is needed for dressing rooms at specific times of the day. By contrast, most renewable energy systems generate energy continually (or during daylight in the case of solar panels). Storage systems capture that energy for use during peak hours.

They usually take the form of batteries for electricity or water tanks for heat. They are not common in theatres. Unless you have a very large array of PVs, you're likely to use the electricity yourself (or send it back to the grid). Batteries raise issues such as fire compartmentation, which need professional advice.

7 'Pay-back'

Money invested in reducing energy use will be paid back by reduced energy costs. Well-planned investment in sustainability should therefore cost nothing – so long as you can raise the money for the initial investment.

8 Challenges for Renewables

Renewables such as PVs demonstrate a theatre's commitment to sustainability. They are needed to reach zero carbon. However, in terms of impact, they are less important than measures to make the building need less energy (insulation), and measures to make it use less energy (efficiency). Indeed, renewable energy only has impact on a building that conserves heat efficiently.

The difficulties of installing renewables include:

- Planning and heritage permissions for solar panels, external plant and other changes.
- Finding plant space either internally or on roofs.
- Upgrading roofs before you place PVs or other plant on them.
- Upgrading services systems to suit the new energy source.

7 Biodiversity and Water

1 Introduction

The climate emergency is also a crisis of resource use and biodiversity.

Sustainable buildings have an important part to play in biodiversity and efficient water use. Supporting biodiversity also creates more humane places to work and visit, raising staff wellbeing and creating a sense of place.

2 Water

Water is a valuable resource. Sustainable water use in the theatre and its surroundings focuses on reducing, recycling and reusing.

Water systems such as toilets and showers should minimise consumption. Not all the water theatres use needs to be drinking water. Rainwater, treated on site without chemicals, works for irrigating plants or green roofs, and serving water features.

Reducing Water Use

'Non-potable water' does not meet drinking water standards for human consumption, but is suitable for other uses, such as toilet flushing, or irrigation.

'Potable water' is fit for human consumption and meets drinking water standards. Cutting down the consumption of drinking water can be achieved by:

- Low-flow and waterless fixtures.
- Leak prevention systems that quickly report water leaks.
- Reducing water demand for irrigation by careful planting along with intelligent irrigation systems that use harvested and treated rainwater.
- Using non-potable water for irrigation or toilet flushing.

Greywater

Greywater is waste water from fixtures such as sinks, showers, laundry, or drinking fountains (not toilets and urinals). It can be reused for purposes like flushing toilets.

However, installing a greywater system is often expensive and disruptive. Double pipework is needed, as well as storage tanks and filtration. The first step is a feasibility study to check how much greywater you might save, how much you could use, and whether you have space for greywater storage. For many theatres it is not practical.

Rainwater

Rainwater harvesting means collecting run-off from roofs and terraces to store for future use. Filtered rainwater harvesting can be used for toilet flushing, laundry, and cooling systems, or for irrigation of planting.

Rainwater harvesting can be applied to many buildings, although it does require a storage tank (which is heavy) and filtration, particularly in cities.

3 Biodiversity

Buildings can support biodiversity. Planted landscapes, green roofs and living walls are all ways in which a theatre can provide a habitat for life.

Plan the biodiversity of your theatre. Is it in the city-centre (like most theatres) or in the country? Have the surroundings been previously polluted? Are there existing habitats for biodiversity, which need to be protected? What are the species most likely to colonise new planting? Professional advice from an ecologist may be needed to answer some of these questions.

A theatre's sustainability plan must include measures to deliver a positive impact on biodiversity for all of the buildings and land under its control.

Green Roofs

Green roofs can clean the air and support urban wildlife.

Select plants that support insects, require little irrigation, and survive a dryer, warmer climate.

Green roofs also help by absorbing rain, preventing it from overwhelming drainage systems. Good water management means balancing irrigation needs and water demand as efficiently as possible.

4 Other Opportunities

Think how a theatre can improve biodiversity and use water efficiently.

- Landscape, terraces and green roofs can create 'green corridors' between buildings and parks.
- Partnership with neighbours and local communities can connect sites by shared plans.
- Car parks offer opportunities for planting, rainwater capture, and below-ground storage and treatment.

Sedum Roofs

These are living roofs, where vegetation is used as the top layer of the roof build-up. A sedum roof should be self-sufficient and develops over time. These roofs absorb carbon dioxide, attenuate rain fall and rainwater build-up, increase a building's biodiversity and create a point of interest.

You need advice to make sure the roof is strong enough to take the extra weight.

