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# Introducing Behavioral Wedges and Nudging Into the Production Process to Reduce CO2

## *Frontløberne* and the First Attempt to Create a CO2 Neutral Production in Denmark

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**ABSTRACT**

In January 2020, two actors in Denmark started an association, *Bæredygtig Scenekunst NU* (BS NU), dedicated to making theatre environmentally sustainable. Six weeks later, the country closed down due to COVID-19, and theatres closed. A few weeks later, Jacob Teglgaard from BS NU and Anne Gry Henningsen, Artistic Director of Mærkværk agreed that the play *Frontløberne* would be BS NU's pilot project and proof of concept to test the policies and procedures BS NU hoped to eventually institute throughout the performing arts industry in Denmark. BS NU introduced behavioral wedges in the forms of an Environmental Policy, an Environmental Action Plan, and monitoring into the production process with the goal of nudging behavior to reduce emissions. In light of these behavioral wedges, this article will examine BS NU and Mærkværk's journey of sustainability, the steps taken to create a sustainable production, elaborate the successes and failures of the process, and, most importantly, create a baseline CO2 figure for the production. Furthermore, it will discuss whether the behavioral wedges and nudging have led to shifting mindsets and long term behavioral changes that reduce CO2 emissions in theatrical production processes at Mærkværk.

**KEYWORDS**
Sustainability, green theatre, sustainable theatre, bæredygtig scenekunst NU, mærkværk, sustainable production practices, pehavioral wedge, nudging

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# Introducing Behavioral Wedges and Nudging Into the Production Process to Reduce CO2

## *Frontløberne* and the First Attempt to Create a CO2 Neutral Production in Denmark

**Introduction**

In her *What is Scenography?* from 2009, Pamela Howard, researcher and scenographer, noted the unsustainability of theatrical production practices stating, "Scenographers…have a responsibility in these times to address the problems of today and to fuel change and alternatives, to the way our practice has continued since the middle of the last century. Can we really justify the huge amounts of public or private money spent on materials that, once used, become no more than unrecyclable junk?"[1] The answer is no; we can not justify it. The basic premise of *make it, use it, junk it* needs to be addressed and the mindset changed in light of an ever-worsening global climate situation.

In January 2020, two Danish actors, Jacob Teglgaard and Christian Gade, started an association, Bæredygtig Scenekunst NU[2] [Sustainable Performing Arts NOW] (BS NU), aimed at changing the make it, use it, junk it mindset to make theatre environmentally sustainable in Denmark. Six weeks after their initial general meeting, COVID-19 hit Denmark, and the country and theatres closed. (Most of BS NU's early ambitions working with larger theatres were halted because of the pandemic.). A few weeks later, while small gatherings were permitted, the theatre company, Mærkværk, and its Artistic Director Anne Gry Henningsen took up the challenge to make the play *Frontløberne: En activist klimafortælling* [The Front Runners: An activist climate story] CO2 neutral. She also agreed to *Frontløberne* being used as BS NU's pilot project and proof of concept to test the policies and procedures BS NU hoped to eventually institute throughout the performing arts industry in Denmark. Mærkværk is a Copenhagen based youth theater project whose economic viability is dependent on receiving grants from foundations and the state. Mærkværk does not have its own theatre, so it rents performance space.

From the beginning, the idea of creating the first CO2 neutral[3] production in Denmark became the major production parameter of *Frontløberne*. According to Mærkværk's website, "It's no secret that *Frontløberne* is activist theater with a clear and direct message… But as the work to understand the seriousness of climate change and the performance progressed, it became clear to us how necessary it is to use all means, including the theatre's. If we as humans are to have the opportunity to inhabit the earth in the long term, we ourselves had to become frontrunners in the climate fight."[4] As the play itself was about climate activism, it was not only logical but also necessary to create as sustainable a production as possible. On 30 September 2020, *Frontløberne* opened at Teater Grob in Copenhagen and closed on 9 October 2020. The *Frontløberne* team committed to making environmentally sustainable decisions in

1 Howard 2009, 222.

2 Bæredygtig Scenekunst NU took its inspiration from the British organization Julie's Bicycle https://juliesbicycle.com/

3 Environmental sustainability encompasses many different areas such as water, pollution, air quality, deforestation, etc. For this production, the focus was on reducing CO2 emissions.

4 *Frontløberne: En Aktivist Klimaforteælling.* Mærkværk.

the front of house, backstage, and onstage activities that would not compromise the creative and artistic quality of the piece, and it worked with BS NU and the author to help it navigate the complex issues involved in creating sustainable theatre. The *Frontløberne* team consisted of twelve people, two actors onstage, and ten people working backstage and front of house.

