



Green Theatre

Taking action on climate change

September 2008

MAYOR OF LONDON

Greater London Authority
September 2008

Published by
Greater London Authority
City Hall
The Queen's Walk
More London
London SE1 2AA

www.london.gov.uk

enquiries 020 7983 4100
minicom 020 7983 4458

ISBN 978-1-84781-191-2

Copies of this report
are available from
www.london.gov.uk

Printed on 100% recycled paper.

Contents

1.Foreword by Boris Johnson, Mayor of London	2
2.Why go green?	4
3.Total carbon footprint for London's theatre industry	5
4.What can we do to reduce the footprint?	6
4.i Practical actions: leadership	7
4.ii Practical actions: heating, cooling and hot water	10
4. iii Practical actions: lighting	14
4.iv Practical actions: in the office, rehearsal space and general work environments	19
4.v Practical actions: production management	21
4.vi Practical actions: set design and construction	26
5. An expensive messy waste	27
6. Travel behaviour	31
6.i Reducing our own travel emissions	31
6.ii Audience travel	32
Appendix 1: Further information	34
A1.i Top ten list of practical actions for theatres	34
A1.ii Top tips for green procurement	36
A1.iii Sample letter to suppliers	37
A1.Vi Building management systems explained	38
Appendix 2: Acknowledgements and methodology	45
A2.i Scope of theatre footprint analysis	46
A2.ii Methodology principles: theatre venues	47
A2.iii Methodology principles: audience travel	49
A2.iv Methodology principles: pre-production and production activities	50
A2.v Conversion factors used	51
Appendix 4: Top tips to go greener	53

1. Foreword by Boris Johnson, Mayor of London

Theatre is of vital importance to London. Our artistic talent and reputation for excellence are well known around the world, but theatre also makes a significant contribution to the economy, and last year was no exception - attendances reached 13.6 million, making it the most successful year on record.

As a global city London has the ability to trailblaze new and exciting initiatives, with the potential to inspire and influence. London is in a very important position, as what we do here will be watched around the world.

I am committed to a 60 per cent reduction of London's greenhouse gas emissions from 1990 levels by 2025. This plan will help enable all of us to reach that target and avoid some of the potentially disastrous consequences of carrying on 'business as usual'. It will help theatres to communicate the message about climate change to audiences, without imposing on their artistic integrity or reducing the quality of shows.

This plan is a response to the overwhelming concern of the theatre sector to reduce any negative impact on the environment and its production has been aided by some of the most influential players in the cultural world. These span commercial and subsidised theatres and arts organisations, and include The Theatres Trust, National Theatre, Royal Court, Live Nation, Ambassador Theatre Group (ATG), and Arcola Theatre.

I leave you with one final thought before you read the rest of this plan: if all central London theatres challenged the age-old practice of keeping stage lights on and only switched

them on half an hour before the performance, they could collectively save over £100,000 a year in energy costs. The changes we make do not have to be expensive or difficult to manage in order to have a huge impact on our purses as well as the planet. I look forward to working with you to make London's theatres the greenest in the world.

Boris Johnson
Mayor of London

‘...Arts Council England is delighted to be a partner in the Green Theatre Programme for London, recognising the importance of this work in helping theatres to increase the efficiency of their business processes thereby reducing the industry's carbon footprint while saving money and continuing to attract artists and audiences.

A programme such as this demonstrates that the arts in England can lead internationally in responding to the pressures of climate change, moving beyond a duty of compliance with issues such as

energy management, to a role of inspiration and influence much greater than that due to the industry's size alone. That this leadership should emerge from London is of great encouragement to those artists and audiences that are drawn to this world city for its ability to innovate...’

Moira Sinclair, Executive Director London,
Arts Council England



2. Why go green?

Take the lead

London's theatre's productions and venues are renowned worldwide, and the city is one of the most important touring locations for companies globally. London theatres are not a large contributor to carbon emissions but their ability to influence is extremely significant. London theatres can reduce their own carbon emissions and at the same time have a much wider reach by showing our audiences and other theatre industries what is possible.

Save money

Being green saves you money.

Many of the ideas in this plan – switching to greener lighting, reducing energy consumption, reusing materials – will, in the medium term, save you a considerable amount of money. With rising electricity, gas and oil prices, there is a financial urgency to take action.

It is only a matter of time before legislation catches up with green issues. There is already new legislation concerning lighting and light fittings. Industries that get ahead of the game can not only better influence policy but reduce the pain of hasty compliance later on.

Attract talent

The growing momentum to act on climate change has come from artists, directors, production staff and others within the theatre, arts and cultural industries, all eager to make a difference.

Who is this plan for?

This plan is for anyone working in London's theatre industries, from small independent production companies and arts venues to large groups of commercial theatres.

It aims to guide you through some of the most practical and effective ways to reduce your energy use and make London theatres greener – while also saving you money

Recommendations have been grouped into broad areas of responsibility and technology, although you may find it useful to read all sections to begin with.

Further information on the carbon footprint calculations is given in the appendix, and further information on the practical recommendations is available at www.london.gov.uk/mayor or www.theatretrust.org.uk

3. Total carbon footprint for London's theatre industry

To enable a reduction in theatre's carbon emissions, our starting point was to measure where the emissions come from. Identifying the main problem areas within the industry gave us a picture of where best to focus our efforts to achieve the most effective results.

The total emissions from London theatres (excluding pre-production and audience travel) are approximately 50,000 tonnes a year¹

The industry footprint is roughly equivalent to:

- ten per cent of London's total bus emissions
- driving a car 1.5 million times round the M25
- the yearly energy consumption of almost 9,000 homes
- total TV emissions from all homes in Westminster

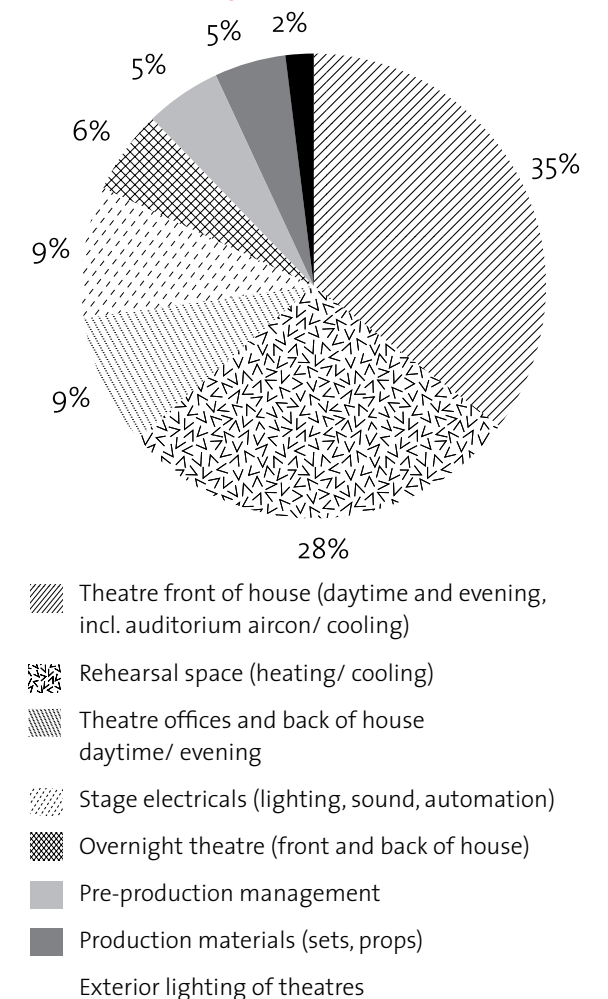
The figure of 50,000 tonnes does not include indirect emissions from audience travel, estimated at approximately 35,000 tonnes of carbon dioxide (CO₂) per year. London audiences are good at using public transport. However, around one third still travel by car or taxi. Encouraging audiences to use more sustainable modes of transport is also key to reducing the theatre industry's carbon footprint.

Without action, emissions and fuel bills are set to grow, in particular with the trend of West End productions using more energy to create ever more visually spectacular shows. There are plenty of actions we can take now to increase the energy efficiency of

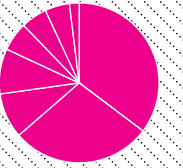
productions and theatre environments, without sacrificing artistic quality.

If all actions recommended in this plan are taken, London theatres can reduce their CO₂ emissions by almost 60 per cent from 1990 levels by 2025.

London's theatre industry's carbon footprint: 50,000 tonnes a year



¹ Notes: • To avoid double counting with other areas, indirect emissions from audience travel and embedded carbon in waste are not included in this footprint figure but are addressed later in the document.
• Due to the lack of historical data, 2007 has been taken as the base year for the calculations used in this report.
• It is assumed that base-line ('do nothing' scenario) emissions would grow in line with London's overall commercial and public sectors.



4. What can we do to reduce the footprint?

At every stage of a show's production carbon emissions savings can be made. This applies from the moment any research begins, scripts are printed and sets constructed, through to rehearsals, the performance run and the eventual get-out. London has a target to reduce emissions by 60 per cent by 2025, and within their industry theatres are well placed to achieve this target.

Artistic integrity

Significant savings can be made by management and staff within the theatre venue, and also by the creative and production team, without sacrificing artistic integrity. This document seeks to be a pragmatic and useful guide to those opportunities.

Carbon calculator for productions

Many of the buildings-related suggestions will be most applicable to theatre venues so we have created a 'carbon calculator' to help identify the environmental impact of decisions made in the pre-production stage. You can access the carbon calculator at www.london.gov.uk/mayor

Indirect emissions

Theatres have told us that there is significant scope to reduce 'indirect emissions' through better disposal and recycling of waste, and influencing the travel behaviour of our audiences. Audience travel and waste are discussed later in the document.

Exciting and making a impact

Reducing electricity use is likely to have the biggest environmental benefit, whereas waste generation and disposal is possibly the most visible and attention-grabbing area for staff and audiences.

In devising a green plan for your theatre, it's usually important to balance initiatives that are visible but may have lower carbon impact (paper cups) with those that may seem rather dull (actions associated with the air-conditioning) but will ultimately create the savings.

Did you know... The estimated cost of installing low-energy lighting will pay for itself in just two and a half years.

Significant financial and CO₂ savings can be made by simply replacing incandescent bulbs with compact fluorescent bulbs (CFLs).

Further savings will also be achieved in the need for less air-conditioning, fewer lamp replacements and less maintenance. The examples below illustrate how much can be saved by replacing existing front-of-house fittings with more sustainable resources.

What about listed buildings?

Although listed buildings can present extra challenges, there is plenty that can be done, and which complies with regulation, within the fabric of the building. Plus most of the savings opportunities will come from behavioural change. English Heritage Projects (www.english-heritage.org.uk/server/show/nav.1043) may also be able to provide specific advice for listed buildings.

Venues or production companies? Which are best placed to take charge?

Both! To make a difference, theatres and production companies will need to work together and consider each other's needs. You'll find lots of helpful hints in this plan.

But the technology doesn't exist?

Some of the greener technologies, such as lower emissions stage lighting, are still being developed and tested. By working together and asking our suppliers for green alternatives, simple market forces will encourage their development.

What about the cost?

We recognise that larger capital expenditures may not be feasible and have tried to focus recommendations on low-cost quick wins. Larger projects, as identified for heating and cooling, typically pay back in energy savings – just over a longer period (as indicated). Larger-scale investments can often be incorporated at the time of a refurbishment at little extra cost.

4.i Practical actions: leadership

Effective leadership from the top is the best way to achieve change. These are some of the things that boards and chief executive officers can champion:

• Work out your carbon footprint

To reduce your emissions, it's best to start by identifying where to make changes to achieve maximum impact. Organisations such as the Carbon Trust offer free surveys to help you work out how much carbon and waste your organisation is producing and where best to make reductions. They will help you develop an action plan tailored to your needs. For more information,

see www.carbontrust.co.uk or call 0800 085 2005.



- **Write an action plan** This should articulate your organisation's goals and targets, outline the basic approach and produce an action plan for achieving those targets. For more information, see www.carbontrust.co.uk/energy/startsaving/tech_energy_management_implementation.htm
- **Involve staff** Provide training to change old practices so that lights are switched off, waste reused and recycled where possible, and heating and cooling settings are always correct/switched off when spaces are not in use. Training may be

needed more frequently for front-of-house staff than for other staff, reflecting higher employee turnover.

- **Designate 'environmental champions'**
Give 'green' responsibilities to specific staff members. Consider branding the training programme to raise staff awareness and enthusiasm. For example, use certificates and badges to recognise trained staff, or ask staff what they think should be changed. Global Action Plan offers short training for environmental champions who then disseminate the lessons they learn (see www.globalactionplan.org.uk). Above all, reward success and make it fun!
- **Keep accurate records** Knowledge is power: if you record your energy consumption, you can track how you are doing against targets and identify peaks in usage. Where building management systems are installed, use these to record plant operation. Comparing this to energy usage can identify significant savings. For example, high recorded energy usage could be caused by heating, cooling and ventilation systems operating continuously or outside of necessary hours.
- **Write 'green' policies into contracts**
This will ensure that your suppliers are also working with you, and can have a significant impact through your supply chain. Sign up to London Remade's Green Procurement Code (see www.greenprocurementcode.co.uk) for help to design a green procurement policy and incorporate green specifications into products or services that you buy or

design. Don't forget to communicate this approach to staff

- **Open up your facilities for your partners**
If you are a theatre venue, help your partners (such as production companies) to recycle and manage their waste by giving them access (even if this means a charge) to the contracts you have set up with recycling and waste firms.
- **Create financial incentives** More accurate meter measurements would enable commercial theatres to charge production companies for their specific energy usage. Factor energy consumption by equipment and lighting into the costs allocated or charged to the production.
- **Ensure that capital expenditure incorporates savings from energy efficiency measures** For some heating and cooling investments, payback is achieved in around three years. The Carbon Trust can help prepare business cases for these kinds of bigger investments and can help with identifying potential suppliers.
- **Buy 'green tariff' renewable electricity**
This will help support the adoption of renewables technologies, but may not in itself lead to a direct reduction of UK carbon emissions. Therefore, sourcing green tariff electricity is not a substitute for the other actions suggested in this document.