8 Gathering Information

1 Introduction

The ETC Theatre Green Book for Sustainable Buildings is supported by a Building Survey Tool which you can download from the resource area of the ETC website. The Building Survey Tool asks you a series of questions about your theatre:

- Its building fabric (roofs, walls, windows and doors).
- Its services systems (their condition, operation and the fuel they use).
- Renewables and opportunities for installing them.

Once you've deleted the actions which are not appropriate for your theatre, you will have a simple Sustainability Plan (see next section).

It's important to know how your theatre is performing, to set a baseline for improvement. As improvements are made, you can track your progress towards zero carbon.

Measuring how your theatre operates allows you to:

- Compare yours with other theatres
- Identify areas to focus on (helping you refine your Sustainability Plan)
- Set targets

2 Measuring Energy Use

You need to understand your energy use in order to reduce it. Therefore, meter readings are important in reducing energy consumption.

Regularly record and assess your energy meter readings. For example, reading meters before and after a show will show the impact of your 'show loads'. Each time you instal new equipment, measure energy to assess its impact. The more you meter and check, the more you understand what consumes the most energy.

Record energy consumption in kilowatt-hours (kWh), rather than the power in kilowatts (kW). If you currently have limited sub-metering, instal sub-meters to monitor specific circuits.

Air temperature and quality can also be measured, to help you focus heating and ventilation on the spaces and times which need it most.

If you have a Building Management System (BMS), it can help identify problem areas. Professional consultants use tools to "diagnose" systems and can make significant savings.

3 Benchmarking

In some towns, regions and countries, public buildings are encouraged to assess their energy use (or carbon footprint) to a shared standard. This allows building operators to measure their energy use against other buildings.

ETC members have the opportunity to share data, and benchmark energy use against similar theatres within the network. It is not possible to compare carbon impact, since this will depend on the carbon factor of each country's electricity network. However, energy use in kilowatt hours (kwh) is a useful shared measurement.

Theatre's journey towards sustainability depends on sharing knowledge, experience and data. Use theatre networks to share experience and contacts, support others and disseminate lessons learnt.

9 Developing a Sustainability Plan

1 Introduction

The ETC Theatre Green Book's Building Survey Tool can be downloaded as an Excel workbook from the Resources area of the ETC website. It lists all the actions you can take to upgrade your building for sustainability. These include everything from roof insulation to entrance doors, from the state of your boilers to the possibility of fitting PVs on the roof.

These actions are already divided into three categories:

- Easy Wins
- Maintenance Projects
- Capital Projects

Within each category, actions are listed in order of impact, so you tackle the most important actions first.

For each action, the Building Survey Tool asks a question to decide whether that action is possible for your theatre or not. Once you have deleted those actions which are not possible, you have a preliminary Sustainability Plan

Your Sustainability Plan will answer the two key questions:

- What are the works our theatre needs?
- In what order should we tackle them?

2 What Are the Works Our Theatre Needs?

The tool is based around a long list of the possible interventions that will make a theatre building sustainable.

As you go through the Building Survey, it will rule out actions you've already taken.

It will also identify works which aren't possible. For example, it may not be possible to fit a draught lobby to the entrance of a historic foyer. In that case, it will suggest alternatives: a revolving door, or a heat curtain.

It helps identify realistic compromises. Secondary glazing is less effective than window replacement - but is cheaper, and better than leaving old windows as they are.

The tool will identify the works your theatre needs. It then helps define the order in which you deliver them.

3 What Order Should We Tackle Them?

The right Sustainability Plan needs to balance two different factors:

- What has the most impact?
- What's easiest to achieve?

What Has the Most Impact?

Buildings move towards sustainability by tackling building fabric first (Insulation), then services systems (Efficiency), and then Renewables. The Building Survey Tool automatically prioritises interventions in this way

But some actions are easy to achieve, while others are expensive and difficult. A good Sustainability Plan has to take into account what's easiest to achieve.

What's Easiest to Achieve?

Some high-impact works are expensive (requiring fund-raising), need planning or heritage permissions, or close the theatre for disruptive works. However, good progress in sustainability can be made through works that have less impact, but are easy to do.

So works must be triaged into three categories:

- Easy Wins
- Maintenance Projects
- Capital Projects

The Building Survey Tool does this automatically.

Easy Wins can be carried out straightaway, with little cost or disruption. An example is adding timing controls to lights and heating systems.

Maintenance Projects are works which don't involve closure or planning permissions, and can be carried out as part of annual maintenance works. An example is installing secondary glazing to dressing room windows, or replacing lights with LED.

