Greening the Globe: Integrating Sustainability into Regional Theatre Productions and Operations

Credit: The Old Globe

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Abstract

The theatre industry is rarely discussed from a sustainability standpoint despite having significant environmental impacts, raising billions in revenue annually, and employing nearly 100,000 people in the United States alone.[1] Between energy-intense productions with considerable carbon emissions, substantial material waste, a demanding work environment with long hours, and often unfair wages, the performing arts industry has many avenues for improvement. Theatre in particular presents a fascinating case study for sustainability, as there are many avenues to considerably decrease environmental impacts without sacrificing production quality or budget. This article explores theatre's impacts on the environment and offers scalable, actionable recommendations for how theatres can "green" their productions and become more sustainable. Created in partnership with San Diego's Old Globe Theatre, the project culminates in a 100+ page guidebook full of sustainable theatre case studies and tips and tricks for turning the theatre greener, which is housed online and available in English and French. By identifying concrete strategies to reduce environmental impacts in the theatre industry, the project aims to help cut the costs and carbon emissions of regional theatre companies and ensure the artform's longevity in a warming world.

My Motivation

Growing up, I always had my nose in a book and a cat on my lap. I'd glare at anyone who even thought about tearing me away from either one — as you can imagine, I had a lot of friends.

It was *The Tempest* that started to change everything.

It sounds overdramatic, but if I hadn't seen my school's production of Shakespeare's final play when I was a second grader, I doubt I'd have found my way into theatre right when I needed it most. From the moment the stagelights first washed over me, I was hooked. I never wanted to leave the theatre, and so I didn't. The rest of my childhood and adolescence was spent among gaff tape and ghost lights as I dove wholeheartedly first into acting,

[1] Statista. 2024. "Live performance theater: total employees US 2023." Statista. https://www.statista.com/statistics/1181778/number-of-live-performance-theater-industry-employees-us/.

then into costumes, and finally into stage management, my true theatrical passion.

For me, theatre is and has always been one of the most freeing ways to break away from the worries and stressors of everyday life and step into the wonders, heartbreaks, and intimacies of a narrative brought to life before our eyes. Under the catwalks, we're encouraged to suspend our disbelief, peer through the proscenium arch, and fall headfirst into someone else's story; or, if we're on stage or backstage, we create that alternate reality.

It's an escape — a place of comfort and a willful disengagement with reality that many of us crave. Why, then, would I suggest tying in climate change, the most daunting existential crisis of our time?

I want our art to adapt to a warming world. I want to use theatre as a mechanism to combat the climate crisis, and I want the arts to not just survive, but thrive sustainably.

A lot goes into theatre-making: a lot of time, people, money, effort, and energy. Unfortunately, that means a lot comes out of theatre-making too: carbon emissions, material waste, energy waste, burnout. Once I learned about theatre's environmental impacts, I knew it would be harder to let myself fully enjoy it if I didn't at least try to do something about it and mitigate those effects.

And, I knew there were lots of ways to reduce those negative environmental impacts so we don't have to choose between performance and the planet. That's ultimately why I chose this project: I wanted to do my part to help 'green' the theatre.

Contextual Background

Being sustainable is more than just being eco-friendly — sustainability entails fair wages, social justice, and more. The Brundtland or "people-planet-profit" approach essentially views sustainability as a three-pronged approach:

environmental, social, and economic sustainability.[2] The theatre industry has far to go in achieving sustainability in all three areas.

Environment

Theatre by its very nature is a transient and always changing form. Shows at a regional theatre cycle from pre-production to performance to post-production in approximately three months, often shorter. Despite the brief lifespan of an individual production, the entire theatre-making process is a more long-term cycle of systemic consumption, production, and waste. Many to most of the major pieces used in a show — set dressings, costumes, props, etc — are created specifically for each production. Certain components can be reused, if able to be stored, but most are simply thrown away because the materials often aren't created in a way that enables their reuse. In this way, theatre truly embodies its epithet as a so-called "disposable artform," particularly as "most shows are not designed with a life beyond closing." [3]

Additionally, the performing arts are energy-intensive. Between lighting, sound, motorized rigging, and HVAC systems that all run for hours at a time, significant amounts of power are necessary to keep the stage lights on. Theatres in London alone already produce at least 50,000 tonnes of greenhouse gas emissions (GHGs) annually without including pre-production or audience travel.[4] For perspective, this is approximately equivalent to driving 125 million miles in an average gas-powered car.[5] The environmental impacts of scenery, lighting, costumes, and more will be discussed at length later in this text during their respective sections.

Society and Economy

The performing arts are not known for being particularly lucrative. Coupled with long, irregular working hours and inconsistent employment, making a

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[2] World Commission on Environment and Development. 1987. "Our Common Future: Report of the World Commission on Environment and Development." Sustainable Development Goals. https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf.

[3] Wieland, Lily. 2020. "Sustainable Theatre: How to Craft Environmentally Friendly Scenery." Lily Wieland Stage Manager. https://lilywielandsm.com/sustainable-theatre-how-to-craft-environmentally-friendly-scenery/.