**Literature review and theoretical framing**

The history of sustainability in theatrical productions is relatively short, and there is not a great deal of literature on the subject. Due to limited space, this review is not exhaustive. The extant literature generally falls into two distinct categories: geared toward practitioners and the more limited academic/practice based.[5] The practitioner-oriented texts include one of the first books on the subject, Larry Fried and Theresa J. May's 1992 *Greening up our houses: A guide to more ecologically sound theatre*. It examined "the business of theatre…for the environmental impact of its operations."[6] Despite a resurgence of environmental consciousness in the 1990s, the book did not revolutionize production practices. Ellen Jones wrote a how-to book entitled, *A practical guide to greener theatre: Introduce sustainability into your productions* in 2014. Like Fried and May's book, Jones' book covers the entire business of theatre, front of house, onstage and backstage, and gives practical advice on how to produce more sustainable theatre. Both of these texts are essentially reference books for theatre practitioners and were consulted during *Frontløberne*'s production process.

In 2008, two interest groups from Broadway and London independently launched campaigns to reduce the environmental impact of the performing arts and, thus, are geared toward practitioners: Broadway's Green Alliance campaign and The Mayor of London's Green Theatre Plan. Both have implemented sustainable reforms on Broadway and in London. Broadway's Green Alliance's website contains a wealth of practical information and tools for implementing sustainable practices throughout the theatre. Other organizations have websites that deal with sustainability in theatre, and they offer carbon calculating tools, case studies, and seminars to help practitioners green the industry.[7]

There have been occasional articles in trade magazines for theatre professionals and other interested parties. In *American theatre* from 2008, there was "Mike Lawler on theatre and sustainability," and Christopher Kompanek's 2012 article looked into set designer Donyale Werle's use of sustainability in her designs. Mike Lawler also has the *Ecotheater* blog. Additionally from the publisher of *American theatre*, Theatre Communication Group, is an essay by Jem Pickard, "On Eco-Theatre" in *Innovations in five acts* from 2015 where he attempts, among other things, to define eco-theatre. In *Lighting & sound America,* November 2014, Katie Oman's article "Stage lighting and the environment" was a yearlong study that gathered data "that would help inform environmental decision-making about stage lighting."[8] In their 2013 article, "Theatre design & production reimagined: Four principles for a sustainable future" in the magazine *Theater design and technology*, Paul Brunner and Michael Mehler, both theatre practitioners, wrote, "A common comment heard among those advocating for more sustainable theatre practices is that we are many years behind other industries in these endeavors."[9] Many people in the industry have clear ideas of how to produce more environmentally friendly theatre, but these ideas are not necessarily taken in to wide-scale use.

In the academic literature, Wendy Arons and Theresa J. May's 2012 *Readings in performance and ecology* is one of the few academic texts on the subject. The fifth chapter "Case studies in green theatre" and two of its articles are of particular interest. These articles are Ian Garrett's "Theatrical production's carbon footprint," Justin A. Miller's "The labor of greening Love's Labour's Lost." Both of these articles deal specifically with issues of sustainability in theatrical

5 This review is not exhaustive given the limitation of this article's length.

6 Fried & May 1994, back cover.

7 https://www.broadwaygreen.com, https://www.sustainabletheatre.org, http://www.sustainablepractice.org, Encompasses all art not just theatre, https://www.bushtheatre.co.uk/about-us/environmental-sustainability, http://www.theatrecrafts.com/pages/home/topics/sustainability, https://ecotheater.wordpress.com, Mike Lawler's blog, https://ecoscenography.com, https://juliesbicycle.com

8 Oman 2014, 108.

9 Brunner & Mehler 2013.

practice, the obstacles involved, and ways to overcome them. While they are informative and potentially inspiring, all productions face different issues. There is no one size fits all when it comes to sustainable theatrical production practices.

Another prominent practice based researcher is the scenographer and academic Tanja Beer. She has published several articles on sustainable theatre practices: "An introduction to ecological design for the performing arts" from 2013, "The Living Stage: A case study in ecoscenography" from 2015, "Ecomaterialism in scenography" and "Reimagining the ruins of scenography" in 2016, "Saved from the Scrapheap" in 2017, and with Dominique Hes "Sustainability in Production: Exploring eco-creativity within the parameters of conventional theatre" from 2017. She was also the special editor of the most recent issue of *Theatre and performance design* published in December 2021 that dealt with ecological design in scenography, and she wrote the article for "Regenerative inspiration for ecoscenography" for the issue. Lastly, her book *Ecoscenography: An introduction to ecological design for performance* came out in 2021. All her inquiries are done in practice-led research where she integrates the eco-efficiencies of reduce, reuse, and recycle into her creative process and advocates for exploring and demonstrating opportunities for sustainable practice. The *Frontløberne* team also worked from this reduce, reuse, recycle premise, but also included a fourth R: repurpose. Beer promotes a "new philosophy for theatre production that promotes ecological, holistic, interconnected and symbiotic practices," targeted at scenographic design paradigms.[10] She also laments that "the environmental impacts of theatrical design are yet to be adequately and widely documented…."[11] This case study on *Frontløberne* aims to document and quantify some of these theatrical environmental impacts to establish a CO2 baseline for Mærkværk that includes front-of-house, backstage, and onstage activities.