Capital Projects are major works which require expense, disruption or permissions. They include re-roofing, replacing foyer windows, putting in new services systems, or replacing boilers with heat pumps.

4 Finalising the Plan

Every theatre is different. To complete your Sustainability Plan, adjust it for the specific challenges of your building.

First, shift actions between Easy Wins, Maintenance and Capital Projects, depending on your own knowledge of the theatre and organisation.

Next, re-order them to match your maintenance programme. For example, roof insulation may be important – but the best time to do it is when your roof coverings need replacement. The table in Section 11 Maintenance identifies typical refurbishment works for theatres, and the sustainability works you can achieve at the same time. Use this table to plan your list of green actions.

Finally, there may be good reasons to delay some works or prioritise others. For example, you may have gas boilers which are unsustainable. However, if they're only a few years old, don't replace them until they're older.

Remember to go through this exercise with all your buildings.

5 Setting a Timeline

The process outlined above will create a Sustainability Plan that:

- Identifies the works your theatre needs to make it sustainable
- Places them in order of priority under three headings: Easy Wins, Maintenance Works and Capital Projects

The final task is to set a timetable for achieving each of those actions.

6 Theatre Green Book Standards

The Theatre Green Book helps theatres plan their transition through three standards: Basic, Intermediate and Advanced. The same standards are used to measure progress in upgrading your building.

- To reach Basic, make a Sustainability Plan and put in hand the Easy Wins.
- To reach Intermediate, develop the plan with professional help and carry out the Maintenance Projects.
- To reach Advanced, develop and put in hand the Capital projects that will make your building as sustainable as possible.

Professional Advice

The ETC Theatre Green Book supports theatre owners and managers to develop Sustainability Plans quickly. But decision-making can be complex, and some elements of the plan may not be feasible. Once you have a basic Sustainability Plan, you need to involve professional sustainability consultants, engineers, architects, surveyors and others to help confirm feasibility, refine costings, and turn the Sustainability Plan into a final working document.

If you don't have the money, then start with the Easy Wins and Maintenance Projects, and gather a professional team to develop the Sustainability Plan in the next phase of your Capital Projects.

10 Easy Wins

1 Introduction

Easy Wins improve sustainability with little cost or effort. The Building Survey Tool helps identify them.

Energy costs are among a theatre's biggest expenses. Theatres can save as much as 20-25% of these costs through Easy Wins.

2 Responsibility

Many ETC member theatres are not responsible for their building, making it hard to plan Maintenance or Capital Projects. However, they may still be able to do Easy Wins – or persuade the building owner to do them.

Easy Wins are cheap, and not disruptive. They reduce energy costs, and often pay for themselves quickly.

If the building owner is unresponsive, carry out a Building Survey to identify Easy Wins, and present them as a plan. If possible, obtain approximate costings from contractors. Emphasize the savings they will bring.

3 Measuring

One easy win is to improve your understanding of your energy use by sub-metering or fitting clamp-on meters. They don't save energy, but help you improve your Sustainability Plan.

Measure your energy before making any other changes, so you can see the effect of the changes.

4 Your Power Source

Some ETC member theatres are in countries whose electricity supply is carbon neutral. For them, switching from gas or oil to electricity is an easy way of accessing zero carbon power (see sidebar). For example, theatres can switch hot water taps from the gas boiler to an electric point-of-use water heater.

Others may be able to connect to a District Heat Network, for an efficient low-carbon source of power.

5 Common Easy Wins

The following list covers some common easy wins that you may be able to put in hand at your theatre:

Insulation

- Draught proofing windows and doors
- Installing a draft lobby or electric "air curtain" to main doors

Efficiency

- Thermostats and timers for heating, cooling and ventilation
- CO2-controlled ventilation to the auditorium
- Better lighting controls by installing daylight and/or occupancy sensors
- Changing hot water operating hours to match occupation
- Hot water flow restrictors on taps and showers
- Replacing old fridges etc with A-rated appliances
- Better use of a Building Management System (BMS)
- Cleaning mechanical ventilation filters
- Improving hot water tank insulation
- Installing /upgrading insulation on hot water pipework

Biodiversity and Water

- Flow restrictors on taps and showers
- Installing more planters
- Rainwater butts for irrigation

11 Maintenance Projects

1 Introduction

Many ETC member theatres are not responsible for maintaining their buildings. Others find it difficult to fund maintenance, while busy schedules make maintenance projects difficult.