[4] Greater London Authority. 2008. "Green Theatre." Greater London Authority. https://www.london.gov.uk/sites/default/files/green_theatre_summary.pdf.

[5] EdenSeven. 2022. "What does a tonne of CO2 look like?" EdenSeven. https://www.edenseven.co.uk/what-does-a-tonne-of-co2-look-like.

living in the theatre industry is difficult. Despite Actors' Equity being created over a century ago to improve working conditions and assure fair wages for actors and stage managers, many in the industry still struggle to make ends meet. In 2022, the New York Times profiled an expert costume artist and first hand who made less than $20,000 a year post-tax.[6] The same article highlighted other disheartening examples of insufficient wages for professional and full-time roles: a theatre with a $5 million budget pays an artistic assistant $26,000 annually; an assistant director of education at a Tennessee theatre rakes in $21,000 every year (pre-tax). All are below the 30th wage percentile and are significantly lower than the national average.[7]

Theatre is also physically demanding. "10 out of 12s" or where the cast is called to rehearsal for 10 hours over a 12-hour period with a two hour break. Everyone else is usually there earlier and later, meaning that the 10/12 often turns into a 13/15 or even a 14/16 in what is often already a six-day or eight-show work week. While physically exhausting, this also prevents the cast and crew from spending time with their family, which in turn often bumps up childcare costs for working parents. And, pressure to keep working through breaks "just to get by" means that "many designers and associates get stuck in a cycle of being perpetually in [technical rehearsals], particularly in 10/12s, with no time in between for the body to rest and reset."[8] Fatigue also impairs judgment, leading to more accidents and safety risks.

Additionally, high ticket costs can be economically prohibitive for low- and middle-income individuals, making the audience less diverse, impeding cultural growth, and cutting attendance. Though this stems largely from systemic issues around arts funding, ticket prices remain a barrier to accessing the theatre. According to Washington D.C.'s Mosaic Theatre, inclusivity and accessibility can be addressed through "affordable ticket

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[6] Green, Jesse. 2023. "When Paying Dues Doesn't Pay the Rent, How Does the Theater Survive? (Published 2022)." The New York Times. https://www.nytimes.com/2022/07/06/theater/pay-equity-salaries.html.
[7] OMNI Calculator. n.d. "US Income Percentile Calculator." OMNI Calculator. Accessed June 3, 2024. https://www.omnicalculator.com/finance/us-income-percentile.
[8] Stoll, Becca. 2023. "Why I Support No More 10/12s (and a cap of 12 hours a day for all workers)." SoundGirls. https://soundgirls.org/why-i-support-no-more-10-12s-and-a-cap-of-12-hours-a-day-for-all-workers/.

options, ADA-compliant physical accessibility, ASL interpretation, captioning, trigger and content warnings, and other adaptations for ability."[9]

The opportunity

Consumers are increasingly making purchasing decisions based on their values — especially younger generations. 75% of Gen Z searches for authentic brands that prioritize consumer safety and treat employees fairly.[10] Additionally, members of Gen Z are willing to pay up to 10% more for sustainable products and experiences.[11] While this stems in part from the average Gen Z-er and Millennial being more concerned about climate change than other age groups, it signals a change in consumer values as the purchasing power of younger generations skyrockets.

The theatre industry remains on the rebound from the COVID-19 pandemic but is steadily reclaiming its market share. Still, the pandemic accelerated a shift in theatrical audience demographics. Those 55 and up — the "traditional" theatregoers for decades — have been ousted from their set as the main performing arts attendees. By whom?

Younger generations.

Over half of Gen Z reports that they attend a live theatre performance at least once every few months.[12] Coupled with a growing penchant for principle-based purchases, building sustainability in the theatre industry is critical to ensure continued interest by younger generations.

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[9] Mosaic Theatre. 2022. "Why Inclusion, Diversity, Equity, and Accessibility is Vital in the Performing Arts — Mosaic Theater." Mosaic Theater. https://mosaictheater.org/blog/inclusion-diversity-equity-and-accessibility.

[10] Petro, Greg. 2021. "Gen Z Is Emerging As The Sustainability Generation." Forbes. https://www.forbes.com/sites/gregpetro/2021/04/30/gen-z-is-emerging-as-the-sustainability-generation/?sh=9226ed686995.

[11] Petro, Greg. 2021. "Gen Z Is Emerging As The Sustainability Generation." Forbes. https://www.forbes.com/sites/gregpetro/2021/04/30/gen-z-is-emerging-as-the-sustainability-generation/?sh=9226ed686995.

[12] Wilson, Laurnie. 2022. "Live Theater Attendance Statistics | Younger Audience Trends." CivicScience. https://civicscience.com/live-theaters-post-pandemic-comeback-driven-by-new-younger-audiences/.

It's not just younger generations — 87% of audience members are worried about the climate crisis, according to a 2023 survey from Indigo-Ltd that received approximately 17,500 complete responses.[13]

And, they hold their theatres to high standards, with 93% expecting organizations to make their buildings as energy efficient as possible. The same survey found that three out of four audience members believe that theatre and other cultural organizations "have a responsibility to influence society about the climate emergency."[14] Not even 20% of respondents feel that those organizations are doing enough to combat climate change or their impacts on the climate crisis.