The *Frontløberne* teams' sustainable journey will be framed using the concept of behavioral wedges and nudging. Behavioral wedges are discussed in Dietz, Gardner, Gilligan, and Vendenbergh's 2009 article in the *Proceedings of the national academy of science*. Their research deals with the idea that household behavior can make a substantial difference in reducing greenhouse gas emissions. Their focus was on short-term options with "substantial potential for carbon emissions reduction" through using "behaviorally oriented policies and interventions."[12] According to them, "This potential 'behavioral wedge' can reduce emissions much more quickly than other kinds of changes and deserves explicit consideration as part of climate policy."[13] Another way to influence sustainable behavior without changing people's values is through nudging. The idea of nudging is to help people, in this case, theatre practitioners, make decisions around the process of creating theatre that are better for the environment.[14] These behavioral wedges and nudging function on two levels. First, they get people to rethink personal patterns of use in daily life/work life. On a deeper level, BS NU wants theatre practitioners to question the choices they make in creating theatre. What artistic choices are being made? What are the drivers in these choices, and how can these choices be more sustainable?

The environmental impact of theatre, its front-of-house, backstage and onstage activities, is not well researched. Paradigm shifts can not occur until baseline figures are established. This case study examines *Frontløberne's* sustainable journey, and the steps taken to create an environmentally sustainable production. Furthermore, it will elaborate the successes and failures of the process and create a baseline CO2 figure for the production. Looking at *Frøntløberne* through the lens of the behavioral wedges and nudging that BS NU introduced into the production process, the question is how did the behavioral wedges and nudging lead to shifting mindsets and ultimately changing behavior that over time will reduce carbon emissions and make future productions more sustainable?

**Defining the aims: Three behavioral wedges/nudges**

The first behavioral wedge BS NU introduced was an Environmental Policy. BS NU posits

10 Beer 2021, 2.
11 op. cit., 3.
12 Dietz et al. 2009, 18452.
13 Ibid.
14 Mont et al. 2014, 6.

that involving the production team in agreed sustainability goals and actions will lead to better outcomes in reaching the set goals.[15] An environmental policy nudges people to make better sustainable decisions. Furthermore, BS NU believes the best environmental policies are realistic and reflect the production conditions and the team's common commitment. The environmental policy must be adapted to both the production and the people involved with the production, so the first step of Mærkværk's sustainable theatre journey was to define the environmental policy for *Frontløberne*. The second behavioral wedge was to develop an Environmental Action Plan, and the last behavioral wedge was to monitor the production to develop a CO2 baseline. On 30 April 2020, Anne Gry Henningsen met with Jacob Teglgaard from BS NU and Whitney Byrn from Copenhagen Business School (CBS) to develop the environmental policy and the environmental action plan for *Frontløberne*. The environmental policy had five main objectives although only four will be included.[16]

**Part 1: The environmental policy**

1. Establish a baseline for Mærkværk's current environmental situation

Mærkværk had little idea of its environmental impact, so it was important to establish an environmental baseline for future comparison. Different forms of data were collected throughout the production process. These data were used to calculate Mærkværk's baseline figure. Additionally, semi-structured interviews were conducted with the personnel to determine individual attitudes towards theatre sustainability and personal sustainability habits.

2. Acquire knowledge about theatre and the environment

Throughout the process, the team worked at generating new knowledge at the intersection of sustainable theatre and environmental sustainability. When a course of action was not clear, the team would refer the specific dilemma to the author who would investigate the options available and present them, so a more informed decision could be made.

3. Reduce the use of paper

The production team wanted to reduce the use of paper as much as possible both in the front-of-house activities, such as marketing, ticketing, and advertising, and through the rehearsal process. As devised theatre, new scripts are normally printed for each rehearsal. The team wanted to reduce and/or stop this practice.

4. Reduce the impact of theatre production on the environment

As a general principle, the *Frontløberne* production team agreed to adhere to the 4 Rs: Reduce, Recycle,[17] Repurpose, Reuse, as much as possible to minimize the carbon footprint of the production. Additionally, there was a general desire to reduce transportation related to production processes.

The environmental policy was written in broad strokes focusing on general areas where nudging could lead to better, more sustainable decisions being made. Mærkværk tailored its environmental policy to reflect *Frontløberne's* specific production conditions and the team members' common commitment.