However, good maintenance is essential to sustainability. Maintenance ensures:

- Equipment works efficiently
- Problems like leaks are dealt with quickly

Maintenance is also an opportunity to put in hand mid-scale works for sustainability.

2 Responsibility

ETC members who are not responsible for maintaining their buildings should try to maintain close and supportive relationships with the building operator (often the City Council). If they are unresponsive, use the Building Survey Tool to identify Maintenance Projects, and present them as a plan to the building owner. Emphasize the energy cost savings, which will quickly pay back the cost of maintenance works.

3 Planned Preventive Maintenance

Regular maintenance increases the life of equipment, reducing replacement costs. It ensures systems operate efficiently, reducing energy use and cost. Maintenance often pays for itself through cost savings.

Planned Preventive Maintenance identifies problems before they occur. It plans in advance for regular equipment upgrades and replacement.

Refurbishment tasks typically undertaken within theatres	**Green Intervention worth considering**	**Green Intervention Reference**
Bar refurbishment	A-rated appliances	C33
	Underfloor heating	C23
Auditorium seating	Consider displacement-ventilation opportunities	C41
Toilet upgrades	Increased airtightness around wall/floor junctions	L7
	Install LED lighting	C1
	Improve lighting controls - install daylight and/or occupancy sensors	C2
	Install instantaneous point-of-use water heaters	C10
	Underfloor heating	C23
	Replace extract-only with mechanical ventilation and heat recovery (MVHR)	C27
	Install auto-stop hot taps	
Office (or back of house) upgrades	Increased airtightness around wall/floor junctions	L7
	Install LED lighting	C1
	Improve lighting controls - install daylight and/or occupancy sensors	C2
	CO2 controlled ventilation	C3
	Install instantaneous point-of-use water heaters at tea points	C10
	Upgrade naturally ventilated spaces to include MVHR	C37
Accessibility improvements	Enhance door air leakage improvements	L8
Stage lighting enhancements	Convert stage lights from Tungsten to LED	C13
Rewiring whole or part of the building, or extending wiring to new facilities	Install sub-meters on areas known or suspected as high usage	C15
	Replace old light fixtures with LED fixtures	C1
	Install movement-sensor and/or daylight sensor lighting controls where relevant	C2
	Increase electrical load capacity to future-proof electric heat	
	Rationalise switching	
Lamp replacement	Replace any remaining tungsten or CFL lamps with LED equivalents	C1
	Replace fluorescent tubes with plug-in LED replacements	C1
Resurfacing roof to cure leaks	Add insulation	L05
	Strengthen to support PV panels	
	Install skylight to enhance daylight	L06
	Paint surface white to reflect solar radiation and minimse the heat island effect	
Replacing rotten windows	Ensure good quality double (or triple glazing if the room often needs heating) and insulated frames (required by Building Regulations anyway)	L02
Redecoration	Replace old light fixtures with LED fixtures	C01
	Install movement-sensor and/or daylight sensor lighting controls where relevant	C02
Replacing gas/oil boiler(s) supplying heat to radiator systems	Check flow and return temperatures that the system runs at. If close to 40° then heat pumps could be considered, but seak professional advice first	G01
	Install heating zone valves	C18
	Install water sub-meters to domestic hot water	C29
	Upgrade insulation to hot water pipework	C08
	Consider upgrading heating emittors (like radiators) to accommodate low-temperature heating.	C23
Replacing gas/oil boiler(s) supplying heat to Air Handling Unit only	Dedicated heat pump or upgrade AHU to include integrated heat pump	C26
Renewing controls	Install or update Building Energy Management System	C16
	Install thermostatic radiator valves (TRVs) on radiators	C17
	Improve timing and zone controls	C18
	Optimised start/stop	C14
	Weather compensation	C14
Replacing hot water	Electric point-of-use heaters – especially if pipe runs are long	C10
Chiller needs replacing	Consider a heat pump with simultaneous heating and cooling functionality	
Replacing /upgrading ventilation plant	Install CO2 sensors to demand-control fresh air rate (post-Covid)	C03
	Install a heat recovery mechanism	
	Install units with integrated heat pumps to reduce the demand on fossil-fuel heating.	C26
	Install high efficiency fans with variable speed drives (and suitable controls)	C25
	Install electric and heat sub-meters	C15
	Simplification or upgrade of BMS controls	C16
Adding/refurbishing showers	Install low-flow water efficient shower heads	C11
	Waste water heat recovery system	C40

4 Sustainability Upgrades

Maintenance programmes are also the opportunity to put in hand important sustainability works, for example, changing lights to LED, or installing secondary glazing to windows.