Why theatre?

Theatre presents a particularly interesting case study for sustainability, as there are many avenues through which negative impacts can be considerably decreased without sacrificing production quality or budget. Going green can save money in the long run, ensure the longevity of your production company, and cut back on carbon emissions. And, "audiences recognize the unique power cultural organizations hold, both individually and collectively, to influence society" at all levels.[15] As the performing arts industry continues its post-pandemic rebound, opportunities to overhaul operations and practices abound, particularly when cost savings are involved.

Brief Project Overview

I conducted a sustainability audit of the Old Globe Theatre's operations and analyzed the San Diego theatre's 2024 world-premiere production, *The Age of Innocence* by Karen Zacarias, as a case study. My research culminated in three versions of a 100+ page guidebook meant to help theatre industry professionals 'green' the theatre. One version of the guidebook is aimed at the Globe in particular and a second version, which is freely available online, presents scalable and replicable recommendations that other theatres can

[13] Indigo-Ltd. 2023. "Act Green 2023." Indigo Share. https://s3-eu-west-1.amazonaws.com/supercool-indigo/Act-Green-2023-Benchmark-report-c-Indigo-Ltd.pdf.
[14] Indigo-Ltd. 2023. "Act Green 2023." Indigo Share. https://s3-eu-west-1.amazonaws.com/supercool-indigo/Act-Green-2023-Benchmark-report-c-Indigo-Ltd.pdf.
[15] Indigo-Ltd. 2023. "Act Green 2023." Indigo Share. https://s3-eu-west-1.amazonaws.com/supercool-indigo/Act-Green-2023-Benchmark-report-c-Indigo-Ltd.pdf.

implement. Additionally, I translated that version into French. An executive summary of the booklet is also available.

Methodology

I created my guidebook recommendations following a thorough literature review, quantitative data analysis, tours of the Old Globe's theatre complex and technical center, and interviews with many staff members from around the Old Globe.

Though I read a wide range of academic articles, books, resource guides, and popular articles, the following were the most impactful in shaping my project. First, Jones and Pribble's *A Practical Guide to Greener Theatre: Introduce Sustainability Into Your Productions* (2013) was an invaluable resource throughout the planning process. Additionally, as I was unable to interview a member of the Globe's costume staff, the "Costumes" chapter of my guidebook strongly relies on the text.[16] The *Sustainable Production Guide* by UK-based nonprofit Julie's Bicycle was the source of many of the case studies included in the guidebook; the *Theatre Green Book* provided much of the nitty gritty details.[17] [18]

My quantitative data came from the Old Globe. Specifically, I collected purchase logs from the set, costume, prop, and lighting departments, as well as 15 monthly electricity and gas bills for the theatre complex and technical center and other relevant data. I sorted and cross-analyzed the material data to pick out usage trends; while interesting, this didn't play a huge part in my guidebook. Then, for the energy data, I used Google Sheets to plot and graph energy usage trends and pull out patterns. Finally, I also relied on the Industry Green (IG) Tools to estimate the Old Globe's carbon footprint. The IG Tools were created by Julie's Bicycle to help the arts industry quantify their environmental impact. I only used their carbon calculator, though an entire suite of arts-targeted impact calculators is available.

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[16] Jones, Ellen E., and Jessica Pribble. 2014. A Practical Guide to Greener Theatre: Introduce Sustainability Into Your Productions. First ed. Burlington, Massachusetts: Focal Press.
[17] Julie's Bicycle. 2013. "Sustainable Production Guide." Julie's Bicycle. https://juliesbicycle.com/wp-content/uploads/2022/01/Sustainable_Production_Guide_2013.pdf.
[18] Theatre Green Book. 2021. "GREEN BOOK 1_Beta issue_b." Theatre Green Book |. https://theatregreenbook.com/wp-content/uploads/2021/03/THEATRE-GREEN-BOOK-ONE_beta1.pdf.

I collected my qualitative data through a series of interviews with Globe staff members from the Production, Sets, Technical Center, Props, Lights, Stage Management, and Front of House departments, as well as through personal observations collected during facility tours. Interviews were generally open-ended; however, all interviewees were asked about a particular production (*The Age of Innocence*, which is discussed at length later in this paper) and any particularly sustainable or unsustainable moments from their time at the Globe, in addition to department-specific questions.

I then collated and analyzed all of my data to create an outline for my guidebook. Then, I spent about two and a half weeks writing the copy for my guidebook, which added up to just over 100 pages once properly formatted and about 18,500 words. The remainder of Spring Quarter was devoted to editing the copy, writing this paper, creating the visual component of the guidebook, and developing the website on which the guidebook is hosted.

Theatre Sustainability Takeaways

The guidebook lays out an extensive list of suggestions to make theatre more sustainable. Recommendations are broken down by department (e.g. scenery, costumes, etc) for easy reference; however, many of the suggestions are applicable across departments. Below follows selected excerpts from the guidebook, which have been edited for clarity, length, and voice.