**Part 2: The environmental action plan**

From the four objectives in the environmental policy, the second behavioral wedge was introduced when an Environmental Action Plan was developed. This plan included concrete targets and actions to reach the goal of producing a CO2 neutral production. There were eight[18] clearly defined target headings with fourteen action subheadings. Julie's Bicycle advises, "Where possible set SMART - Specific, Measurable, Attainable, Relevant and Timely - objectives and targets, backed up by clear actions, responsibilities, deadlines etc."[19] Individual team members

15 BS NU 2020, 7.

16 The fifth objective dealt with optimization of the tour. All of Mærkværk's productions tour, but due to COVID19 restrictions and delays, this portion of the environmental policy will not be included.

17 It should be noted that recycle is the least desirable of the Rs because it is the only one that requires more energy. In the recycling process, energy is used to unmake and remake objects, so the recycling process is not environmentally neutral.

18 The tour target and action subheadings have been omitted for this article.

19 Julie's Bicycle 2017.

taking responsibility for individual actions leads to better outcomes.[20] These concrete actions help change mindsets and ultimately change patterns of behavior that will lead to reductions in CO2. Dietz et al. divide the household behaviors into five categories: Weatherization (W), Equipment (E), Maintenance (M), Equipment Adjustments (A), and Daily Use Behavior (D).[21] As Mærkværk does not have its own theatre space and, instead, rents a performance venue, weatherization and maintenance do not apply, but the other categories can be adapted for theatrical use. The following will show the specifics of the environmental action plan and the type of behavioral wedge to which each relates.

The eight targets set for *Frontløberne* were:
Reducing and sorting trash D
Introduce recycling and sorting of trash in the rehearsal space
Establish a box for the reuse of used paper before being recycled
Personnel D
No plastic bottles, bags, or single use plastics in the rehearsal space
Meatless lunches in the rehearsal space
Paperless production D
Minimize the use of paper in conjunction with developing the script and marketing material. Paper should be from recycled or sustainable sources.
Self -produced electricity on stage E
Install a bicycle on the stage that can produce electricity
Lighting E, A
Research alternative electrical sources/ generate own electricity on the stage
Calculate energy use for lighting and sound equipment.
Reduce electricity use A
Turn off computers, lights, printers, lights, etc. when not in use
Scenography D, A
Reuse existing scenography
New re-used material should be from sustainable sources
Reduce the weight of the set in relation to the tour
All costumes should be reused or from sustainable sources D
Use the 4 Rs of reuse, reduce, recycle, repurpose as a frame for making or procuring costumes.

A little over half of the objectives and targets fall within daily use behavior where nudging shows good results and leads people to better choices.[22] However, daily use behavior for the theatre designers entails much more than simply turning off the lights. Here, fundamental changes in how they create theatre needed to be considered. When these objectives and targets were presented to the *Frontløberne* team members, they opted to expand these original targets to include switching to oat milk from dairy milk for the ever-present rehearsal coffee, which falls under the D category. When an organization has the ability to decide aspects of consumption, nudging works.[23] Here, the behavioral wedge could already be seen to have had a nudging effect on the team that resulted in a more sustainable decision.

**Part 3: Monitoring**

The last component necessary to develop a baseline CO2 figure for *Frontløberne* was monitoring the production process, which is the last behavioral wedge. Rigorous monitoring of the targets is essential to developing a realistic knowledge base and determining a baseline for the production. Every point in the environmental action plan was assigned to a specific person who took responsibility for monitoring it. Taking responsibility for monitoring encourages active participation in the process, makes people more cognizant of their impact, and leads to better

20 BS NU 2020, 7.
21 Dietz et al. 2009, 18454.
22 Mont et al. 2014, 14.
23 Ibid., 52.

results. The author determined what data to collect. Each person was given information on the data needed and how the data should be collected. At the end of the production, the data were sent to the author who analyzed them and made calculations.

**Discussion**

The following section will discuss how the individual aspects of the Environmental Policy and the Environmental Action plan manifested themselves during the production process.

**Reducing and sorting trash**

Receptacles were placed in the rehearsal space, so that trash could be sorted into plastics, organic, paper for re-use and eventual recycling, and ordinary trash to change daily use behavior. As far as possible, the team committed to avoiding single use plastic packaging in the rehearsal space. However, it was not always possible. One morning, Jacob Teglgaard was late for rehearsal and had not eaten. He bought a container of yogurt, which sparked a dilemma for him; he related: ”How can I avoid this plastic thing? Well, then I have to change something that’s deeper. It’s habits… So…it’s deeper. This is a holistic way of thinking. Like, okay, I need to change something. And this [yogurt container] suddenly becomes a symbol of that. So, it really awakens my mind, and I hope this will do it for everybody in this production because it becomes something that is a collective teamwork… Instead of fuck we’re polluting. Because I don’t think that you can create a theatre production without any pollution. I don’t think it’s possible. ... So, in a way, it’s instead of, you know, guilt, guilt, guilt, it’s more like, how can we make it better?”[24]