Success Stories



ATG/ABTT Technical Sustainability Forum: A forum to help technicians reduce the carbon footprint of their theatres

Ambassador Theatre Group (ATG) and the Association of British Theatre Technicians (ABTT), working with the Mayor's Office, launched a Technical Sustainability Forum for technicians in the theatre sector at New Wimbledon Theatre in May 2008.

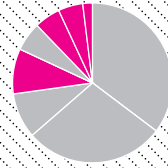
They estimate that theatres can achieve 5 per cent savings in energy simply from increasing staff awareness of environmental management. At the first meeting ABTT, Dirty Harry's, Selecon, Scenery Salvage, the Timber Trade Federation and White Light each gave a talk on ways in which their services could help technicians to reduce, recycle and make better use of renewables.

At the meeting ABTT announced that its new edition of the Technical Standards would feature sustainability updates.

A number of ATG venues have been involved in energy saving initiatives with in-house teams and 'Enviro Champions' progressing their own ideas such as low energy and LED lighting in common areas of theatres or Passive Infra Red Occupancy switches in dressing rooms and toilet areas. ATG hopes to hold a second forum later this year and hopes to introduce more initiatives to bring the benefits of energy savings to their venues and theatre technicians.

'...It was a valuable opportunity to share good practice and to develop awareness of the simple actions that technicians can take to reduce the carbon footprint of their theatres...'

Phillip Brown, Group Head of Safety and Environmental Services, ATG



4.ii Practical actions: heating, cooling and hot water

The following are quick wins that could be implemented at relatively low cost:

- **Check you are not simultaneously** heating a room with one appliance while drawing in air-conditioning with another. For appliances that both heat and cool, make sure that the temperature settings are appropriate.
- **Remember to turn down heating settings in summer.** Similarly, reduce temperatures for night-time hours (frost protection mode).
- **Avoid using electric heaters** particularly to supplement central heating. If the environment is uncomfortable, first check the temperature settings and thermostatic radiator valves to see if this corrects the problem. If not, it may mean your entire central heating system needs checking.
- **Regularly check air flows from ventilation systems**, as any blockage will cause the system to work harder and waste energy. Similarly, ensure filters are clean in air handling units, as dirty filters reduce air flow, making fans work hard and increasing energy usage.
- **Check that your thermostat** is located away from draughts, direct sunlight, or any sources of heat (like a fridge, photocopier, kettle) so as not to measure the wrong temperature.
- **Set your thermostat** for lower temperatures in workshops and storage areas.
- **Establish a ‘dead-band’ control** between heating and cooling so that neither is turned on until temperatures are outside acceptable levels of comfort (typically 18-24 degrees Celsius).
- **Fit an ‘optimiser’ for heating and hot water control systems to adjust for when the theatre/work space is open.** The optimised controller then looks at outside and indoor temperatures and information from preceding days. The controller uses this to work out what time systems need to come on. In older systems, an optimiser can be fitted retrospectively and is not an expensive modification in itself.
- **Service your boiler annually.** The typical cost is between £50 and £100 but a well-serviced boiler can be 20 per cent more efficient than a poor one.
- **Check regularly for dripping taps** and fit washers where needed. Over days and weeks, a dripping tap can waste huge amounts of water.
- **Reduce your immersion thermostat** (if you have one) to 60 degrees Celsius to make sure your water is not too hot. In general, don’t reduce the temperature of stored hot water below 60 degrees Celsius², to avoid the risk of legionella.

The following Initiatives will pay back in energy savings over the medium term, typically up to three years:

- **Check the efficiency of your electrical equipment** with a ‘power factor’ survey. Power factor equipment is finite and needs to be reviewed at least every 20 years or following significant equipment or layout changes. Don’t forget to check equipment following any power factor correction. Your utility provider may offer a power factor survey free or for a reduced charge. Alternatively, for details of recommended surveyors, call the Carbon Trust on 0800 085 2005 or go to www.carbontrust.co.uk
 - **Check your boiler’s efficiency rating.** New boilers are over 15 per cent more efficient. Boilers have an official efficiency rating from A to G, where A is the most efficient. For more information about the best boiler for you, see Energy Efficient Boilers and Heat Distribution Systems, choosing the best for your site (Carbon Trust, 2005).
 - **Fit a modern variable speed drive (VSD)** to control the supply fan motors of any oversized cooling motors and allow for variable levels of air flow to the auditorium. Fitting VSDs will enable you to control the speed of the motor so that it matches the speed of the equipment it is driving. For the Carbon Trust’s guide to selecting a variable speed drive, please see www.carbontrust.co.uk/Publications/publicationdetail.htm?productid=GIL152
 - **Install insulation** on internal appliances, and with external walls, windows and roofs. Insulation can be a big opportunity to reduce energy consumption. Even in historical and listed buildings, there are often quick and easy changes that will give a financial payback in a year or two through savings.
 - **Installing air quality sensors and temperature sensors** in the auditorium will provide additional control, which will enable the system to run at a reduced rate when the auditorium is not fully occupied.
- For further technical details, please see the section on Arup’s building management system guidelines in Appendix 1 of this document.
- Adapting theatres to climate change is also important. The possibility of installing green roofs and rainwater harvesting systems should be investigated when carrying out a theatre refurbishment.
- “The Green Theatre Programme is a fantastic step towards a more sustainable future. The theatre sector has responded magnificently to the collective challenge that is climate change – not only by addressing building-related issues, but also by recognising theatre’s unique ability to communicate complex issues and change behaviour.”
- Juhi Shareef**, Sustainability Consultant for the Creative Industries, Arup

² This refers to water pasteurisation at the immersion heater. Water is likely to have cooled as it travels through building pipes (60 degrees would be quite hot at taps).

Success Stories

The Theatres Trust

No action is too small: Building sustainable theatres

The Theatres Trust, the national advisory public body for theatres, is leading the promotion of sustainable theatre buildings.

Following its organisation of the PLASAO7 special interest seminar 'Theatres act on CO₂', The Theatres Trust has been working with the Mayor's Office on the Green Theatre Programme.

ABTT, ETC, Arup, Carr & Angier, Charcoalblue, Harlequin Floors, Northern Light, Theatre Projects, Consultants, White Light, Max Fordham, the National Theatre and the Southbank Centre all supported The Trust's

annual conference in 2008 at the Cottesloe Theatre, which looked at how to make theatres more environmentally sustainable.

The clear message from Conference08: 'Building Sustainable Theatres' was that no action is too small to make a difference.

In future The Theatres Trust will be gathering information on theatres' energy use to inform legislation and provide advice to theatres introducing climate change adaptations and implementing Display Energy Certificates. Visit www.theatrestrust.org.uk for more information.

'...Theatres need to go green, from the stage door to box office, to make sure we're doing everything we can to make our work sustainable and environmentally friendly...'

Alistair McGowan, Actor, impressionist and WWF Ambassador

Recognising the limited budgets of most theatre organisations, it may be most feasible to incorporate these kinds of investments into your ongoing refurbishment cycle. The following case study from ATG illustrates such an approach.

Success Stories



Ambassador Theatre Group (ATG): Refurbishing theatres

In the last few years ATG has realised that replacing its ageing boilers, many of which had not been upgraded for more than 15 years, would achieve huge savings in its energy consumption, energy bills, and carbon footprint.

The boilers at the Piccadilly and Comedy theatres were both replaced with minimal disruption to performances of Guys and Dolls and Boeing Boeing, both showing at the time.

ATG Group opted to use boilers recommended for their high efficiency, costing up to 25 per cent of the theatre's annual CAPEX budget. However, ATG calculated that this investment would pay for itself within five to ten years and therefore that all its future boiler replacements should also be highly efficient.

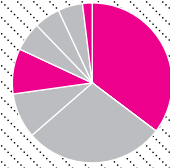
At the same time as upgrading its boilers, ATG is investing in the air conditioning system at the Fortune Theatre. The current system, which is over 25 years old and in very poor condition due to age and water damage, provides a fraction of the fresh air required and runs at less than 68 per cent efficiency. The new system will be 98 per cent efficient (a 30 per cent improvement in performance) and will cut expensive running costs in one stroke.

These examples from ATG illustrate how incorporating environmental considerations, and taking a medium-term perspective on CAPEX calculations, can lead to overall financial savings and a reduced footprint. For more information on buildings operations, please see the Arup guide in Appendix 1.

The Better Buildings Partnership

The Better Buildings Partnership, an initiative developed by the London Climate Change Agency, brings together a number of the largest commercial and public property owners in London under one recognition scheme. They are all working to improve the sustainability of London's existing building stock and accelerate the reduction in CO₂ emissions from those buildings. The partnership influences the market place and delivers solutions enabling sustainable building retrofit in London. By doing so, it demonstrates leadership and best practice to the wider commercial property market.

To find out more about the Better Buildings Partnership, visit www.lcca.co.uk



Did you know... if all central London theatres switched the rig on at the 'half-hour' call, they could collectively save over £100,000³ a year in energy costs alone

4. iii Practical actions: lighting

- **Check the efficiency of your electrical equipment with a 'power factor' survey**

Your utility provider may offer this free or for a reduced charge. Alternatively, for details of recommended surveyors, call the Carbon Trust on 0800 085 2005 or go to www.carbontrust.co.uk

- **The Big Switch-Off – switch off the lighting rig when not in use**

When not required for actual performance, switch off discharge lighting between the end of the reset or rig check in the late afternoon and at the half-hour call (35 minutes before the show starts), and between matinee and evening performances. When first adopting this approach, it may give extra confidence to have the lighting technicians return to the theatre for the half-hour call.

- **Exterior lighting and hoardings**

Switch to low-energy bulbs – swap standard tungsten bulbs with low-energy compact fluorescent light (CFL) bulbs, or consider retrofitting external lighting schemes with LEDs. Switch off exterior lighting in the daytime when lighting impact isn't visible. See National Theatre's case study for more information (page 21).

- **Front of house**

Switch to low-energy bulbs in the foyer and backstage lighting. Use motion sensors and timer switches to switch off lights in the theatre office, bar, cloakroom, corridors, lobby, foyers and toilets when not in use. (Note: if installing motion sensors to switch lights off and on, consider using the same sensors to switch off heating and ventilation in some areas).

To find out what kind of lighting may be appropriate for you, go to www.carbontrust.co.uk and click on 'Solutions' and the 'Lamp selection tool'.

Manufacturers that produce power-efficient discharge lighting include: Martin Professional A/S (www.martin.com, Denmark) and Vari-Lite (www.vari-lite.com, Texas).

"...TippingPoint brings together artists and scientists to explore the wider cultural issues around climate change. We look forward to continuing to work with the Mayor's Office on the Green Theatre Programme, as it is providing a series of critical and invaluable tools to enable the industry to take the practical steps necessary to reduce its carbon emissions..."

Angela McSherry, TippingPoint

Case study: The Big Switch-Off

Switch off discharge lights between the end of the reset or rig check and 35 minutes before the show starts

In recent years, stage technology has improved enormously. There is no longer a need to 'warm up' lights to make sure they won't fail during the middle of a show.

In February 2008, The National Theatre decided to challenge the age-old practice of keeping moving stage lights switched on (and shuttered) for hours before performances.

Over 12 days and 18 performances of the award-winning production *War Horse*, the National Theatre switched off its moving stage lights at the end of the rig check in late afternoon until 35 minutes before the show began. Every time, the lights came on cleanly and never failed during a performance.

This makes an estimated annual saving of £1,200, or 30 per cent of typical lighting use. Further savings will be achieved in reduced air-conditioning requirements, and from extended bulb life due to the reduction in use.

The National Theatre's technical crew are now so confident of the quality and performance of today's stage lights that they are making the Big Switch-Off standard practice when there is a clear hour between the end of the reset and the re-strike time.

"Discharge lighting fixtures from Martin™ are built to withstand a reasonable number of mains power on/off cycles with no detrimental effect on the fixture, its performance or its lifetime. If light output from fixtures is not required for a period of one hour or more, it is generally a good idea to cut lamp power from the control desk."

Discharge Lighting Shutdown Guidelines, Martin Professional A/S

"All Vari-Lite luminaires utilising arc lamps are designed to allow remote lamp dousing without requiring fixture recalibration. This greatly reduces the overall power consumption of the fixture and allows users to douse lamps when they are not in use."

Rich Booth, Vari-Lite Brand Manager

"Currently, moving stage lights, just in central London, use over 1 megawatts of energy per hour, generating around 5 per cent of the carbon emissions in theatre venues. Cutting the power supply for periods of inactivity greater than an hour is recommended by lighting manufacturers."