Design

Every show that is brought from page to stage starts with design. Because design is a production's starting point, designers can interweave sustainability into the heart of the production from the onset. Plus, up to 80% of a production's "environmental impacts are locked in by decisions made during design;" there's a big opportunity for improvement.[19] Sustainable design and a flawlessly executed artistic vision don't have to cancel each other out — instead, they can work in tandem with the designer at the helm.

It's both possible and necessary for designers to consider sustainability during the early stages of the design process. When a production was designed to

[19] Julie's Bicycle. 2013. "Sustainable Production Guide." Julie's Bicycle. https://juliesbicycle.com/wp-content/uploads/2022/01/Sustainable_Production_Guide_2013.pdf.

utilize recycled or previously-used items, or to be easily broken and components saved, shared, or recycled, it's easier to implement those sustainable practices than if they hadn't been considered at the start of the process.

Reducing waste starts with changing how we think about waste. Most standard production models are built on a cradle-to-grave philosophy, or one where the project has a linear lifespan. The show is created, then its component parts are tossed out. Shifting toward a cradle-to-cradle mentality transforms that value chain into a circular lifecycle, where products that end their life in one form are repurposed (and often upcycled) into another valuable product.[20] That way, materials that are still able to be reused or reclaimed don't end up in landfill.

Through sustainable design techniques, and asking questions like "How can I design for reuse and recyclability?" it's possible to minimize the materials needed to put on a stellar production.

Draw on sustainable design philosophies to help reduce waste. Organic design amplifies the "raw and authentic qualities of materials" by showcasing their unique characteristics.[21] In a theatre setting, this might involve a designer first surveying the materials available to make a set/costume/etc and then creating or adapting a design to incorporate what is already in the theatre's possession. This isn't unprecedented — in fact, organic design won the 2012 production of *Peter and the Starcatchers* a Tony Award.

Other strategies like collaborative design, backwards design, or modular design can help reduce waste.

Sets and Props

Set construction is one of the most impactful areas of the theatre on the environment. Between carbon-intensive or environmentally degrading materials, copious amounts of waste, and a potentially dangerous or hazardous work environment, sets have significant sustainability ramifications. On the flip side, this makes a theatre's sets and scenery division

[20] McDonough, William. n.d. "Cradle to Cradle." William McDonough. Accessed April 26, 2024. https://mcdonough.com/cradle-to-cradle/.
[21] Le Gris, Dan. 2022. "Organic Design: Drawing Inspiration from Nature." Dans Le Gris. https://danslegris.com/blogs/journal/organic-design.

a wonderful testing ground for integrating sustainability interventions, as small actions taken can have large cumulative effects.

Scenery comprises a significant portion of theatre's carbon footprint, though this varies significantly depending on the type of material and if it is raw, recycled, or reused.[22]

Certain materials are more sustainable than others; certain materials are cheaper than others too. Striking a balance between cost and consequence is tricky and takes time. Consider how and where materials are sourced, their future lifespan, any potential toxicity concerns, and any awarded environmental certifications.

While most agree that wood-based products are the most sustainable choices for set construction — as it comes from trees, a renewable resource — the environmental impact varies significantly based on the type of lumber used. The most commonly used types of lumber in theatre are plywood, lauan, hardboards like masonite and medium density fiberboard (MDF).

Lauan — sometimes spelled luan — unfortunately has some of the most significant environmental impacts of any lumber used in theatre. The industry suffers from poor regulation, mediocre forest management, and little to no international oversight, contributing to rampant rainforest deforestation. Replacing or reducing lauan with greener materials like recycled lumber, plywood, or certain types of engineered lumber (e.g. MDF, cork, or homasote, a cellulose-based fiber wallboard) can avoid deforestation-related impacts and toxicity concerns.[23]

Similarly, choose recycled metal whenever possible and prioritize steel over aluminum, though both metals have significantly more embodied carbon than lumber.[24] Rely heavily on water-based paint with low amounts of volatile organic compounds for color. For props and large set pieces, create a "build, pull, buy" list at the start of the construction process to make better use of what is already in stock.

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[22] Theatre Green Book. 2021. "Theatre Green Book I - School Edition." Theatre Green Book |. https://theatregreenbook.com/wp-content/uploads/2021/09/GREEN-BOOK-1_01-issue_education.pdf.

[23] Jones, Ellen E., and Jessica Pribble. 2014. A Practical Guide to Greener Theatre: Introduce Sustainability Into Your Productions. First ed. Burlington, Massachusetts: Focal Press.

[24] Forest Products Laboratory. 2010. "Wood Handbook: Wood as an Engineering Material." Forest Products Laboratory. https://www.fpl.fs.usda.gov/documnts/fplgtr/fpl_gtr190.pdf.

Locally sourced materials are more sustainable than those traveling long distances due to the carbon emissions incurred from transport. Consider contacting local schools or other regional theatres before a show has closed to see if they could make use of the set pieces.