Doing these works progressively, as part of maintenance, spreads costs over a number of years.

5 Cost Efficiency

By planning general maintenance alongside sustainability works, you can reduce costs as much as possible.

For example, if you have to build scaffolding to paint the theatre, you can also use the scaffold to replace windows. The best time to insulate your roof is when you are re-roofing. By doing both works together, you can reduce overall cost.

The table above offers examples of such opportunities.

12 Capital Projects

1 Introduction

Some sustainability improvements are expensive. They often need planning and heritage permissions. They may be disruptive, requiring closure of the theatre.

Therefore, they need to be done as part of a 'capital project' – or through a series of capital projects.

2 Prioritising Sustainability

Theatres have many conflicting priorities. Most capital projects have multiple goals. For example, as well as sustainability improvements, theatres may need to improve access, re-furbish the auditorium, or build a new studio.

Sustainability sometimes comes at the bottom of this list. Projects that support artistic growth , engagement, or revenue can be given higher priority. Funders often prefer more public projects to sustainability works like insulation. It's therefore important to prioritise sustainability goals among your goals, and make sure all funders agree on it as an urgent need.

Make sure everyone realises that sustainability projects are an essential part of your transition to achieve the ETC target of net zero of 2030.

3 Stakeholders

Make sure all stakeholders are fully behind the sustainability project.

Write a list of the external stakeholders who need to give the project their support. They may include owners, landlords, authorities, and funders. Talk to them early to get their support.

Consider the internal stakeholders you need to develop the project. They may include department heads (who may have different priorities and agendas). Try to create a shared goal of sustainability (climate literacy training can help).

4 Starting Out

Your capital project needs to start from defined goals based on your theatre's Sustainability Plan.

The ETC Theatre Green Book Building Survey Tool gives you a prioritised list of actions to target.

The next step is professional advice to:

- Confirm the sustainability thinking
- Confirm feasibility
- Assess costs

5 Building a Team

Theatres are specialist buildings which need specialist expertise. The team you need may include architects, sustainability consultants, services and structural engineers, acousticians, fire and access consultants, as well as project managers and cost consultants.

Make sure all of them are experts both in theatre buildings, and in sustainability. Be certain they understand the project's sustainability goals. To achieve a successful project, you need the right people.

Large expert teams can be costly. The more thinking you do for yourself, or supported by a small team, the better the chance of your running through ideas to shape the project in a way that suits your theatre, and your sustainability goals.

Capital projects aren't easy. They need:

- Energy and determination to drive them through
- Flexibility to shape them to changing circumstances

6 Heritage

Many theatres are historic buildings. Upgrading them for sustainability needs sensitivity and expertise. It requires careful decisions between heritage value and sustainability. Some things won't be possible. However, keeping an existing building is far more sustainable than building a new one – even if it's designed to the best modern standards.

Heritage expertise is essential to achieve the best outcome. Before any works, start by commissioning a Conservation Management Plan, to define the heritage value of the building, and guide decision-making about change. Engage heritage authorities in the process and make the most of their expertise.

The Conservation Management Plan should include a section on opportunities and challenges relating to sustainability. If you already have a Conservation Management Plan, update it to include this section.

7 Programming Capital projects

Closing theatres for capital works is always difficult. If possible, divide the works into separate projects that can be carried out separately.

8 Designing and Building Sustainably

Capital projects involve building work, which uses resources and creates carbon emissions. The energy that goes into making steel, bricks, concrete etc is known as 'embodied energy'. In all building works, you should minimise embodied carbon (and consumption of resources) by designing and building as sustainably as possible.

Briefing

The first question is to ask whether any new building is necessary at all? New building damages the planet, and should be avoided if possible. Often, there are other ways of achieving a theatre's goals, for example, by repurposing existing spaces. The less you build, the less harm you cause.

If you need to build, make sure that designing and building sustainably is central to the instructions you give your design team.

If you're writing the brief for a capital project, think what your building needs to help you operate more sustainably. For example, reuse and recycling needs more storage, so make it a priority.

Designing

Make sure your designers are experienced in sustainable design, and expert in the standards and principles of sustainable design and building.

Use materials and techniques that minimise embodied carbon. Where possible, choose long-lived materials which won't need replacing. Use reused and recycled materials wherever you can. Heavy steel and concrete structures are carbon-intensive. A lighter, smaller building will cause a lot less damage to the earth.