Bryan Raven, White Light

"PixelRange LED luminaires offer both energy and labour saving benefits – including low maintenance, low heat output and low power consumption. Theatres are beginning to embrace this new technology as the future of lighting."

Ashley Lewis, PixelRange

³ £100,000 annual savings assumes an electricity cost of 10p per kWh, and an average switch-off of three hours a day. These calculations do not include the further savings that will be delivered from the reduced load in air-conditioning and reductions in maintenance and lamp replacement. Any actions that reduce energy consumption during peak demand periods are likely to have disproportionately large financial benefits as they will reduce the

peak consumption figure used by electricity suppliers, as well as deliver the savings in themselves. Front-of-house and external lighting are good examples. Central London estimates are based on the existing lighting technology supplied to the West End (as estimated by White Light). The total London figure will be even higher.

Case study: National Theatre and Philips

National Theatre

National Theatre and Philips

The National Theatre is working with Royal Philips Electronics to replace its lighting in a five-year partnership package.

Phase 1 is ongoing and involves renewal of external lighting, reducing energy consumption of the previous installation by an estimated 50 per cent.

In Phase 2 the National Theatre is trialling the replacement of tungsten down lights with LED replacements in the Olivier Circle foyer. This is showing an 88 per cent saving in energy. Following extensive trials the National has changed the light source and control gear in the ETC Source 4 Profiles (spots on wall bars) throughout the foyers with Philips 70 watt Master CDM-T Elite technology. By changing the light source, the theatre will save 90,000kWh (75 per cent reduction compared with the current lighting) and 39 tonnes of CO₂ per year. There is a range of similar improvements using Philips technology underway across the building.

Phase 3 will involve replacing the electronic SEEFACt sign with a Philips Vidiwall. This will result in a reduction of 55 per cent in electricity consumed, saving 30 tonnes of CO₂ per year.

'...I think the most important thing is that it has completely turned the tide within the building. It signalled that we were about to make large changes in our lighting and in the way we used energy...'

John Langley, Theatre Manager,
National Theatre

"Although the total wattage of the outside lighting may be much lower than the performance rig, the impact is surprisingly high because of the length of time it is on."

The costs to install LED lighting are approximately half that of discharge lights. This iconic example shows that all theatre bill board lighting could be LED. Although the payback periods can initially look quite long, the main saving will come from reduced maintenance costs, especially in very inaccessible areas that require specialist equipment.

In the absence of a capital expenditure programme to support a change-over to LED fittings, there are still many actions theatres can take to reduce their external electricity consumption. Theatres can save money by replacing any non-performance lighting to more energy-efficient sources, whether it is CFLs, LED or fluorescent. At the same time, fitting daylight sensors on external lighting avoids waste."

Matthew Griffiths, PLASA

Case study: Replacement of tungsten with LED in front-of-house areas

National Theatres

In spring 2008, National Theatres replaced existing tungsten lights in the foyer of the Oliver Theatre with LED lights.

A total of 120 units, used on average ten hours a day, were replaced. This cut energy use by 88 per cent, taking annual consumption from 25.5 to 3 MWh and achieving almost 10 tonnes of annual CO₂ savings.

It is estimated that annual electricity bills will fall from over £1,500 to about £185 – an 88 per cent saving.

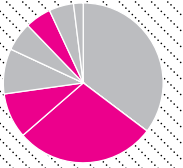
Arcola Theatre

In 2008, Arcola Theatre installed a low-energy LED lighting system in the café-bar area. Because of the opportunities to showcase the technology, the lights were supplied free of charge, as part of an ongoing sponsorship relationship, by LED lighting manufacturer PixelRange.

It is estimated that the new lighting system has reduced energy costs in the bar by 60 per cent, saving 4 per cent of the total annual electricity bill and reducing CO₂ emissions by 628kg.

There is an additional benefit to the lighting systems in that it has great flexibility in light levels and colour, and is perfect for daytime operation as well as for café-bar performances.

A series of educational LED workshops are planned at Arcola Theatre in conjunction with PixelRange (see www.pixelrange.com).



Success Stories

Paule Constable – Lighting design with carbon transparency

One of the UK's leading lighting designers, Paule Constable has worked for Glyndebourne, The Royal Opera House, English National Opera, Welsh National Opera, Theatre de Complicite, the Royal Court and the National Theatre. She is currently working on Ivanov for the Donmar and Oliver! for Cameron Mackintosh.

As someone who tries to be as environmentally aware as possible - cycling, composting, co-operative food shopping and commuting on public transport - Paule is equally passionate about trying to make her working life more environmentally responsible, despite being a self-confessed 'tungsten queen'. She's starting to look at how she can feed her concerns into decision making processes, operational policy, and into choices about using more energy efficient lighting and staging. She is leading the way for a new generation of lighting designers.

Paule's top tips

1. Every light in the rig needs a clear use and purpose. I try not to create options and light the piece to avoid unnecessary equipment.
2. When deciding on equipment I consider what energy a luminaire uses and if the brightness is needed.
3. Does that unit have to be tungsten? I consider whether I can achieve the same effect with a lower powered yet bright discharge unit.

4. Consider the best practices regarding the length of time the rig is on. Attempt to only power up the rig as and when it is necessary.
5. In simple unseen areas such as working lights for off stage I suggest using low energy units as much as possible.
6. I discuss with my production electrician how accepted practices might change to cut down on wastage. Can we use the French equivalent to PVC tape – rubber straps made of old bike tyres? Velcro straps to attach cables to bars? Cable trays? What is possible?
7. Try to pre-plan so deliveries can be made once a day.
8. Use cycle couriers and encourage lighting departments to think about how they travel to work.
9. Introduce more sustainable office practices.
10. And finally, encourage the management to provide good quality mains drinking water on tap.

'...I think that we need to be more carbon transparent in the way we design and light theatre productions. With lighting you're telling people about time and place, and trying to find the right emotional temperature. I want to be able to do this and at the same time be clear about how I'm having less impact on the environment...'

Paule Constable

4.iv Practical actions: in the office, rehearsal space and general work environments

The Carbon Trust estimates that office environments can easily save up to 20 per cent of their annual energy bills through simple efficiencies. The biggest areas of energy saving are likely to be heating, lighting, air-conditioning and office equipment:

- **Switch all lights to low-energy bulbs. Remember to switch off when space is unoccupied.**
- **Set photocopiers to energy saving mode.**
- **Switch off all equipment at the end of the day**, such as computers, monitors, printers and photocopiers. This will save energy and reduce the heat in offices, thereby cutting the need for fans or air-conditioning.
- **Practise general good buildings management**, for example turn off building lights when not in use, don't run air-conditioning with windows open, and ensure windows and buildings are adequately insulated. (See the 'Practical actions: heating, cooling and hot water' section in this document.)
- **Sign up to the green procurement code** at www.greenprocurementcode.co.uk. This can have a significant impact, through your supply chain, on the use of resources and materials, with little cost to you.
- **Use recycled materials**, especially 100 per cent recycled paper, which not only diverts

waste from landfill, but has a more environmentally friendly manufacturing process than virgin paper.

"The National Theatre is delighted to be supporting the Green Theatre Programme. There's so much that can be done to make ourselves more energy-efficient – whether it's attention-grabbing initiatives, or the incremental DIY stuff that delivers the extra percentage points. The National Theatre is on a track to take 20 per cent of its historic electricity consumption. There's no need to switch the lights off – it's about being smarter and getting everyone involved."

Nick Starr, Executive Director, National Theatre

Further information

- See **www.carbontrust.com** for general environmental advice, information on carbon mapping and suggestions for office environments, including straightforward action plans.
- The Energy Saving Trust (see **www.energysavingtrust.org.uk**) is another excellent source of advice. Although primarily with a domestic focus, advice is easily applied to the work environment.
- The London Development Agency's (LDA) Envirowise (see **www.envirowise.gov.uk**) offers free, independent and confidential advice and support, and links to numerous sources of further information. If you are not sure what help you need, are just starting out or would like to simply discuss your options, the Envirowise Advice Line (0800 585794) can point you in the right direction.
- London Remade Solutions (see **www.londonremade.com/greening-the-office**) can help businesses to reduce the waste they produce, reuse office items and start up or improve office recycling.

Did you know....Lighting an office overnight wastes enough energy to heat water for 1,000 cups of tea.

Switching off non-essential equipment in an office overnight saves enough energy to run a small car for 100 miles.

A London-wide switch to double-sided printing could save 17.5 billion sheets of A4 paper every year, enough paper to wrap around the earth four times.

Source: Carbon Trust, Brother UK

4.v Practical actions: production management

- **Use the Production Carbon Calculator tool (www.london.gov.uk/mayor) to understand your production footprint**
This tool helps to identify the source of your carbon emissions, so you can work out which are the biggest areas and where you might want to focus. Work with the relevant production areas (as identified in the rest of this plan) to take action. Also be aware of the implications of decisions made during production planning. (Read below for more detail about this.)
- **Factor equipment energy costs into your production budget**
Encourage actors and directors to choose low-energy options where possible. For example, the National Theatre restricts the use of the turn stage for its £10 series, as a way of making those productions more sustainable and financially viable.
- **Reuse materials wherever possible, or implement recycling schemes**
For example, review how you deal with sets and props, batteries, costumes and so on. (See the section 'An expensive messy waste' in this document.)
- **Reduce paper in script production**
Print both sides of paper, print on A5, only reprint those pages with text changes and reduce the size of show programmes. Use electronic mailings and digital marketing such as blue tooth communications. Think twice before printing and consider carefully how many copies you really need.

- **Use 100 per cent recycled paper wherever possible**

Recycled paper can be used not just for back-office and cast materials but also in programmes, posters and tickets.

- **Plan as much as possible to save on travel**

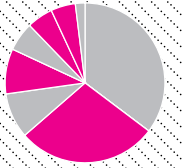
- Try to find rehearsal spaces near to your production stage, to avoid extra travel.
- Decide whether courier services are necessary, and make decisions in plenty of time to find alternatives.
- Use pushbike couriers rather than motorcycle couriers whenever possible.
- Reduce the volume of equipment taken on tours by using local facilities (such as lighting rigs) and trusted partners as much as possible.

- **Choose well-managed (insulated, for example) rehearsal spaces**

Ask third parties to supply their carbon footprint (perhaps through the Carbon Trust), to encourage environmentally friendly behaviour.

- **Source timber from certified sustainably managed forests**

- Greenpeace has created a 'good wood' guide to help with timber buying (see **www.greenpeace.org.uk/media/reports/good-wood-guide**). The Carbon Trust website provides further information on environmental purchasing (see **www.carbontrust.co.uk**).



Carbon calculator for production planning

The majority of the carbon footprint relating to a specific production is determined during the pre-production stage – through numerous decisions made in lighting, staging, set design and so on.

To help you understand the environmental implications of these decisions, we have developed a carbon calculator to estimate a footprint from each of the main production

areas. This is intended to highlight which areas in a given production are the biggest creators of carbon emissions. Many of the specific actions that can reduce this footprint are those detailed throughout this document.

The carbon calculator is available for download at www.london.gov.uk/mayor and www.theatretrust.org.uk

Sample input page

Production		
What is the estimated show running time?		hours
What are the total number of showings of the production?		no
Approximately what is the total number of stage lights to be used?		no
Approximately what is the total number of spot lights to be used?		no
How many hours before the show begins will the stage lights be switched on?		hours
How many hours will the stage lights stay on after the show has finished?		hours
Approximately what is the electrical demand of sound equipment that will be used?		kWh
How many hours before the show begins will the sound equipment be switched on?		hours
How many hours will the sound equipment stay on after the show has finished?		hours
What is the size of the auditorium?		m ²



The Living Unknown Soldier at Arcola Theatre, driving the 'eco-cultural frontier' through partnership

Arcola Theatre: A five-year programme to reduce carbon emissions

London's Arcola Theatre, one of the UK's leading independent venues, aims to become the world's first carbon neutral theatre.

Arcola has already installed a hydrogen fuel cell to power café/bar lighting and selected main house shows. The fuel cell operates almost silently, producing nothing but electricity and clean water. The 5kW fuel cell system takes pride of place in the foyer of the theatre and provides a spur for discussion about the benefits and challenges of this groundbreaking technology.

Arcola also installed a low energy LED lighting system in the café/bar area supplied by PixelRange.

It is estimated that the new lighting system has reduced energy costs in the bar by 60 per cent and motivates lighting designers to reduce main house lighting energy consumption by 60 per cent.

'...The environmental impact of all theatre productions can be reduced without artistic compromise through careful choices and creativity. I urge all directors to demand not more light and bigger set budgets but the right light and the right set...'

Mehmet Ergen, Artistic Director

'...Small but significant changes in operations can deliver immediate CO₂ and financial benefits. Such actions are critical to motivating and demonstrating that more radical sustainability visions can be realised – theatre has a crucial role in acting fast to show that change is possible and positive...'

Dr Ben Todd, Executive Director

Making an impact

All partners involved in the production and staging of The Living Unknown Soldier helped to make an impact in the following ways.