Lastly, for theatres part of regional coalitions (e.g. the League of Resident Theatres, the California Theatre Consortium, etc), consider ways to leverage member organizations to increase sustainability. Whether this looks like sharing knowledge of sustainable practices, offering used sets or costumes for sale, hire, or swap, or even creating a shared database of resources, consortiums are an untapped resource to take advantage of.

Costumes

For many audience members, the costumes are some of the most memorable parts of a production. Costume designers and departments face different challenges regarding sustainability than other areas like scenery or lighting, as costumes aren't interchangeable from show to show like a simple flat or a lighting instrument could be — they must be tailored to each unique actor for every show.

As a general rule of thumb, creating designs that can reuse and upcycle existing garments from stock and repurpose off-cuts or fabrics from the workshop are great ways to lessen the environmental impact. For instance, raw material usage and the associated costs can be cut back by considering from the get-go how many functions any one garment can serve. This can help cut the number of costume pieces that must be made or procured.

Much of the knowledge base across a theatre is contained in the people. However, when a staff member retires, leaves for vacation or an injury, or moves to a different theatre, the department can be left in disarray without access to key information. It's possible to avoid this situation with a bit of foresight and work on the front-end.

Creating a regularly updated, comprehensive database of stock costume pieces is a valuable way to improve knowledge sharing throughout the costume department (and other departments, for that matter).

Externally, it can serve as a resource to be shared with costume designers who may not be in the local area or are unable to search through the stock themselves. Internally, a database is extremely useful for onboarding new employees and safeguarding the department's functionality when a long-term staff member moves on.

Plus, because a database enables quick review of stock rather than an intense search that can take hours, it can help improve overall productivity and allow time to be used for other projects.

Still, sustainable costume construction can be difficult due to the environmental impacts associated with many commonly used materials. The clothing industry produces a ridiculous amount of waste, emits significant carbon emissions, and uses over 24 trillion gallons of water annually, which could meet the needs of five million people.[25]

Few textiles are truly sustainable; still, some options are better than others. Whenever possible, avoid polyester and use rayon sparingly. Organic cotton, though more expensive, is much less environmentally degrading and less risky for human health than cotton sprayed liberally with pesticides.[26] Seek out textiles with environmental certifications. Additionally, spend a little extra time on the front-end of a project to prevent wasted dye, water, and fabric — be sure to analyze the fabric type and choose a dye accordingly.

When purchasing fabrics, it can be difficult to determine how sustainable the fabric actually is. Sustainable textile certification programs, while not perfect, can help provide some guidance — the Global Organic Textile Standard, Global Recycling Standard, and OEKO-TEX Standards 100 and 1000 are great starting points.

Various alteration techniques exist that can make it easier for a garment to be reused in the future by another actor.[27] However, consider the costume

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[25] Geneva Environment Network. 2024. "Environmental Sustainability in the Fashion Industry – Geneva Environment Network." Geneva Environment Network. https://www.genevaenvironmentnetwork.org/resources/updates/sustainable-fashion/.
[26] Jones, Ellen E., and Jessica Pribble. 2014. A Practical Guide to Greener Theatre: Introduce Sustainability Into Your Productions. First ed. Burlington, Massachusetts: Focal Press.
[27] Jones, Ellen E., and Jessica Pribble. 2014. A Practical Guide to Greener Theatre: Introduce Sustainability Into Your Productions. First ed. Burlington, Massachusetts: Focal Press.

piece's potential for reuse and then decide if the alteration is worth the time and effort. Costume builders will often purchase a wide range of clothing items — sometimes dozens of outfits — to create 'closets' for particular characters and actors. Buying from second-hand stores or thrift shops and local shops is more sustainable than purchasing clothing online, as there are fewer embodied emissions from transport and production.

Only so many costume pieces can be saved in stock after a show ends. Generally, prioritize saving items from commonly portrayed time periods and those that are easily alterable. Additionally, be sure that costumes pulled from stock are returned to stock — for reuse to be effective, it should happen on both ends of the production process.

For theatres with significant storage space, renting out costume pieces to other regional theatres or local high schools can be a beneficial secondary source of income and can temporarily open up room in stock. For those with little storage space, consider donating used costumes to schools, universities, or other theatres rather than throwing them away. Online platforms can also be leveraged to offer costume stock to those not in the region.

Lights

Of any theatrical department, lighting may have the most challenges to overcome. Lighting can use a lot of energy and makes up a large portion of any individual production's environmental impact. Annually, nearly 10% of an average theatre's overall energy use comes from lighting — that figure is often higher.[28] While 10% might not sound like much, it becomes more impactful when considering everything else that uses electricity in a theatre, particularly those that have on-site costume or prop shops or technical centers. Keeping the lights on requires a lot of electricity — and it's not cheap for a theatre's wallet or its carbon budget.