His realization is echoed on the Broadway’s Green Alliance website, “It is impossible to be 100% “green” - we can only be *greener*.”[25] He needed to eat, and his normal habit would be to grab something convenient. However, the nudge of no single use plastics in the rehearsal space and greater understanding of the environmental sustainability consequences explored in the production made him question his own behavior. He became more conscious of the environmental impact of his decisions and looked for ways to sustainably modify his daily use behavior.[26] It is a small change, but every change that minimizes ones CO2 footprint and results in sustained behavioral changes is important.

Personnel: CO2 savings from food changes

During rehearsals, the team switched to oat milk, which is another daily use behavior. According to Poore and Nemecek, production of a liter of cow milk produces 3 kg. CO2-eq,[27] while production of a liter of oat milk produces .9 kg. CO2-eq.[28] Consequently, the twenty liters of oat milk that were used during the production produced 18 kg. CO2-eq. If twenty liters cow milk had been used, it would have produced 60 kg CO2-eq. The switch to oat milk resulted in a savings of 42 kg CO2-eq.[29]

The CO2 savings from switching to vegetarian lunches is difficult to calculate.[30] The figures are

24 Teglgaard 27.8.2020.

25 Broadway Green Alliance n.d.

26 The plastic yogurt container did not go to waste. Piles of trash were needed for the scenography, so it was used on the set. It will be recycled when no longer needed.

27 Poore & Nemecek 2018. A carbon dioxide equivalent or CO2 equivalent (CO2-eq) is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential. The original calculations that Poore and Necemek made for diary milk vs oat milk were done using a carbon dioxide equivalent. Eurostat 2017.

28 Poore & Nemecek 2018, 988.

29 This figure may seem small, but if a similar change was made at the Danish Royal Theatre that has approximately 1000 employees, for example, the savings over six weeks would be ca. 7000 kg. CO2-eq. and over a season, 49000 kg. CO2-eq. (The calculation is based on there being on average six people per day at rehearsals at Mærkværk).

30 The necessary data collection is far too complex, and the level of granularity needed to calculate absolute numbers is nearly impossible. The CO2 savings are calculated from research on vegetarian vs. diets with meat in Denmark. These types of calculations will always be a simplification because there are so many nuances within each category, for example, organic or not, produced in Denmark or not, etc.

approximate, but they still give an understanding of how dietary choices affect the climate.[31] During the production process, the *Frontløberne* team consumed 144 vegetarian lunches resulting in a savings of 87.84 kg CO2. The combined savings from switching to an ovo-lacto lunch and using oat milk was 129.84 kg CO2. There were a few missteps in the beginning as to what an ovo-lacto vegetarian lunch could include, but once the guidelines were clearly outlined, everyone eating at rehearsal adhered to the ovo-lacto vegetarian lunch and their daily use behavioral changes led to reduced CO2 emissions.

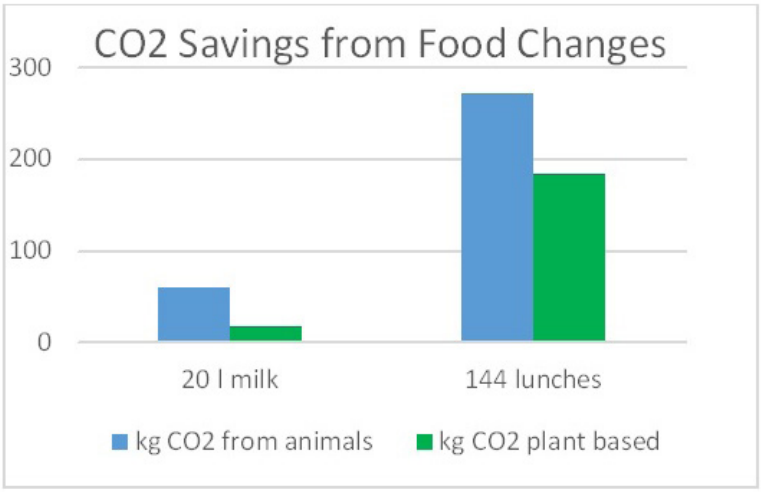


*Figure 1: CO2 Savings from Food Changes*

**A paperless production**

The *Frontløberne* team's decision to create a paperless production occurred on two levels. One was the printing of scripts. The other was the printing of marketing material, tickets, posters, programs etc. Instead of printing a new script every day, the actors made a behavioral change and worked from iPads.[32] As both the iPads used in *Frontløberne* were older than three years, CO2 emissions came from charging them. In 2012, an analysis by the Electric Power Research Institute showed that iPads used less than 12 KWh of electricity over the course of a year, based on a full charge every other day, which corresponds to 0.033 KWh per day.[33] *Frontløberne* was in rehearsal for thirty-four days with one actor using an iPad for twenty-nine days, and the other actor using the iPad for twenty-seven days,[34] so the two iPads used during rehearsal generated 250 gm of CO2.