- Water and energy consumption was reduced, in particular by using energy saving products. This included reducing unnecessary wattage of stage lights and using energy saving lights throughout the theatre (including stages).
- The use of materials was reduced wherever possible. For example, by reducing the amount of white space, pages were saved in the unstapled programme.
- Adopting a policy of 'zero waste to landfill' resulted in more recycling, composting and reuse.
- Material was sustainably sourced, from the pulp in programmes to the wood used in sets.
- A hydrogen fuel cell was used to generate on-site electricity to power the show's lighting. This may signal the approach of a new technology in which hydrogen becomes a viable energy storage solution. Moreover, the capacity of the fuel cell was used to set a cap for the total wattage available to the creative team.

This July, Arcola delivered low-energy lighting and hydrogen fuel cell power for the renowned Latitude Festival, providing lighting for the entire theatre arena using a mixture of LED and low-power tungsten technologies. This cut power consumption by 70 per cent.

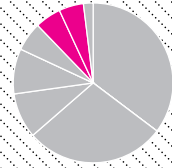
Arcola Energy is operating a blog for theatre practitioners to share experience and ideas: see www.arcolaenergy.com/contribute

'Working in a sustainable way proved to be far more practical than expected. Some costs were higher but were offset by others – second-hand costumes, for instance, helped pay for 'green' paint.'

Lilli Geissendorfer, Strawberry Vale Productions

'I did this for artistic reasons rather than social ones. By 'going green', we opened up a plethora of possibilities. I learnt that sustainability in theatre does not need to be a hindrance.'

Sebastian Armesto, Director



4.vi Practical actions: set design and construction

- **Use insulated spaces**

Ensure that the buildings in which sets are manufactured are adequately insulated, just as for any other workspace.

- **Encourage suppliers**

Incorporate the use of environmentally friendly behaviour by suppliers and partners into contracts, and wherever possible create financial incentives. Write 'green' policies into contracts. This will ensure that your suppliers are working with you, and can have a large impact through your supply chain. Sign up to London Remade's Green Procurement Code at www.greenprocurementcode.co.uk. See also 'Top tips for green procurement' in Appendix 1 of this document.

- **Be careful with paint**

- Toxins released from VOCs (volatile organic compounds) in paint release low-level toxic emissions. Due to increased awareness and market demand, most paint manufacturers now produce at least one non-VOC variety of paint. Look for VOC content on labels, usually listed in grams per litre, ranging from 5 to 200.
- Buy the right amount of paint for the job to avoid waste.
- Paint brushes and rollers used for an ongoing project can be saved overnight, or even up to a week, without cleaning.

Simply wrap the brush or roller snugly in a plastic bag, squeeze out air pockets and store away from light. The paint won't dry because air can't get to it. Simply unwrap the brush or roller the next day and continue the job. (This works for water and oil-based paints and stains. It does not work for varnishes or lacquers.) Turpentine, mixed with a couple of drops of washing-up liquid, is an environmentally friendly solvent that is excellent for cleaning brushes used for oil-based paints.

- **Buy environmentally friendly materials**

Source timber from sustainable forests. Look for Forest Stewardship Council (FSC) certification, which is recognised by many environment organisations as the best standard for sustainable forestry. The scheme links the finished timber product to an independently certified forest via timber mills and merchants who are also certified. FSC timber is not universally available but the number of suppliers is growing. For more information about the scheme and where to find products, go to www.fsc-uk.org or call 01686 413916.

5. An expensive messy waste

Reuse of materials saves embedded carbon, that is to say carbon that would have otherwise been released to the atmosphere but is instead contained for the long term (for example in wood and plastics). The embedded carbon in sets, props and costumes can typically represent between five and ten per cent of the total production footprint.

Due to the restricted storage facilities of many theatre venues, environmental management of physical waste can be particularly problematic. Some of the main areas are listed below, with suggested actions for how to manage them.

- **Batteries**

It is estimated that between 500,000 and 600,000 batteries are consumed by London's theatres. Ensure all batteries are recycled rather than put in the bin, which would otherwise release toxic materials. The Mayor's Office and WRAP (Waste & Resources Action Programme) are sponsoring a collection scheme. For more details, see 'Battery recycling scheme' in Appendix 1 of this document.

- **Light bulbs and lamps**

Ask your lighting supplier to collect dead bulbs and lamps. Most should offer this service.

- **Waste Electrical and Electronic Equipment (WEEE)**

Since July 2007, under the WEEE directive all businesses need to dispose of equipment in a sustainable way (see www.london-recycling.co.uk/reporting/weee.php). When you buy electronic equipment, ensure your supplier specifies in the contract how these items will be disposed of at the end of their life cycle.

- **Sets and timber**

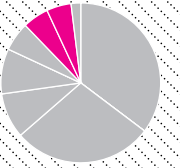
Use a waste removal service with a large element of recycling and reuse. Scenery Salvage (www.scenerysalvage.com) provide services tailored for the theatre industry (see the case study below). Any Junk (www.anyjunk.co.uk) is very active in London and commits to reuse and recycle as much waste as possible.

- **Cups**

Switch to reusable heavy duty-plastic cups to avoid single-use disposables. Recycle waste produced in bars and restaurants (include recycle bins in restaurants and kitchens where there's space). Avoid using bottled water as much as possible, and offer free tap water front of house. Consider installing a water cooler back stage. Green Care H₂O (www.greencareh2o.com) supplies mains-fed water units that could replace bottled water.

- **Unused leaflets and programmes**

Ensure these are collected and recycled.



- **Polystyrene and plastics**

Polystyrene is not generally recyclable and should therefore be avoided if possible. Switch to cups made of recyclable materials, and separate out the polystyrene ones to ensure these never reach landfill.

- **Costumes**

The Freecycle Network (www.freecycle.org) is a good source of costumes for productions on a tight budget. Costumes can also be collected through organisations such as TRAIID (www.traid.org.uk) or donated to charities.

Wasteful water consumption

The National Theatre has shown it is possible to achieve water consumption savings of roughly 50 per cent by installing:

- infra-red sensors to detect people movement, which in turn controls urinal flushing in public toilets
- low-content cisterns during lavatory refurbishment
- flow restrictors on taps during refurbishments
- aerating taps and showers.

Case study: National theatre, Scenery Salvage and prop supermarkets

Dirty Harry's
clean london



Theatres and production companies can now recycle or sell their old scenery and props, and reduce their waste management costs at the same time.

Scenery Salvage, a company used to taking away scenery in the television and film industries, is now offering a similar service for theatre productions. Their first trial with National Theatres completed successfully in March 2008. For more information, go to www.scenerysalvage.com or call 01494 866110.

On average, 80 per cent of props and 40 per cent of scenery is saleable

Reusable props and parts of scenery are catalogued and listed on Scenery Salvage's website for resale. If not sold within six months, the props and scenery get broken down, the plastics are recycled and the timber parts chipped.

Cost competitive

There is a competitive cost for taking away waste, dependent on the likely sales value of components. Deals can be made with Scenery Salvage that range from flat tonnage rates to simple free removal or a share of the resale price for elements with high resale value.

By working with Dirty Harry's, ATG – which runs 23 venues - was delighted to find it could save money by recycling (paper, glass, plastic, timber, fluorescent tubes and batteries), compared to

conventional waste removal services. Visit www.scenerysalvage.com for more information.

'...The quote [Dirty Harry's] gave us was, believe it or not, cheaper than the current price we were paying for waste collection and would also include the ability to recycle paper, glass, plastic, timber, fluorescent tubes and batteries. We have now been using Dirty Harry's for over six months and recycled 90 tonnes of glass, 11 tonnes of paper, 3 tonnes of cardboard and 1.5 tonnes of plastic. After a very successful six months there is no looking back...'

David Blyth, Operations and Building Development Director, ATG.

Within the screens industry Scenery Salvage have established relationships with studios, whereby their information is passed to production companies as part of their welcome pack. This ensures even temporary users of facilities can achieve environmentally friendly waste management. The equivalent would be theatre venues facilitating direct access to environmental waste services for production companies

Battery recycling scheme

The Mayor has joined up with WRAP⁴ to launch a battery recycling service for London's theatres, and the partnership has provided funding to support every London theatre to get recycling

When talking to London's theatres about developing and implementing carbon reduction initiatives, many people expressed concerned by the number of waste batteries they were consuming and throwing away. It is estimated that over 500,000 batteries are consumed annually by London theatres.

To make recycling simple, battery collection boxes of various sizes are available (smaller BattBoxes and larger Tube-10s). The joint Mayor/WRAP recycling service will provide initial facilities to get you going.

If you don't use many batteries (less than 50 batteries per week). Please call G & P Batteries on 0121 5683200 to receive your free BattBox.

This will hold about 200 AA batteries. When it's full, call the same number to request your free collection.

After this, it's over to you. A BattBox and collection from G&P Batteries costs just £25, so there's no easier way to reduce your environmental impact and get recycling.

If you use a lot of batteries (over 50 batteries per week). WRAP has bought some Tube-10s, which you can have free of charge. To find out more and request your free Tube-10, please call Sophie Easteal on 020 7983 4412.

If you'd like to buy further BattBoxes, please call G&P Batteries on 0121 5683200 or go to <http://battbox.co.uk>

6. Travel behaviour

To avoid double counting with other sectors of London's overall footprint, travel has not been included within the theatre industry's carbon footprint. However, there are many opportunities for theatre to reduce its own, as well as its audience's, significant travel footprint.

6.i Reducing our own travel emissions

- Reduce unnecessary transport by considering emissions while planning tour routes. Transport Direct (www.transportdirect.com) provides journey planning and emissions calculations for national travel.
- Encourage staff, crew and cast to use public transport wherever possible.
- Travel in low-emission transport modes where possible (for example, avoid flying within the UK). Production transfers (particularly between New York and London) and touring represent distinct challenges. As a last resort, offset unavoidable air travel through a recognised DEFRA scheme. For general information on carbon offsetting, go to www.defra.gov.uk/environment/climatechange/uk/carbonoffset/faqs.htm. Visit London's website at www.visitlondon.com/people/green/responsible-tourism gives recommendations on responsible tourism, including offsetting partners.

- Use smarter meeting tools such as teleconferencing, desk top or videoconferencing to reduce travel requirements. A number of commercial Voice over IP ('VoIP') network providers offer these services. (Find these on the web or talk to your telecomms provider.)
- Reduce supplier frequency and quantity of deliveries and collections through better planning. In particular, try to avoid last-minute supplier calls, which will usually require a dedicated trip.
- If couriers must be used, consider using cycle couriers where possible; a number of these operate within London.
- Reduce touring volumes by using trusted local partners, for example use local lighting rigs where possible.

'There are ten million empty seats on our national road network every day.'

Source: Good Going

⁴ Waste & Resources Action Programme

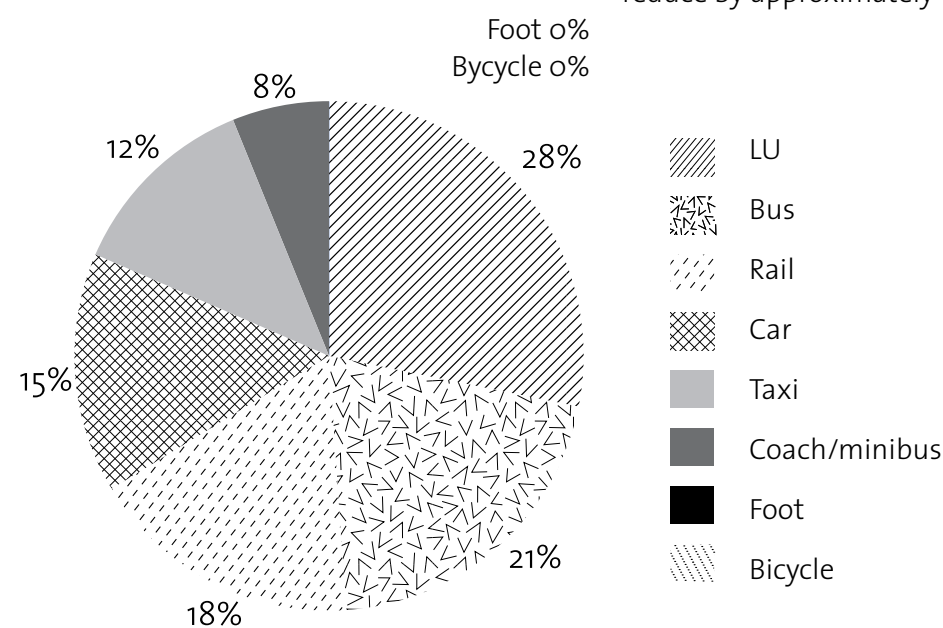
6.ii Audience travel

Audience travel to London theatres accounts for about 35,000 tonnes of CO₂ a year – larger than theatre venue emissions

The total footprint of all London theatre audience-related travel is approximately 35,000 tonnes of CO₂ a year. This reflects the fact that not all of audience travel can be directly attributed to the theatre trip.

London audiences are pretty good at using public transport. However, almost **one third still travel by car or taxi**.