Less renewable energy is available at night, whether from the grid or from on-site sources like solar panels. As a result, a higher percentage of fossil-powered electricity flows through the grid during evening hours, even for those enrolled in community choice aggregation programs (CCAs) that

[28] Julie's Bicycle. 2013. "Sustainable Production Guide." Julie's Bicycle. https://juliesbicycle.com/wp-content/uploads/2022/01/Sustainable_Production_Guide_2013.pdf.

provide renewable power. The evening hours of 4 - 9 pm are also when demand for electricity spikes and drives the cost up. Even though demand falls after 9 pm and costs shift into off-peak, the fossil fuel to renewable power ratio remains the same.

Most performances occur at night; while one or two matinees may show each week, five to seven evening performances show weekly depending on the theatre. The fossil-based electricity bumps up the overall GHG emissions. Energy use interventions are possible — and they can save costs and carbon.

While many of the most effective interventions are technology-based, altering certain design practices can have significant impacts. Replacing traditional incandescent bulbs with LEDs or other energy-efficient lighting can save thousands of dollars and kilowatt-hours (kWh) annually. Incandescent bulbs use energy inefficiently, as over 90% of the power consumed is lost as heat.[29] LEDs use up to 90% less energy than incandescent bulbs and can last up to 50,000 hours.[30] Plus, they produce far less heat, which cuts down on cooling needs.

Still, though it is steadily getting easier, replicating the exact colors and temperatures provided by incandescent bulbs using LEDs is difficult. Temperature — that is, how warm- or cool-toned the light is — provokes emotional responses from the audience. Particularly with incandescent bulbs, Jones and Pribble write, “we are accustomed to seeing the light moving into an even warmer range as power to the unit is decreased to dim the light.”[31]

From a technological standpoint, measuring energy use and managing cues are two of the most important interventions. Additionally, there are many easy behavioral interventions that can reduce energy usage and save costs. For theatres with warm-up routines, reducing the warm up time of light rigs and creating routines for turning light rigs on and off are both small changes that can have a big pay-off.

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[29] Jones, Ellen E., and Jessica Pribble. 2014. A Practical Guide to Greener Theatre: Introduce Sustainability Into Your Productions. First ed. Burlington, Massachusetts: Focal Press.
[30] Department of Energy. n.d. “Lighting Choices to Save You Money.” Department of Energy. Accessed April 26, 2024. https://www.energy.gov/energysaver/lighting-choices-save-you-money.
[31] Jones, Ellen E., and Jessica Pribble. 2014. A Practical Guide to Greener Theatre: Introduce Sustainability Into Your Productions. First ed. Burlington, Massachusetts: Focal Press.

Stage Management and Front of House

Stage managers truly have a finger in every pie of the theatre — they help the production go off without a hitch. Most of the environmental impacts remain in the departments themselves, however. Still, here's a few suggestions for ways that the stage management team can help cut back on waste throughout the production process while also making their jobs a little bit easier.

Rather than posting paper rehearsal agendas throughout the rehearsal space, daily schedules, rehearsal reports, and directorial notes can be shared via email every day. Additionally, beginning-of-rehearsal / actor packets can be shared digitally before the first rehearsal.

Scriptation, a script annotation program, can be used to keep track of blocking and notes digitally. The program makes it easy to track changes, add or delete pages of the script, and import PDFs. Plus, rehearsals (and especially tech week) can be simplified by features that can act like digital sticky flags, can automatically add facing pages for ease of blocking, and can bookmark pages.

Largely, the front of house (FOH) impacts come from patrons; these will not be discussed at length. Still, there are ways to improve the sustainability of audience-facing operations — the most impactful of which has to do with the playbills.

Plenty of audience members choose to keep playbills as souvenirs. But, many don't; programs are often left in the theatres or tossed in the trash. When making pre- or post-show announcements, add a brief note to the tune of "Please leave your programs on one of the marked podia after the show if you do not wish to keep it." Additionally, make recycling bins prominently available. Many of the programs left on the podia could be reused for another show. Encourage ushers to spend an extra couple of minutes sifting through playbills to see which ones are of good enough quality to be reused.

Case Study: San Diego's Old Globe Theatre

The Old Globe Theatre in San Diego, California, is one of America's leading regional theatres and is approaching its 90-year anniversary. Built in 1935 as

part of the California Pacific International Exposition, the Globe presents 15-17 productions annually across its three-theatre complex.

Known for premiering shows ranging from *Into the Woods* to *Damn Yankees* to *Dr. Seuss' How the Grinch Stole Christmas*, the Globe has sent over 20 productions to Broadway and won 13 Tony Awards, including the 1984 Tony Award for Outstanding Regional Theatre.

I caught up with staff members from around the Globe to learn more about some of the theatre's sustainability challenges and successes. Following two short highlights is a more in-depth look at the Globe's recent production of *The Age of Innocence*, a world-premiere adaptation of Edith Wharton's novel of the same name and an analysis of the theatre's energy usage.

El Borracho

El Borracho, a show following a dying alcoholic reuniting with his ex-wife and son during his final months, premiered at the Globe in 2022. Part of the set required large quantities of glass alcohol bottles to create a 'moat' around the edges of the stage. Rather than purchasing lots of new glass bottles, the Globe partnered with many of the local bars and restaurants within and around Balboa Park — the cultural park where the Globe resides — to collect their empty bottles. In total, the production used 3,778 pre-used beer and alcohol bottles.