The team was not able to rely solely on the iPads for the entire rehearsal process. As opening night approached, both actors found it difficult to memorize their lines from their iPads, so they printed paper scripts. In the end, 204 sheets of paper were printed, but by using iPads during the rehearsals, the team avoided using 1980 sheets of paper. According to the Environmental Paper Network website, 1980 sheets of paper made from post-consumer recycled paper

31 The calculations are extrapolated from the latest data on Danes' dietary habits from the Department of Food at the Technical University of Denmark (DTU) and the Danish green think tank CONCITO.

32 Two different iPads were used and both were purchased in 2015. One was an iPad Air 2, and the other was an iPad mini 2. Apple's environmental reports calculate an iPad's use as 3 years. In 2015, an iPad Air 2's greenhouse emission over its life cycle was 170 kg CO2-eq., of which 10% came from use; while an iPad mini 2's greenhouse gasses over its life cycle were 120 kg CO2-eq., of which 14% came from use. (Apple 2015; Apple 2016).

33 Reisinger 2012. It was not possible to find more current energy usage figures for iPads that could be converted to KWh.

34 Dividing the annual use of 12 KWh into a daily figure and multiplying that figure by the number of days of use per actor corresponds to the iPads using 1.85 KWh of electricity to charge during rehearsals. One KWh of electricity produced in DK creates 135 g of CO2,(Energinet, 2020).

creates 35.52 kg CO2-eq.[35] If the paper had not been from recycled sources, it would generate more than double: 85.67 kg CO2-eq.[36] The 204 sheets of 100% post-consumer recycled paper generated 3.68 kg. CO2-eq. Consequently, by using iPads and minimizing printing, the *Frontløberne* team used 3.93 kg CO2-eq. The behavioral wedge and the nudging saved 35.27 kg CO2-eq.

The second level of paper consumption was for front-of-house activities. Mærkværk received a grant from *Sportsgoodsfonden* for a live learning project that consisted of the foundation buying all the tickets, so they could be given away. In return, Mærkværk produced educational material and arranged debates for students. Giving away the tickets to schools meant that Mærkværk did not need to market the show to get an audience. Normally, the PR person, Janne Hovmand Storm would mail sales material to the schools consisting of flyers, cards and posters. With the grant, this material was unnecessary. The normal paper use for marketing a production, excluding tour marketing, would generate 66.37 kg CO2-eq. With the grant, the CO2-eq for paper used in *Frontløberne's* front of house activities was reduced to 1.03 kg.[37] The grant enabled a 98.5% reduction in CO2-eq emissions from the normal front-of-house paper use. Behavioral wedges and nudging related to paper use generated significant CO2 savings.

**Lighting and energy use at Teater Grob**

One of the biggest sources of electrical consumption in the theatre comes from the lighting. Initially, the *Frontløberne* team discussed generating electricity from a bicycle on the stage. Several ideas were discussed in rehearsals about using the bike to illuminate a practical onstage instrument, such as having audience members bike or having the actors alternate pedaling to keep the instrument lit. Everything needed to create the apparatus was sourced, but as the rehearsal process progressed, the shifting focus made it dramaturgically difficult to work the electricity-producing bicycle into the play. Subsequently, the idea was abandoned.

When asked about his personal sustainable goals for this production, the lighting designer, Jari Matsi, stated, "I would like to see the energy consumption and to try to lower that one. And also, to make do with the equipment that the theater has, so there wouldn't be so much need to buy new stuff, for example."[38] He embraced the four Rs of sustainable theatre. He Reused the lighting equipment that Mærkværk already owned. He Reduced the number of instruments needed to a minimum. Everything newly purchased such as adaptors, cables, plugs and bulbs would be incorporated into Mærkværk's lighting stock and would be used in future performances. He bought no new lighting instruments. All burned out bulbs were Recycled. He would have incorporated the fourth R, Repurpose if the bicycle to generate electricity had been used.