Percentage of London theatre audience travel emissions by travel mode



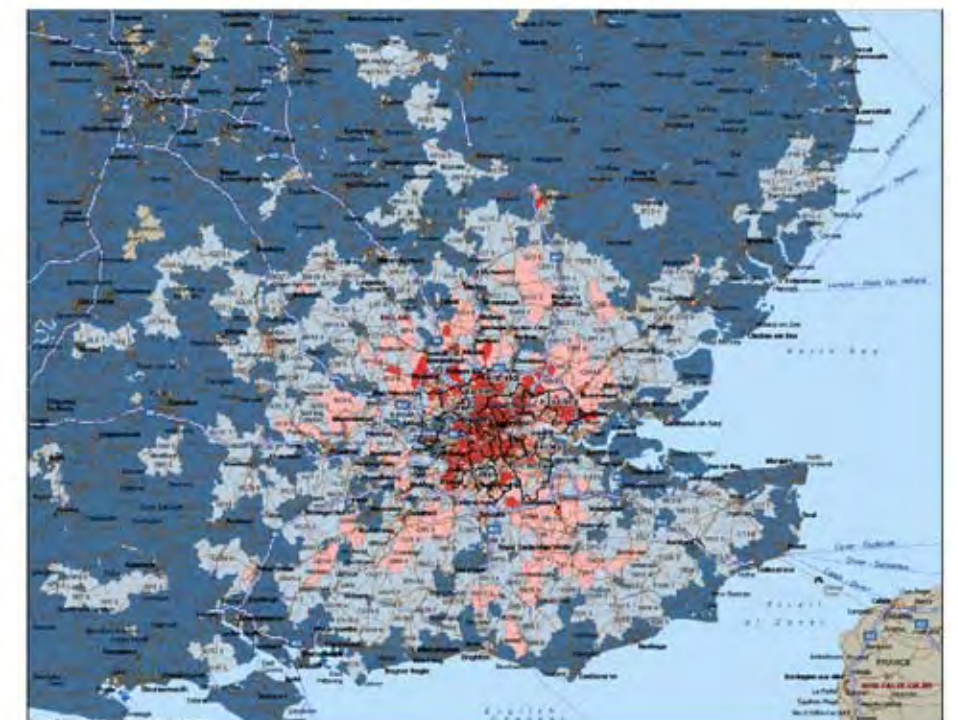
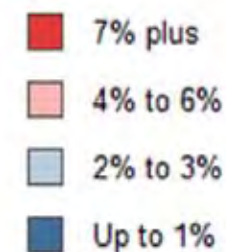
Here are some suggestions for encouraging audience use of public transport:

- Use space in programmes, on tickets and in theatre lobbies to communicate a public transport message to audiences.
- Provide greater visibility and links to Transport for London's (TfL's) journey planner (<http://journeyplanner.tfl.gov.uk>) on the theatre's and the production's website.
- Work with TfL's Oyster team and Visit London's Oyster Plus programme to promote Oyster and offer '2 for 1' deals. For more information, email marketingstrategy@tfl.gov.uk

If all audiences travelling to London theatres by car and half travelling by taxi switched to public transport (bus, tube or rail), CO₂ emissions from audience travel would reduce by approximately 14 per cent.

The catchment area for UK audiences spreads across the Southeast (and beyond)

Percentage of households attending London Venues



Base = all London stages

Appendix 1: Further information

A1.i Top ten list of practical actions for theatres

- 1. Switch off the lighting rig when not in use (see 'The Big Switch-Off' case study).**
 - When not required for performance, switch off discharge lighting between the end of the late afternoon reset/rig check and the half-hour call (35 minutes before the show starts), and between matinee and evening performances.
 - When first adopting this approach, it may give extra confidence to have the lighting technicians return to the theatre for the half-hour call.
- 2. Reduce energy consumption in exterior lighting and hoardings.**
 - Switch to low-energy bulbs. Replace standard tungsten bulbs with CFLs, or consider retrofitting external lighting schemes with LEDs if refurbishing.
 - Reduce running hours of exterior lighting, especially during daylight hours when the lighting impact isn't visible.
- 3. Implement standard lighting savings in front of house.**
 - Switch to low-energy bulbs in the foyer and backstage lighting.
 - Introduce sensors and timings to avoid unnecessary hours of lighting.
- 4. Reuse materials wherever possible, or implement recycling schemes for:**
 - sets and props
 - batteries
 - lamps
 - costumes
 - plastic glasses and consumables – introduce recycling for waste produced from bars and restaurants within the theatre
- furniture, carpets and so on if waste is created, for example after a refit.
- 5. Implement an energy management and staff training programme, and take sensible actions to reduce energy wastage.**
 - Compile a formal energy management policy (including targets and policies).
 - Allocate clear energy management responsibilities, and establish an energy management team with regular reviews and action planning.
 - Staff training can include: turning off lights, reporting waste, correct heating and cooling settings, and setting timers on all electric systems.
 - Establish accurate records of energy consumption.
 - Use recycled content paper, for example for leaflets and programmes.
- 6. Look at your heating and cooling practices and make simple adjustments⁵.**
 - Reduce heating settings in the winter and raise again in the summer.
 - Reduce temperatures for night-time hours (for example, set heating in frost protection mode).
 - Don't run cooling and heating at the same time.
 - Establish 'dead-band' controls so that neither heating nor cooling are run until outside comfortable temperatures (typically 18–24 degrees).
 - Install simple controls to avoid over ventilation in cooling, and to ensure heating and cooling come on at the right times (rather than setting manually).
- 7. Talk to your energy adviser to correct the power factor of the electricity used in the building. This can be a very quick and inexpensive way to make energy and financial savings.**
 - A power factor survey is required to identify these savings.
 - Power factor equipment is finite and needs to be reviewed at least every 20 years or following significant equipment or layout changes.
 - Don't forget to check electrical equipment following any power factor corrections.
- 8. Work with suppliers and partners.**
 - Provide recycling and energy management facilities for production companies and others using the venue, and provide this information, together with your policies, in welcome packs.
 - Incorporate environmentally friendly behaviour by suppliers and partners into contracts, and wherever possible create financial incentives. For example, more accurate meter measurements enable commercial theatres to charge production companies for their specific energy usage. Another example is to specify that production companies must comply with the theatre's recycling and waste management practices and policies and buy from environmentally friendly sources, such as timber from sustainable forests with (FSC) certification.
- 9. Minimise travel emissions.**
 - Personnel: encourage staff, crew and cast to use public transport.
 - Audiences: promote public transport
- options by publicising on tickets, programmes, websites and so on.
 - Suppliers: through better planning, minimise supplier frequency and the number of deliveries and collections to the theatre by vehicles.
- 10. Look to the medium term. The following measures will all give a financial pay-back in savings from reduced energy consumption. However, they are typically larger or more mid-term in nature compared to the 'quick wins' identified in previous points.**
 - Build energy efficiency into the lifetime cost of new equipment purchases.
 - Ensure capital expenditure considerations look at least three years ahead to capture financial savings from energy efficiency measures.
 - Take simple steps to improve building efficiency and insulation (on internal appliances and with external walls and roofs). Even in historical and listed buildings, there are often quick and easy changes that will give a financial pay-back in a year or two through energy savings.
 - Many venues have boilers dating back decades. Consider switching to high-efficiency/condenser boilers and convert oil boilers to gas.
 - Installing air quality sensors and temperature sensors in the auditorium will provide additional control, which will enable the system to run at a reduced rate when the auditorium is not fully occupied.
 - Fit a modern variable speed drive (VSD) to control the supply fan motors of any oversized cooling motors.

⁵ The age of many of these facilities means this can sometimes be difficult because of slow system 'reaction time'. In the medium term, this can be addressed in refurbishment programmes.

A1.ii Top tips for green procurement

Green procurement needn't be complex. Use this action plan to implement green purchasing in your workplace through a simple step-by-step process.

- **Question the need for the purchase in the first place.** Can existing products or equipment be used instead of buying new goods? Can the requirement be met by hiring or sharing instead of buying?
- **Appoint an environmental champion** to spearhead your green procurement strategy.
- **Agree green purchasing objectives** and integrate them into a simple green procurement policy that clearly states your intentions. Ensure this fits in with your environmental policy.
- **Get top-level support** for your objectives from your chief executive or finance director.
- **Communicate your strategy** and processes to staff and suppliers so they are clear on what is expected of them.
- Regularly **review your purchases** to assess their impact regarding emissions to air and water, waste to landfill, resource use and environmental quality.
- **Engage existing suppliers** who may be able to provide products or services to fit in with your new procurement policy. Get their feedback before targeting new suppliers or contractors. Ask your supplier for sample products.
- **Source green alternatives.** Product listings

are available from the sustainable product directory on the Green Procurement Code website (www.greenprocurementcode.co.uk)

- **Incorporate green procurement criteria** into all key contracts, starting with those that are high spend, have a high environmental impact and are easily influenced. This includes: energy and water efficiency, recycled content, reusable packaging and products, no hazardous chemicals and sustainably managed timber such as that certified by the Forest Stewardship Council (FSC).
- **Award new contracts on the basis of value for money and whole life costing**, not the lowest price. This takes into account whole life costs; green purchases may lower operating or disposal costs. Choose products that use less energy (minimum A-rated energy efficient), have a long life span and can be easily repaired or reused.
- **Implement contracts and monitor performance**, including the environmental benefits of your new product or service.
- **Improve performance**, for example by minimising delivery frequency and miles and reducing packaging.

(Source: Mayor of London's Green Procurement Code
www.greenprocurementcode.co.uk)

A1.iii Sample letter to suppliers

Dear Valued Supplier,

In response to current environmental concerns and the need to conserve valuable natural resources, <Theatre Owner/Producer> is committed to reducing the amount of waste generated in our productions. Our commitment will result in improved stakeholder satisfaction, potentially reduced operating costs, and a better quality of life for us all.

A portion of the waste we generate comes from products and packaging that we obtain from you and other suppliers. We hope you will be able to help us reduce this waste wherever possible. We believe that we can both benefit by reducing waste and that the result will be a more sustainable relationship between us. If you would like to join us in our commitment to reducing waste, we would welcome the opportunity to discuss a mutually beneficial programme.

Specifically, we are looking for opportunities to:

- eliminate or minimise packaging by volume and weight by reducing packaging of the products we buy from you
- buy products with reusable packaging, products and packaging that use a significant amount of recycled materials in their manufacture, and products and packaging that are recyclable in the majority of current recycling programmes.

We are analysing the changes we can make now and in the future and are looking to establish baseline information that we can build on. Please tell us what initiatives you have taken to prevent waste and inform us of your future plans.

Thank you for your assistance in our waste prevention efforts. Please call if you have any questions.

Yours faithfully,

<Signature>

(Source: Live Earth environmental guidelines, 2007, adapted.)

A1.Vi Building management systems explained

What is a building management system?

A building management system (BMS) is a: ‘high technology system installed in buildings that controls and monitors the building’s mechanical and electrical equipment such as air handling and cooling plant systems, lighting, power systems, fire systems, and security systems.’

A BMS consists of software and hardware, and can be ‘integrated’ or ‘stand alone’. A BMS can be used to control the systems in one building, or multiple buildings.

An integrated system is one that allows several buildings systems (such as heating, lighting) to communicate with each other, centralising data from all systems into one common platform. A newly installed stand-alone system should be capable of integration at a later stage and should be capable of communication via an IT network. Such a system is cost effective to install and will offer the flexibility for full integration and connection between business and building services at a later date.

Impacts need to be measured if they are to be managed

The key to successful energy management of any building, whether to satisfy ‘comfort conditions’ for rehearsals or to save energy, is the availability of data in a single format that can be analysed to identify problems (or energy usage). This enables the building or facilities manager to take the correct action to resolve those issues. For example, if a rehearsal room is kept heated and lit all day despite being empty, this can not only be

detected by a BMS but also the room’s heating and lighting can be controlled by the building manager from a computer in another location.

It is important that the technology provided should be appropriate to the scale and requirements of the building; too many systems can become overcomplicated.

Why use a BMS?

A BMS can be used to:

- monitor, target and reduce energy, and make it easier to do so
- reduce energy bills
- reduce carbon emissions
- demonstrate environmental leadership and continuous improvement over time
- improve access to information (such as data collection, logs, reports and dashboards), which can help in communication (when reporting to investors, the Arts Council, the general public and so on)
- improve maintenance (with system logging, reporting and performance monitoring)
- reduce dependence on energy suppliers and allow procurement of ‘best of breed’ energy products
- improve continuity of service/business (monitoring/alarms).

When BMS doesn’t work: taking an axe to the system?

A well-known historic theatre has experienced problems with their BMS. As an independent controls specialist, Arup⁶ is in the process of advising them on possible solutions.