Essentially, members of the prop team would go around to the various bars and collect the used bottles each morning. The bottles would then be intensively cleaned before being put into the moat, which made up a significant part of the scenery. After the show, the bottles were taken directly to the recycling center. By the end of the bottles' useful life, "they'd gone from gross to art and now to recycling," said David Buess, the assistant properties director.

Tech Center Solar

Aside from the three-theatre complex, the Globe also operates a 40,000 square foot technical center that houses a full-fledged construction workshop, thousands of square footage of costume, prop, and furniture storage space, and office space.

Late in 2023, 172 solar panels were installed on the roof of the technical center and can produce over 100 kilowatts of electricity under ideal weather conditions. Since the array was installed in December, electricity purchased from the grid has fallen an average of 34% per month and cut the average monthly power bill by 75% compared to 2023.

And, from a financial standpoint, the project pencils out — over the next 15 years, the solar panels are expected to save the theatre $2 million in energy costs.

The Age of Innocence

The Age of Innocence ran at the Globe between February 8 and March 10, 2024; the world-premiere play was written by award-winning playwright Karen Zacarias. Based on Edith Wharton's classic novel of the same name, *Age* transports us to 1870s New York City and enraptures us with a glamorous tale of love affairs gone wrong set against a high society backdrop.

Being a world-premiere and a show of 'typical' size for the Globe, *The Age of Innocence* is intriguing from a sustainability point of view. The majority of the materials were created bespoke for this production; however, budget constraints also came into play.

The set was rather minimalistic, consisting mainly of a table and chairs pulled from stock, benches purchased and reupholstered, and a crystal chandelier handmade by the prop department. After the show closed, everything went into stock and will be reused.

"The hope now is that we can keep them clean," said Buess with a laugh. "Now that we've made this many beautiful, white upholstered chairs, figuring out how to keep them clean in stock is going to be our next challenge."

Instead of scenery, a 450-light rig and intricate costumes were used to transport the audience back to the Gilded Age. Stevie O'Brian Agnew, the Globe's Lighting Director, explained that it's usually difficult to reuse a light rig for another show because of labor costs and how different one show is from the next. For *Age*, however, many of the lighting materials were reused.

“We were able to reuse a lot of our LED tape for the next show,” he added. “Typically, that just gets thrown away because every designer wants a different kind of tape, but we’re starting to build out our inventory and stock.”

Still, lighting can’t do everything — sometimes, you need snow. Katie Lugo, the Front of House manager explained that typically, the Globe uses sudsing bubbles to create snow on stage. *Age* required something that looked a little bit more delicate and fine. The designer opted for a plastic-based shredded material.

In this case, artistic vision took precedence over sustainability. That’s okay, sometimes. The amount of waste created from the plastic was minimal, particularly when considered in the context of the production’s simple set pieces and small amount of waste. Even so, by reusing the shreds for multiple performances, the impact was lessened.

Energy Usage

I calculated the Globe’s energy usage by utilizing electricity data from December 2022 to March 2024.

Over the last year and a half, the proportion of on-peak power usage to off-peak and super off-peak has stayed approximately the same. About 27% of energy is used during on-peak hours — defined here as between 4 pm - 9 pm — with 46% being used during off-peak times (6 am - 4 pm and 9 pm - midnight) and about 27% used during super off-peak hours (midnight - 6 am).

While there was a slight upward trend in energy usage during off-peak and on-peak hours with a small drop during super off-peak hours, it is not possible to determine the statistical significance of these trends with only a year’s worth of electrical data. Multi-year data would be required and more granular data (e.g. hourly or weekly usage) would be valuable to provide more detailed insights.

However, even from the 15 studied pay periods, the data shows clear seasonality. Highest energy usage was consistently during the warmest months of the year and can be largely attributed to air conditioning.

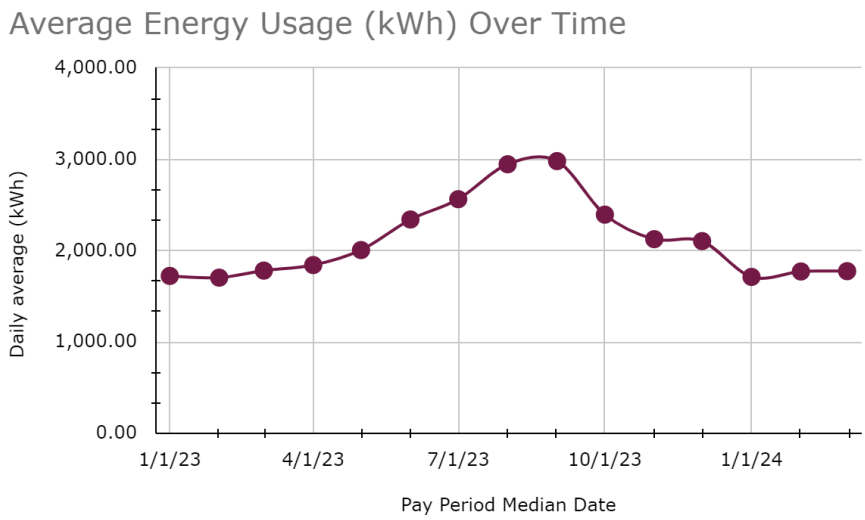

Figure 1: Average energy use (kWh) per pay period; data stretches from January 2024 - March 2024