In his lighting design, he used ten instruments to light the stage: seven were LED instruments, and the three sun strips used halogen bulbs. Teater Grob has an additional sixteen PC lighting instruments over the audience which use halogen bulbs. LED lighting has several sustainable advantages over halogen lighting. LED lighting uses as much as 80% less energy than halogen lighting; LED bulbs last as much as twenty-five times longer than halogen bulbs; and lastly, LED bulbs are recyclable. Upgrading equipment to LEDs could see substantial CO2 savings from lighting. For theatrical use, there are also disadvantages to LED lighting relating to smooth dimmability, color rendering (LEDs can appear cold and harsh), and noise because some LEDs need a fan for cooling the electronics. That said, engineering has improved, and these issues are less prevalent in new LED equipment.[39] Perhaps the biggest impediment for most theatres to switch to LED lighting is the cost. They are expensive, and theatres with limited budgets can not afford to upgrade; however manufacturers now sell LED modules to retrofit Parcan and Fresnel housings, which is lowering the costs.

The electricity meter and the district heating meter at Teater Grob were read when Mærkværk

35 The A4 size is 4% larger than the American 8.5x11 inch sheet of paper used as the standard in the Environmental Paper Calculator. The final CO2-eq figures were adjusted for the size difference and then converted to metric.

36 https://c.environmentalpaper.org/

37 The paper amounts and sizes were first converted to an A4 equivalent and then converted to metric.

38 Matsi 17.6. 2020.

39 Matsi 30.5.2022.

moved into the theatre and again when the production left the theatre. *Frontløberne* used 586 KWh of electricity during its run at Teater Grob. A Danish produced KWh of electricity creates 135 g of CO2,[40] which means that *Frontløberne's* electrical usage generated 79.11 kg of CO2. The district heating used for the duration of the production was 250 KWh. One KWh of district heating generates 49.9 g of CO2. Heating the theatre during the run of *Frontløberne* generated 12.48 kg of CO2.[41]

**Reduce energy use**

The eighth target, reduce electricity by turning off computers, lights, printers, etc. when not in use was another behavioral wedge that proved difficult to monitor and provide a corresponding CO2 calculation. The rehearsal space is in a larger building and does not have a separate electricity meter, and not everyone worked from the rehearsal space. Before *Frontløberne* started rehearsals, the team was made aware that turning off computers rather than letting them remain idle or in sleep mode saved electricity. Those working on computers during the day committed to turning them off. To what extent it happened was never reported. As the production was in rehearsal in August and September, the need for lighting in the rehearsal space was minimal because daylight often sufficed. It is also not clear whether people charged phones and iPads during rehearsals. It is difficult to determine whether this target was met or not due to the lack of data. Clearer methods of data collection and monitoring would need to be outlined to generate usable data for this behavioral wedge. Despite there being no concrete data reported, the behavioral wedge nudged the participants into changing behavioral patterns based on follow-up interviews.[42]

**Scenographic sustainability**

The scenographer, Siggi Oli Palmason, found the idea of using only existing scenography or found objects an exciting design frame. He was determined to re-use or repurpose as much as he could. Nearly everything included in the scenography came from existing scenography, or was salvaged from building sites or recycling centers, or purchased from stores specializing in recycled building materials. The elements that were newly purchased included twelve wheels for the carts, ten meters of fabric to cover the back wall,[43] assorted hardware (screws, nuts bolts, etc.), adhesive, Velcro, thread, needles. The picture appearing through the window of the back wall was printed in a print shop.

The success or failure of the second scenographic target dealing with re-used material being from sustainable sources is harder to determine. A clearly defined understanding as to what this target actually meant was never suitably articulated. Did it mean the objects themselves were made from sustainable sources, or did it mean that the places where the objects were sourced were part of a circular economy and therefore sustainable? Is picking up a mass-marketed plastic toy at a recycling center a sustainable source? Clearly, giving life to objects headed for the incinerator is better than buying new objects and does not add to the demand for such objects. However, a mass-produced plastic toy is not itself from a sustainable source. Most objects on the stage were sourced from recycling centers or the trash, but these objects were not from sustainable sources. The ambiguity inherent in the wording of this target meant it was impossible to monitor the success or failure of this behavioral wedge.

One of the targets for *Frontløberne* stated the costumes should be completely re-used or from sustainable sources. This target proved to be the most problematic. The scenographer

40 Energinet 2020.

41 Hofor 2020. *Frontløberne* was at Teater Grob for twelve days, which included rehearsals and performances. They performed fifteen times for an audience. Distributing the CO2 emissions from the use of electricity and heating across each performance results in each performance being responsible for generating 6.11 kg of CO2. Due to COVID, the potential audience was reduced by half to allow for appropriate social distancing. There was an average of 65 people per performance. When the per-performance CO2 emission is distributed across the audience members, it results in 94 gm of CO2 per audience member for electricity and heating.

42 *Frontløberne* focus group interview, 7.10.2020.