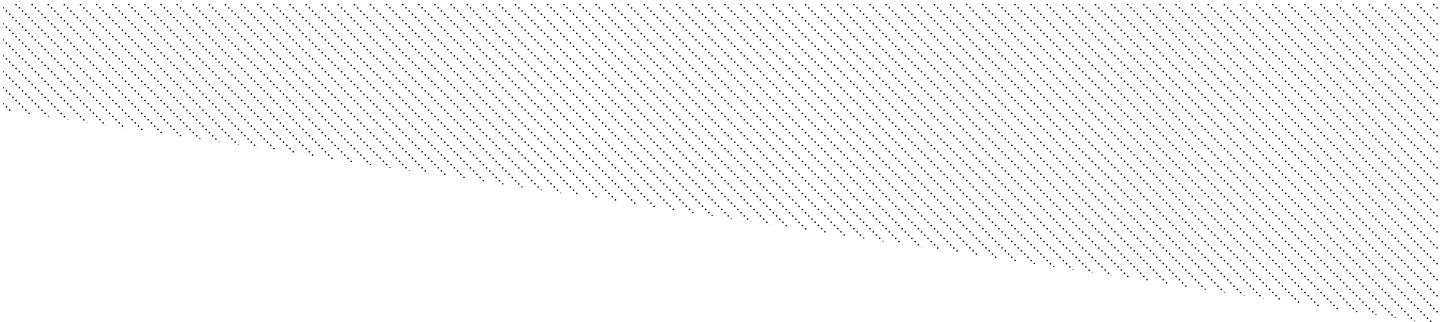
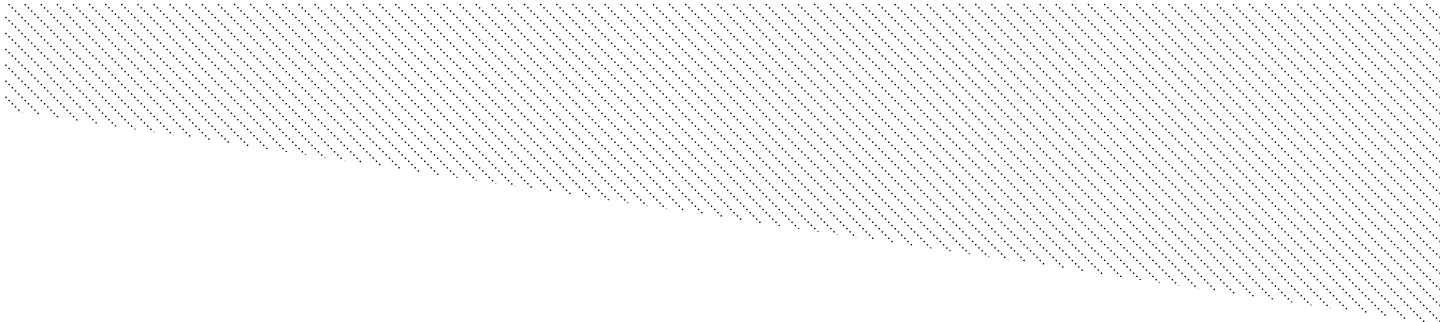
“for the last eight years our inability to maintain temperatures and constant fault-chasing have meant I’ve often wanted to take an axe to the system and return to the golden days of manually opening and closing valves.”

A spokesperson for the theatre, 2008

The below table lists the problems encountered, along with the causes and Arup’s suggestions.

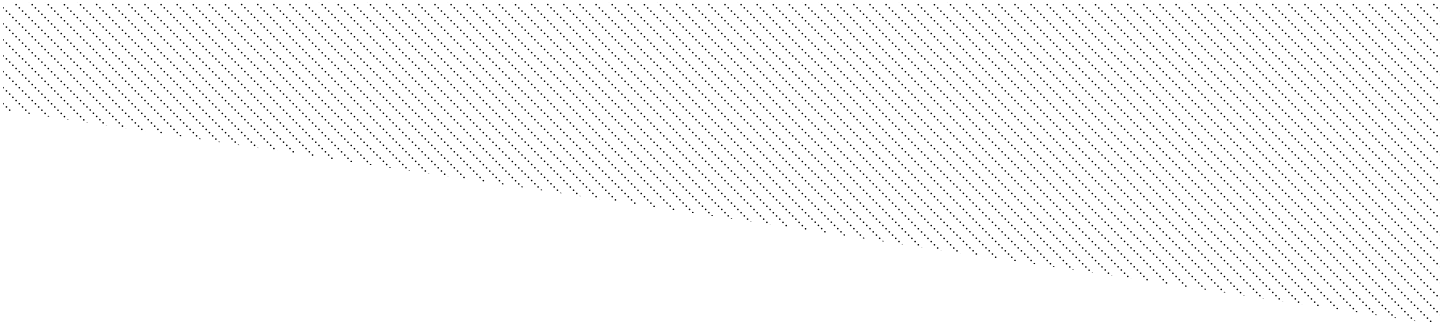
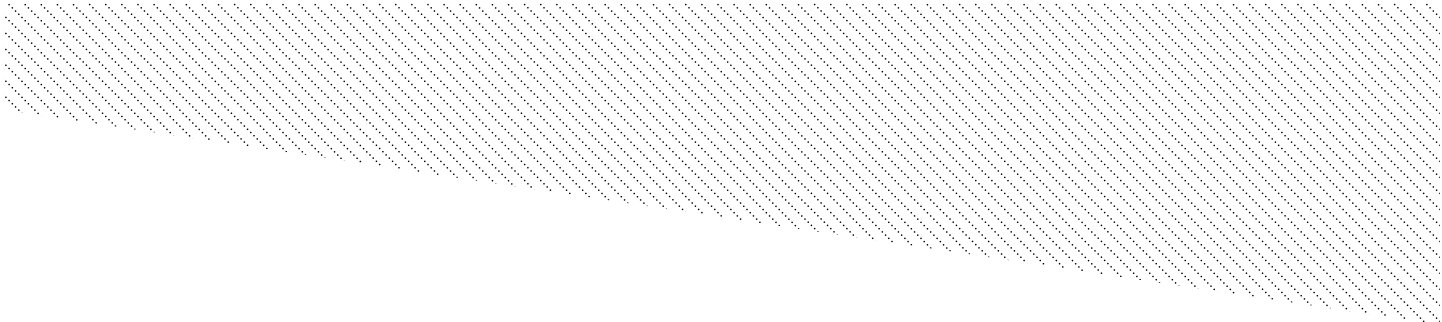
BMS concerns, problems experienced	Suggested solutions, causes
Lack of adequate or competent support from controls maintenance companies: inexperienced tampering with control panels and contradictory information being a regular occurrence	Call an independent controls specialist, namely a specialist company that does not work with specific vendors. Costs may include a site visit. Note: an online search for the answers to common queries may reveal some useful information, but such websites are usually not independent.
Bad advice on supervising software or operator interface	As above.

⁶ Declaration of interest: Arup designs BMS systems, writing specifications for contractors, providing a list of preferred suppliers and contractors and ensuring that the work is carried out to the specifications defined.



BMS concerns, problems experienced	Suggested solutions, causes
Easily corruptible software	Software should be password protected to avoid potential for corruption. Software can be corrupted if incorrectly installed. Contact a control specialist.
Failing temperature sensors that go undetected Also: Alarms	<p>Temperature system should have an 'out of limit' alarm. A correctly set system sets parameters beyond which alarms will sound. Alarms can take the form of an on-screen notification and a paper printout. Some systems can also be set to send alarms as emails or text messages.</p> <p>The specifications for a BMS can be set so that, when an alarm goes off, 'consequential' alarms are disabled. There is no point in a fan failure alarm being activated if associated alarms, caused by the fan failure, also go off.</p> <p>Priority levels can be set for alarms – most systems have up to 99 priority settings.</p> <p>Without supervision, a contractor installing the system often walks away without setting the priority levels. This can be avoided if working with a reputable and independent specialist.</p>
Valve actuators not responding to room 'setpoint' changes	There could be a number of causes for this. For example, the valves may be responding but the demand signal sent to the boiler may not be working.

BMS concerns, problems experienced	Suggested solutions, causes
Valve actuators not responding to room 'setpoint' changes continued	<p>The software should be correctly set to configure the sensor to the control valve. The control valve should undergo 'point to point' testing to ensure that the devices in the field and control panel tie up.</p> <p>Also, check that the control loop software that looks at room temperature and positions the valve accordingly is both working and fully commissioned. This is a common problem.</p>
Lack of competent training	<p>It is the responsibility of the controls specialist or contractor to provide the client with at least one day of training. (Arup usually recommends four to five days of basic training.)</p> <p>Training should be appropriate to different levels of interaction with the system. For example, a user may only need to view and interpret graphics (one day) while a programmer would usually require four days of training plus the basic training (therefore a total of eight to ten days).</p>
Inaccessible controls on many fan coil units	Inaccessible controls (placed in inconvenient positions) are an indication of bad design. For example, if a contractor puts a control panel above a fixed ceiling, it is impossible to reach it.



BMS concerns, problems experienced	Suggested solutions, causes
Inaccessible controls on many fan coil units continued	<p>The problem should be identified well in advance. In new and refurbished buildings, a coordinated installation drawing, with agreement from both the client/architect and the installer should prevent control panels and so on from being located inappropriately.</p> <p>It is vital that someone with experience (the consultant, architect or client) ensures that all equipment is conveniently located.</p>
No clear published strategy	<p>A strategy can refer to specific software in the controller; the system programmer should print out a strategy diagram for future use.</p> <p>A strategy can also describe correct operation, and is a key document for efficient operation of a BMS. This should be requested as part of the specification process and maintenance manual.</p>
Energy consumption of all associated air-conditioning plant is a real worry, with maintenance companies failing to comprehend sustainability imperatives Also: Sustainability policy	<p>HVAC systems such as air-conditioning plant can be hugely energy intensive if not located and operated efficiently. Apart from sustainability impacts (greater carbon emissions contributing to climate change), a poorly installed or operated air-conditioning system has implications for fuel efficiency and corresponding fuel bills.</p>

BMS concerns, problems experienced	Suggested solutions, causes
Energy consumption of all associated air-conditioning plant is a real worry, with maintenance companies failing to comprehend sustainability imperatives Also: Sustainability policy continued	<p>It is easy to make savings in this area. As a minimum, a theatre should give its contractors and suppliers a copy of its sustainability policy. British Standard 8901 gives guidance on writing sustainability policies and implementing a sustainability management system for venues.</p> <p>Contractors are under the control of the theatre management and should be given appropriate guidance.</p>
Many mechanical engineers share the same (negative) views about BMS. It's apparent that there are extremely few companies where there's joined-up thinking between the mechanical (designing) aspect, installation and the controls engineers (programming)	<p>There is often a lack of coordination between mechanical and controls contracts, but unfortunately the only goal for some contractors is to get in, get out and get paid. It is the role of experts in this field, such as independent controls specialists, to provide advice and make sure the job is done correctly. This is money well spent at initial stages, to avoid a reoccurrence of the problem.</p>
A statement from the theatre regarding their BMS issues: "We are addressing some of the above issues and the installation of new supervisor software on our system may allay some of my cynicism." Also: Contractors	<p>When choosing a contractor, their experience and reputation are key indicators of quality. Look for reputable contractors with a breadth of experience in the performing arts. It is suggested that theatres share information about good and poor suppliers. It is important that suppliers receive feedback from theatres and are allowed to respond.</p>

A final note on BMS

The above list of concerns spells out a poorly procured and commissioned system. They are not alone in this experience! Correct specification, handover (training) and witnessing/acceptance by reputable contractors or consultants enables problematic situations such as this to be avoided and ensures the use of a BMS as a key tool in responding to energy bills and climate change.

About Arup

Sustainable thinking has been integral to design-engineering company Arup since it was founded by Ove Arup 60 years ago. Arup is better known for city-scale infrastructure projects and designing buildings such as theatres.

However, Arup also offers services in sustainability (including carbon and ecological footprinting), energy management (including BMS, Energy Performance Certificates and renewable energy), acoustics, lighting design, theatre consulting, transport (including green travel plans and carbon emission modelling), waste, logistics and sustainable event management. Arup developed BS 8901, the British Standard for sustainable event management, which can be used by venues and any form of event including theatre productions.

For more information about theatre sustainability, email Juhi.Shareef@arup.com or Neill.Woodger@arup.com; to contact a BMS expert, email Darren.Wright@arup.com

Appendix 2: Acknowledgements and methodology

The following individuals and organisations have supported the writing of this document. We would like to thank them for their participation and contributions.