The largest percentage of monthly on-peak energy usage — just under 30% of the energy used — also occurred during the summer, though the percentage never varied more than five percent. Off-peak versus super off-peak energy usage were more variable, with off-peak usage ranging between 33 and 52% of the total monthly usage and super-off peak ranging between 22 and 40%.

From an environmental perspective, analysis using the Creative Climate Tools carbon calculator found that the main theatre complex's annual gas and electricity usage created approximately 327,000 kilograms (or 327 metric tons) of carbon dioxide equivalent emissions. This is equivalent to burning 360,379 pounds of coal or driving 836,325 miles in a gasoline-powered vehicle.[32]

And this doesn't take into account the emissions from heating, water, waste, or audience travel. The true emissions count is significantly higher than could be adequately measured with the limited data available.

Why it matters

Energy consumed during peak hours is more expensive than that consumed at other times. And, costs per kilowatt-hour (kWh) go up during the summer

[32] Environmental Protection Agency. 2024. "Greenhouse Gas Equivalencies Calculator | US EPA." Environmental Protection Agency. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

because of higher electricity demand stemming largely from air conditioning. Though particular rates change throughout the year, on-peak rates are also highest during the summer — the highest usage hours coincide with many of the hottest hours of the day. Additionally, as on-peak hours start around the same time as when renewable energy production tapers off for the day, every electron drawn from the grid will be dirtier than one drawn at a different time.

In 2023, **the Globe spent over twice as much money** on monthly electricity costs in July, August, and September than it did in January and February of the same year, as well as January, February, and March of 2024. On-peak energy usage was above average for each of the most expensive months.

Conclusion

Theatre presents a unique opportunity for greening the arts, as it is not only commonly viewed through an environmental lens, but also has many seemingly small solutions that can make a large impact. Going green can save money in the long run, ensure the longevity of production companies, and cut back on carbon emissions.

From a design perspective, integrate sustainability into a production by creating designs that utilize recycled or previously-used items, or that can be easily broken down into component parts that can be saved, shared, or recycled. Draw on strategies like organic design, collaborative design, backwards design, or modular design to help reduce waste.

Sets and props can be made less impactful by opting for recycled materials over virgin materials, those with less embodied carbon, and low-toxicity materials. Creating a “build, pull, buy” list at the start of the construction process can help make better use of stock items. Additionally, choose locally sourced materials over those that must travel long distances.

For costumes, prioritize designs that reuse and upcycle existing garments from stock or that can repurpose off-cuts or fabrics from the workshop. And, creating a regularly updated, comprehensive database of stock costume pieces is a valuable way to improve knowledge sharing. Rely on organic textiles when possible, and avoid polyester and rayon as much as possible, and integrate alteration techniques into costume construction to encourage easy reuse.

Replace traditional incandescent bulbs with LEDs or other energy-efficient lighting to save costs and carbon, as well as reducing air conditioning needs. Consider measuring energy use and managing cues, as well as reducing light rig warm-up time and creating turn on-turn off routines.

For stage managers, transition to digital notetaking, information sharing, and blocking using programs like Scriptation rather than paper-based practices. Reduce the number of paper playbills by making digital copies available and encouraging the audience members to leave their used programs in a selected location so that they can be reused.

Regarding energy load, consider shifting times of maximum energy usage (e.g. performances or other energy-intensive activities) from on-peak to off-peak hours as a way to save costs and carbon emissions. Even if only done with one performance a week, during a certain time of year, or with non-performance high energy loads like carpet cleaning, this can have a significant impact.

Lastly, when economically feasible, consider installing solar panels or a hybrid solar and storage system at the main theatre campus. Though costly up front, it is made less so via numerous state and federal programs, such as those laid out under the Inflation Reduction Act that can help reduce tax liability and/or provide per-kilowatt-hour tax credits.[33]

Adding in the storage element will be particularly impactful from economic and environmental standpoints, as it would enable theatres to save up excess renewable energy and then utilize it to power productions during on-peak hours that would otherwise draw significant amounts of expensive, dirty energy from the grid. The project would also be beneficial from a marketing perspective — few other theatres can say their productions run on renewables; fewer still can let the audience see for themselves.

By taking concrete steps toward reducing theatre's environmental impact, the performing arts industry can improve its sustainability and ensure its longevity for years to come.

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Capstone Advisory Committee

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Members:

- Ben Thoron, MFA, Production Manager at the Old Globe
- Josh Garrett, MPA, CEO of Redwood Climate Communications
- Rishika Mehrishi, Ph.D., Assistant Professor, Theatre and Dance at UC San Diego

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