Building

Building's impact on the climate is caused by:

- The energy and resources embodied in materials like concrete, steel, and bricks.
- The transport needed to bring materials to site, sometimes from far away in the world, and remove waste.
- The energy consumed and waste caused through building processes.

Before you open a building and start using it, it will already have caused damage to the planet. The embodied carbon in a new building is often equivalent to many years of operational carbon. Buildings sometimes claim to be 'zero carbon' because they use relatively little energy. Their ecological harm is in deep concrete foundations, heavy steel frames, and brick fired in energy-intensive kilns.

Therefore, it's important to build only if you need to; and to design the building as sustainably as possible. Material sourcing and site operations also need careful planning by expert consultants. Embodied carbon should be measured: it's as important as a financial budget.

Standards for sustainable design and building help manage these challenges. BREEAM is one of the best-known (see sidebar), but different countries have different standards, and ETC members should choose their own.

9 Sustainability in Operation

Theatres often find that sustainability projects work less well than planned. Therefore, it's important to monitor projects and make sure they deliver all of their sustainability benefits.

Guidance on running your building sustainably will be found in Theatre Green Book : Sustainable Operations.

Sustainability Frameworks

ETC members should use the standards most widely followed in their country. Your professional team can advise on the most appropriate framework to use.

If no national standards are available, BREEAM is a widely recognised framework for ensuring capital projects are sustainably managed. Planning authorities and funders often require projects to achieve BREEAM 'Excellent' standard.

The most appropriate scheme for refurbishments is BREEAM Refurbishment and Fit-Out. You can find more information here: https://www.breeam.com/discover/technical-standards/refurbishment-and-fit-out/

13 Zero Carbon and Beyond

1 Introduction

The goal for every organisation in the ETC is to achieve zero carbon emissions each year: to operate without harming the planet.

For most ETC members, that will take several years to achieve. For some, it may be impossible. Historic theatres can't be fully insulated, and will always need more energy to run at acceptable temperatures.

When theatres can't achieve zero carbon operation, they reach 'net zero' by 'off-setting' the amount of carbon they can't get rid of. Off-setting means calculating your carbon, then investing in a scheme (for example, tree-planting) to absorb the same amount of carbon as the theatre is emitting. In theory, the building's impact is cancelled out: it's 'net zero'.

But accurate carbon calculation is difficult, off-setting is complex, and it can be hard to find reliable schemes. Offsetting is a last resort. The first step is to reduce carbon emissions as far as practically possible.

2 Offsetting

If you decide to off-set carbon:

- Carbon offsets should either be procured directly or via recognised offsetting frameworks.
- Off-setting schemes should demonstrate 'additionality' (i.e. they wouldn't be happening anyway), avoid double-counting and provide a clear process for verifying actual carbon savings.

3 Regenerative Action

Reaching zero carbon is difficult. All the same, it is important to focus on the need to repair the damage we have already done to the planet.

ETC members should aim to take restorative action by generating electricity, supporting biodiversity , and taking whatever measures they can to address the climate emergency.

The journey need not end at carbon zero.

Scope 1, 2 and 3 Emissions

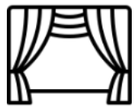
Scope 1 emissions are caused directly by the theatre, when it burns fossil fuels like oil and gas in a boiler.

Scope 2 emissions come from indirect energy generation – i.e. when a theatre buys electricity which the electricity company makes by burning fossil fuels in power stations.

Scope 1 and 2 are mostly within a theatre's control.

Scope 3 emissions are indirect. They're far harder for theatres to control. They're caused by the journeys audience make to reach the theatre, the carbon emissions of supply companies, and the transport needed to deliver supplies and take away waste. It's easy to get confused trying to calculate, let alone change them.

You'll find tools and more in the RESOURCES area



Sustainable **Productions**

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- *Detailed guidance*
- *Case studies*
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Certification

for…

- *Downloadable Self-certification forms*

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Renew Culture are co-founders and co-authors of the Theatre Green Book. We have pioneered the growth of Green Book networks across the world, and are leaders in theatre's journey to sustainability.

https://www.renewculture.co.uk

Renew Culture
The Theatre Green Book

Buro Happold is an international, integrated consultancy of engineers, consultants and advisers. After leading the construction industry in declaring a climate emergency, we've committed to reduce our own impact by achieving challenging science-based targets. We are collectively working towards an equitable and green future by adapting our business to mitigate climate change and the biodiversity crisis and helping others achieve their sustainability goals.

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