AEAT

Alistair McGowan, WWF Ambassador

Ambassador Theatre Group

Association of Lighting Designers

Arcola Theatre

Arts Council

Arup

ATG

BECTU

Carbon Trust

Central School of Speech & Drama

Delfont Macintosh

Dewynters

Equity

ITC

Live Nation

London Remade

National Theatre

PixelRange

PLASA

PMA

Really Useful Group

Roundhouse

Royal Court

SOLT

The Theatres Trust

Tipping Point

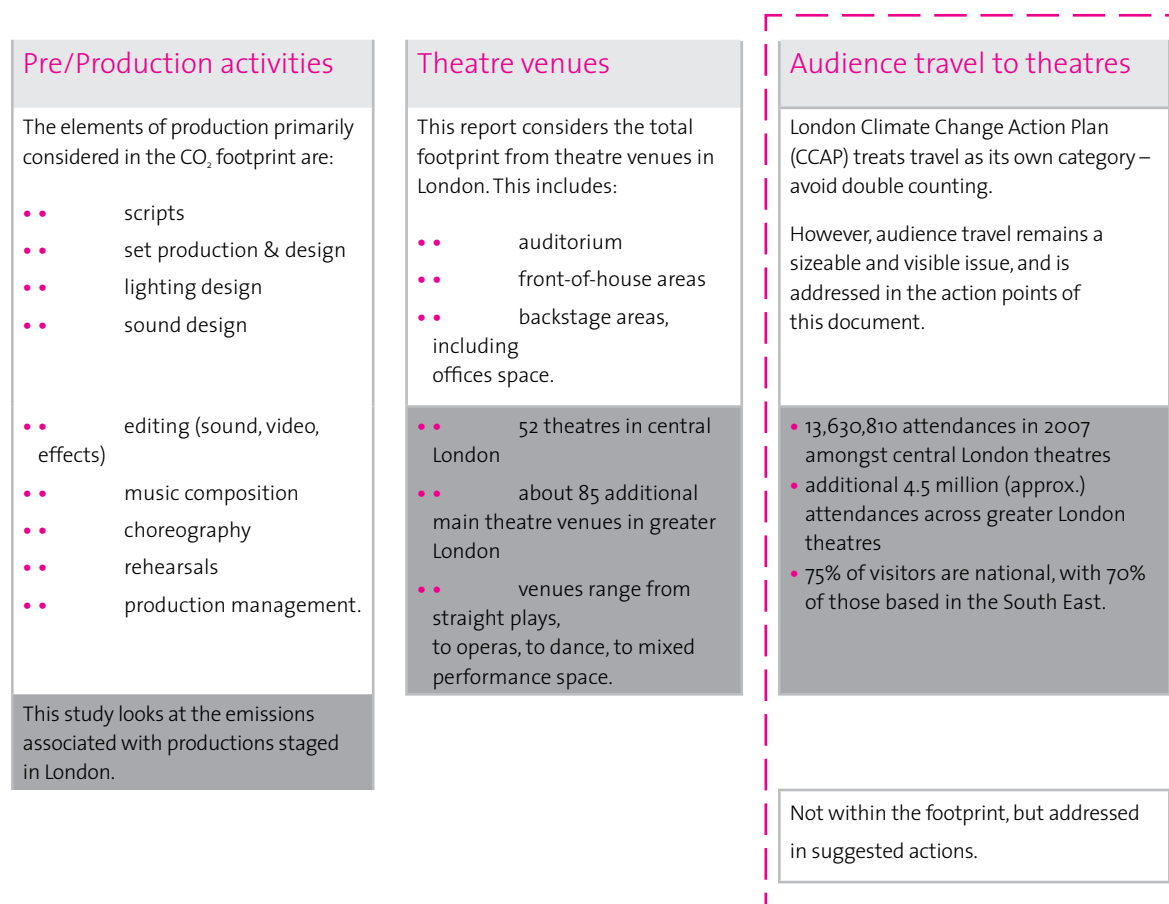
TMA

White Light

WRAP

Young Vic

A2.i Scope of theatre footprint analysis



A2.ii Methodology principles: theatre venues

Footprint calculation framework

(Average emissions per seat) x (number of theatres and seats) x (adjustment for venue type, size, intensity of use)

Data sources

- Carbon Trust surveys: National Theatre, Arcola, ATG Group, Delfont Macintosh theatres, Royal Court, Live Nation
- British Performing Arts Yearbook (2007/8)
- SOLT Theatre Audience Survey (MORI 2003-4)
- Audiences London Snapshot London II
- Arts Council Economic Impact of UK Theatre (2004)
- DCMS Performing Arts data, SOLT box office (2007)
- Theatres' own websites
- White Light estimated lighting usage in London theatres

Assumptions

- Carbon Trust methodology used in footprint audits
- Assumes theatre footprint scales with auditorium size, where survey data not available
- Where footprints unavailable, adjustments from averages have been made to reflect intensity of venue use (for example, musicals create larger footprint than plays, higher frequency of performances in West End)

- Split of total venue footprint derived from audits, as well as data from White Light on average lighting use by type

Excluded

- Supply chain
- Embedded carbon
- Travel

London theatres included in venue footprint calculation

- | | | | |
|---|---|---|---|
| <ul style="list-style-type: none"> • Adelphi theatre • Albany centre and theatre • Aldwych theatre • Alexandra palace • All saints Art centre • Amadeus theatre • Almeida Theatre • Apollo Shaftsbury • Apollo Victoria theatre • Arcola theatre • Arts Depot • Arts educational schools London theatre • The Arts Theatre • Ashcroft Theatre (Fairfield Halls) • Barbican theatre • Barbican Pit theatre • Barons Court Theatre (Curtain Up) • Battersea arts centre • Beck theatre, Hayes • Blackheath Halls, Great Hall • Blackheath Halls, Recital Room • Bloomsbury theatre • Bob Hope theatre (Eltham Little) • Bonnie Bird theatre (Laban dance) • Bonnie Bird theatre studio (Laban dance) • Bridewell theatre • Broadway theatre, Barking • Broadway theatre, Catford (main theatre) • Broadway theatre, Catford (studio) • Brockley Jack theatre • Bush theatre • Cambridge • Canal Café theatre • Charles Cryer studio theatre | <ul style="list-style-type: none"> • the Chelsea theatre • Coliseum theatre • Comedy theatre Courtyard Theatre, Hoxton • Compass theatre • Criterion theatre • Dominion theatre • Donmar Warehouse • Drill Hall • Drury Lane (Theatre Royal) • Duchess theatre • Duke of York's theatre • Erith Playhouse • Etcetera theatre club • Finborough theatre • Fortune theatre • Garrick theatre • Gate theatre • Gielgud theatre • Globe theatre • Greenwich theatre • Greenwich playhouse • Hackney Empire • Half Moon young people's theatre • Hampstead theatre • Hen and Chickens Theatre • Her majesty's theatre • ICA • Jermyn Street • Kenneth More theatre • King's Head theatre • Landor Theatre • Little Angel theatre • London Coliseum • London Palladium • Lyceum • Lyric • Lyric Hammersmith • Millfield Theatre • Morley College, studio theatre • National Theatre, Cottesloe • National Theatre, Lyttelton | <ul style="list-style-type: none"> • National Theatre, Olivier • New London (New End) theatre • New Wimbledon theatre • Noel Coward (Albery) • Novello • Old Red Lion theatre club • Old Vic • Open Air Theatre, Regents Park • Orange Tree theatre • Oval House • Palace theatre • Pentameters theatre • Phoenix theatre • Piccadilly theatre • The Place, Robin Howard dance theatre • Playhouse theatre • Pleasance theatre, Islington • Polka theatre for children • Prince Edward theatre • Prince of Wales theatre • Queen's Theatre • Queen's Theatre, Hornchurch • Questors theatre • Richmond theatre • Riverside Studios, Studio 2 • Riverside Studios, Studio 3 • Rose Theatre, Kingston • Rosemary branch theatre • Royal Court Jerwood theatre downstairs | <ul style="list-style-type: none"> • Royal Court theatre upstairs • Royal Opera House • Sadler's Wells, Lilian Bayliss theatre • Sadler's Wells, Peacock theatre • Sadler's Wells theatre • Savoy theatre • Shaftsbury theatre • Shaw theatre • Soho theatre, main stage • Soho theatre, studio • South London theatre, Bell theatre • Southwark Playhouse • St Martin's theatre • Trafalgar Studios 1, Whitehall theatre • Trafalgar Studios 2, Whitehall theatre • Studio theatre • Tara Arts • Theatre Royal, Haymarket • Theatre Royal, Stratford East • Theatre 503 • Tricycle theatre • Unicorn theatre • Vaudeville theatre • Victoria Palace • Waltham Forest theatre • Warehouse theatre • Waterman's • Westminster Community Theatre • White Bear theatre club • Wyndham's theatre • Young Vic |
|---|---|---|---|

A2.iii Methodology principles: audience travel

Footprint calculation framework

(Size of audience) x (audience transport mode split) x (average emissions per mode) x (average distance of travel) x (percentage of audience travelling primarily for theatre)

allocating journeys to theatre-specific related travel increased the footprint size by +15 per cent

Excluded

- Non-UK travel data

Data sources

- SOLT Theatre Audience Survey (MORI 2003-4)
- Audiences London Snapshot London II
- DCMS Performing Arts data, SOLT box office (2007)
- TfL transport mode emissions database

Assumptions

- Total transport footprint adjusted by stated purpose of travel (reflecting large overlap between theatre travel and general tourist or work commute journeys)
- Average modal split applied to all travel distances, due to lack of available cross tabulated data on distance travelled by mode. This is likely to understate emissions from cars, and overstate those from taxis and buses
- National travel distance capped at 200 miles. It is hoped that future industry survey data will provide greater detail
- All audience journey is assumed to involve return trip

Alternative calculations used to verify footprint

Financial spend (namely, percentage spend relating to theatre versus other activities in trip) used as an alternative proxy for

A2.iv Methodology principles: pre-production and production activities

Footprint calculation framework

Audited production emissions relative to their venues emissions, scaled by total venues emissions calculation

Data sources

- Model box stage dimensions for all theatres in database
- Production audits: Arcola Theatre; National Theatre (three shows); Royal Court (three shows)
- British Performing Arts Yearbook (2007/8)
- SOLT Theatre Audience Survey (MORI 2003-4)
- DCMS Performing Arts data, SOLT box office (2007)
- Theatres’ own websites

Assumptions

- This approach calculates the footprint of productions staged in London venues, rather than the footprint of all London-based production companies (irrespective of performance location). It is not known which of the two is larger, but they are likely to be in the same order of magnitude
- Carbon Trust methodology used in footprint audits
- Assumes production footprint scales with stage size
- Adjustments have been made to reflect intensity of venue use (for example, musicals create larger footprint than plays, higher frequency of performances in West End)

- Production audit data adjusted to reflect nature and size of shows, and distinctions between venue-related and pre-production activities
- Rehearsal space footprint is taken from producing theatres and is a mix of in-house (auditorium usage) and externally hired space. Therefore, this represents emissions associated with all rehearsal time in productions

Alternative calculations used to verify footprint

(Average production footprint) x (number of theatres and stage size) x (adjustment for venue type, size, intensity of use)

Excluded

- Travel
- Laundry
- Some elements of production management office emissions may not be fully captured from entire supply chain

A2.v Conversion factors used

Energy type	Factor (kg of CO ₂ per kWh gross)	Source
Electricity (grid)	0.523	defra.gov.uk conversion factors
Electricity (combined heat and power)	0.295	
Electricity (on-site renewables)	0.000	
Natural gas	0.185	

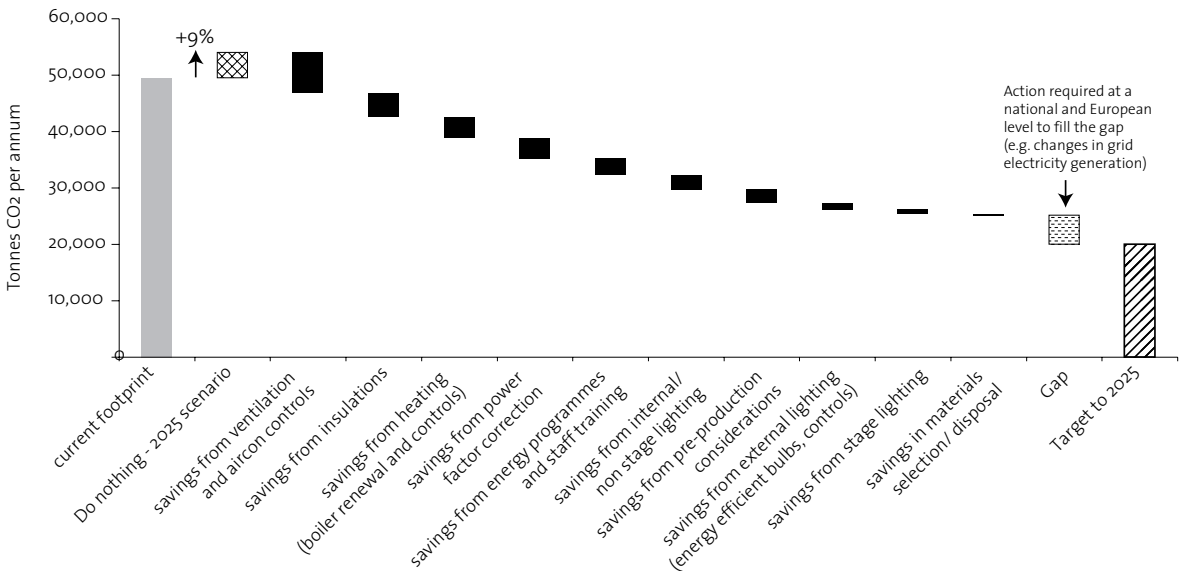
Transport type	Factor (kg of CO ₂ per km)	Source
Car	0.131	TfL Environment Report 2006; ATOC baseline energy statement (Note on buses: 103g of CO ₂ per km is reported in TfL Environment Report 2006 but is currently being recalculated at 80g per km)
Bus or coach	0.080	
Rail	0.060	
Underground	0.055	
Tram or light rail	0.047	
Walking or cycling	0.000	

Appendix 3: Footprint reduction calculations

By 2005, if all actions are taken, theatres can achieve most of the 60 per cent Climate Change Action Plan emissions savings targets

Note: Business as usual scenario assumes theatre emissions grow in line with London’s commercial and public sector growth. Studies by GLA economics suggest the two sectors are closely tied. Moreover, consumption of energy in West End productions continues to grow.

Total CO₂ savings identified to 2025



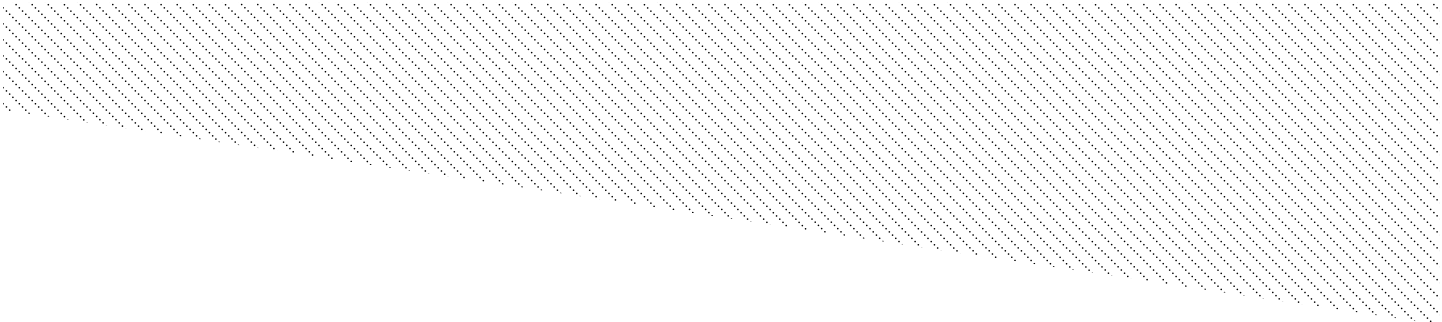
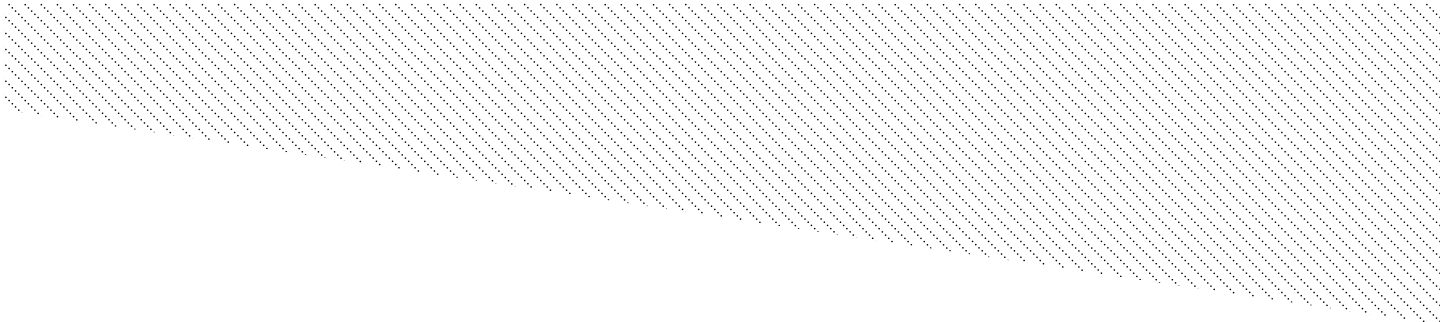
Appendix 4: Top tips to go greener

Areas for savings	Things you can do to reduce emissions	Typical payback time	% of CO ₂ savings (theatre venue)
Ventilation and air conditioning/cooling controls	<ul style="list-style-type: none">• Reduce temperature for night-time hours (e.g. set heating in frost protection mode).• Set your thermostat for lower temperatures in workshops and storage areas.• Don't run cooling at the same time as heating.• Install a 'deadband control' between heating and cooling so that neither is turned on until temperatures are outside acceptable levels of comfort (typically 19-24 degrees Celsius).• Regularly check airflows from ventilation systems and ensure filters are clean in air handling units.• Review operational times and parameters for heavy use equipment, including chillers (e.g. install automatic controls to reduce over-ventilation).• Install air quality sensors and temperature sensors in the auditorium.• Install insulation on internal appliances and with external walls, windows and roofs.• Fit a modern Variable Speed Drive (VSD) to control the supply fan motors of any oversized motors.	<ul style="list-style-type: none">• Instant• Instant• Instant• Instant• <1 year• 1-2 years• 1-2 years• 3 years	10-12%
Lighting	<p>External lighting:</p> <ul style="list-style-type: none">• Reduce hours of operation (especially during daylight hours).• Switch to energy-efficient bulbs –swap standard tungsten bulbs with low energy CFL bulbs or replace external lighting with LEDs. <p>Internal non-stage lighting:</p> <ul style="list-style-type: none">• Change tungsten lamps used in general lighting applications for compact fluorescent.• Set timer switches; fit occupancy sensors and lighting control systems to reduce 'out of performance' lighting. <p>Stage lighting:</p> <ul style="list-style-type: none">• Switch off discharge lighting between the end of the reset/rig check late afternoon and the half hour call before the show starts, and between matinee and evening performances.	<ul style="list-style-type: none">• Instant (no cost)• < 2.5 years• < 2.5 years• <1 year• Instant (no cost)	<div>2-4%</div> <div>5-6%</div> <div>c.2%</div> <div>9-12%</div>
Boiler renewal and controls	<ul style="list-style-type: none">• Consider switching to high efficiency/condenser boilers and convert oil boilers to gas.• Reduce your set temperature by 1 degree to save an average of 8 % on the heating bill.• Turn on auditorium heating later in day (closer to performance time); reduce temperatures for night-time hours (e.g. frost protection mode).• Use automated controls (rather than manual); install thermostatic valves in wet radiators.	<ul style="list-style-type: none">• <5 years• Instant (no cost)• Instant (no cost)• 1.5 years	8-10%

Areas for savings	Things you can do to reduce emissions	Typical payback time	% of CO ₂ savings (theatre venue)
Buildings and electrical insulation	<ul style="list-style-type: none"> • Ensure building insulation is brought up to minimum standards and improve further where practical. • Consider additional insulation to each floor level to minimise the impact of heat gain rising through buildings. • Check if the outside walls of the buildings can be additionally insulated and install where practical. • Improve insulation of hot water storage (tank and pipe) and electric heating cupboards. 	<ul style="list-style-type: none"> • Dependent on building. However, many actions achieve payback in under 2 years 	7-9% ⁷
Power factor correction	<ul style="list-style-type: none"> • Correcting the power factor to your building can be a quick way of making energy and financial savings: it is cheap to install and will have little impact on operations. Check the efficiency of your electrical equipment with a 'power factor' survey which identifies where you can save. • Following power factor correction, electrical equipment will need to be tested and possibly adjusted. Power factor equipment needs to be reviewed at least every twenty years or following significant equipment or layout changes. 	<ul style="list-style-type: none"> • 3 years 	7-8%
Energy management programmes and staff training	<ul style="list-style-type: none"> • Compile a formal energy management policy (including specific targets and policies) and form an energy management committee, with regular reviews and action planning. Allocate clear energy management responsibilities. Make this as fun and informative as possible for staff, possibly with small rewards and incentives. • Staff training can include: turning off lights, materials selection and recycling, correct heating and cooling settings, setting timers on all electrical systems, showing films like Al Gore's 'An Inconvenient Truth' to inspire action. • Collect accurate records of energy consumption (possibly to half hourly detail); track consumption against weather; identify causes of variance against targets. • Build energy efficiency into lifetime cost of new equipment purchases. • Ensure IT equipment is turned off during periods of non office working. • Seek efficiencies in catering equipment (e.g. fridges on timers to go on two hours before show); ensure other equipment only turned on during use. 	<ul style="list-style-type: none"> • <1 year 	5-7%

⁷ In some cases this level of saving may not be physically possible due to the historical or visual nature of the building. Buildings insulation would generally be undertaken as part of larger refurbishment activity

Areas for savings	Things you can do to reduce emissions	Typical payback time	% of CO ₂ savings (theatre venue)
Pre-production considerations	<ul style="list-style-type: none"> • Considerations at the pre-production stage are likely to be a pre-requisite for savings indicated elsewhere. • Use the production carbon calculator in this plan to identify the biggest contributors of your footprint, so you can work out where to take action. • Ensure that energy costs are included in the production budget; consider setting an energy cap as a challenge to the creative team. • Ensure all buildings and spaces used (including those for rehearsals and for set construction) are well managed/insulated. • Try to reduce travel wherever possible, and reduce volume of equipment transported in tours by using local partners wherever possible. • Ensure all materials are sustainably sourced. 	<ul style="list-style-type: none"> • Instant 	c.5%
Minimising travel emissions	<ul style="list-style-type: none"> • From staff: find rehearsal spaces near to production stage to avoid extra travel; encourage staff, crew and cast to use public transport; travel in low emission transport modes where possible (e.g. avoid flying within the UK). • From audiences: enhance visibility of public transport options to audiences by publicising on tickets, programmes, website; work with Oyster Plus programme to look at 2 for 1 deals (email Transport for London at marketingstrategy@tfl.gov.uk). • From suppliers: minimise frequency of deliveries to/collections from the theatre through better planning; use cycle couriers; reduce touring volumes by using trusted local partners (e.g. use local lighting rigs where possible). 	<ul style="list-style-type: none"> • Instant 	c.10%
Materials selection and disposal/recycling	<ul style="list-style-type: none"> • There are usually a number of alternative materials that could be chosen as part of the production process which would lead to an overall carbon reduction e.g. timber from sustainable sources (Forest Stewardship Council, www.fsc.org). • Reuse materials wherever possible, or implement recycling schemes, for example for: <ul style="list-style-type: none"> • sets and props • batteries (join the Mayor's battery recycling scheme, details on page 30) • lightbulbs and lamps • costumes (www.freecycle.org, www.traid.org.uk) • plastic glasses and consumables • furniture and carpets • waste electronic and electrical equipment • unused leaflets and programmes. 	<ul style="list-style-type: none"> • Instant 	Variable. Typically <1%



Areas for savings	Things you can do to reduce emissions	Typical payback time	% of CO ₂ savings (theatre venue)
Working with suppliers and partners	<ul style="list-style-type: none">• Provide recycling and energy management facilities for production companies and others using the venue, and provide this information, together with your policies, in welcome packs.• Incorporate environmental behaviour from suppliers and partners into contracts, and wherever possible create financial incentives. For example, more accurate meter measurements would enable commercial theatres to charge production companies for their specific energy usage.• Specify that production companies comply with the theatre's recycling and waste management practices and policies.	<ul style="list-style-type: none">• Instant	Variable, typically around 20%

Other formats and languages

For a large print, Braille, disc, sign language video or audio-tape version of this document, please contact us at the address below:

Public Liaison Unit

Greater London Authority
City Hall
The Queen's Walk
More London
London SE1 2AA

Telephone 020 7983 4100
Minicom **020 7983 4458**
www.london.gov.uk

You will need to supply your name, your postal address and state the format and title of the publication you require.

If you would like a summary of this document in your language, please phone the number or contact us at the address above.

Chinese

如果需要您母語版本的此文件，
請致電以下號碼或與下列地址聯絡

Vietnamese

Nếu bạn muốn có văn bản tài liệu này bằng ngôn ngữ của mình, hãy liên hệ theo số điện thoại hoặc địa chỉ dưới đây.

Greek

Αν θέλετε να αποκτήσετε αντίγραφο του παρόντος εγγράφου στη δική σας γλώσσα, παρακαλείστε να επικοινωνήσετε τηλεφωνικά στον αριθμό αυτό ή ταχυδρομικά στην παρακάτω διεύθυνση.

Turkish

Bu belgenin kendi dilinizde hazırlanmış bir nüshasını edinmek için, lütfen aşağıdaki telefon numarasını arayınız veya adrese başvurunuz.

Punjabi

ਜੇ ਤੁਹਾਨੂੰ ਇਸ ਦਸਤਾਵੇਜ਼ ਦੀ ਕਾਪੀ ਤੁਹਾਡੀ ਆਪਣੀ ਭਾਸ਼ਾ ਵਿੱਚ ਚਾਹੀਦੀ ਹੈ, ਤਾਂ ਹੇਠ ਲਿਖੇ ਨੰਬਰ 'ਤੇ ਫ਼ੋਨ ਕਰੋ ਜਾਂ ਹੇਠ ਲਿਖੇ ਪਤੇ 'ਤੇ ਰਾਬਤਾ ਕਰੋ:

Hindi

यदि आप इस दस्तावेज़ की प्रति अपनी भाषा में चाहते हैं, तो कृपया निम्नलिखित नंबर पर फोन करें अथवा नीचे दिये गये पते पर संपर्क करें

Bengali

আপনি যদি আপনার ভাষায় এই দলিলের প্রতিলিপি (কপি) চান, তা হলে নীচের ফোন নম্বরে বা ঠিকানায় অনুগ্রহ করে যোগাযোগ করুন।

Urdu

اگر آپ اس دستاویز کی نقل اپنی زبان میں چاہتے ہیں، تو براہ کرم نیچے دیئے گئے نمبر پر فون کریں یا دیئے گئے پتے پر رابطہ کریں

Arabic

إذا أردت نسخة من هذه الوثيقة بلغتك، يرجى الاتصال برقم الهاتف أو مراسلة العنوان أدناه

Gujarati

જો તમને આ દસ્તાવેજની નકલ તમારી ભાષામાં જોઈતી હોય તો, કૃપા કરી આપેલ નંબર ઉપર ફોન કરો અથવા નીચેના સરનામે સંપર્ક સાધો.

GREATER LONDON AUTHORITY

City Hall
The Queen's Walk
London SE1 2AA
www.london.gov.uk
Enquiries 020 7983 4100
Minicom 020 7983 4458

MoL/Septo8/CS D&P/MT/GLA1089 Main