43 Several 1-meter lengths of sample fabrics were also purchased and not used, but these will be used in future productions.

and the director could not agree on a direction for the costumes. Three weeks before opening night, no concrete decisions had been made, which meant the window for trying to find used costumes was quickly closing. Costuming is as time consuming as creating the set. Often, the costume decisions have been made before the rehearsal process starts because of the time it takes to make costumes. Sourcing elements for the set and props had been ongoing from the beginning, but the lack of consensus early enough in the process meant that the costumes had to be purchased. The costumes were ordered from fast fashion retailers online and from a local theatre specialty shop. The costumes were not from sustainable sources nor were they made from sustainable materials.[44] The ambiguity inherent in the wording of this target meant it was impossible to monitor the success or failure of this behavioral wedge.

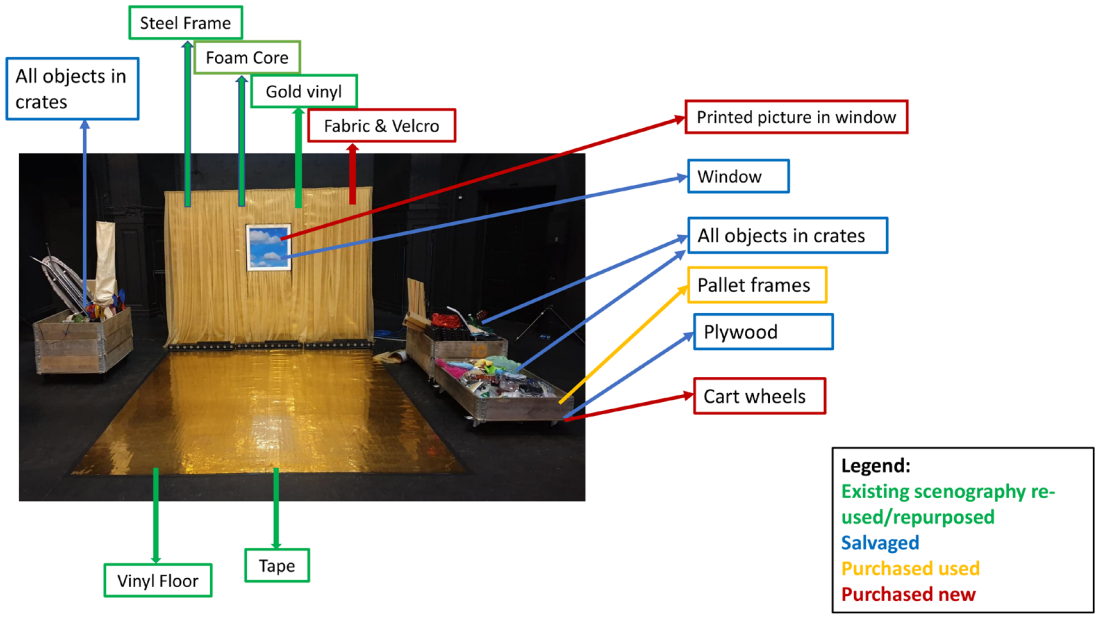


*Figure 2: Source of scenographic elements*

**Transportation**

While reducing transportation was mentioned in the environmental policy, transportation was not mentioned in the environmental action plan. However, it is included as a separate section here because the biggest contributor to the CO2 footprint of *Frontløberne* was transportation.[45] Sourcing the materials needed for the set, costumes, props, and lighting required transport. As the general principle for the scenography was to use already existing materials, numerous trips were made to recycling centers, scouring the streets on the local municipality's large waste collection day,[46] going to a commercial harbor, visiting stores specializing in salvaged

44 Another issue with costuming that was not specifically part of the targets but should be taken into consideration is costume maintenance. Costumes need to be washed or dry-cleaned regularly between performances. Full washing machines and dryers are more energy efficient than half-full machines. If a production has ten people on stage with multiple costume elements that can be grouped and washed and dried as full loads of laundry, it is cost effective and sustainably prudent to have a single costume for each actor. However, in small productions with fewer actors where the individual costume elements do not fill the machine, it could save energy over time to double or triple the costume elements that will be laundered, particularly if those costumes are reused from existing costumes. In this way, laundry is done every other day or every third day, instead of every day. For *Frontløberne,* the costume elements like shirts, socks, and tights were doubled to minimize the need for daily laundry. Doubling costumes saved energy during the run of the show.

45 Transportation usage was not solely for the scenography, although much of what is discussed regards scenography, so it listed as a separate item rather than as a sub-category of scenography.

46 The municipality of greater Copenhagen collects large waste items quarterly in each neighborhood. These trash pick-ups can be an excellent source for finding furniture and objects for use on the stage.

goods, going to a building site, and making several trips to DIY stores. The goods found or purchased had to be transported to the rehearsal space. Anything not used in the production was taken to recycling centers. Several trips were also made to Mærkværk's storage facility to pick up material from earlier productions. Additionally, when the production moved from the rehearsal space to the theatre, everything had to be packed and transported to Teater Grob. Transportation also included errands not related to scenography. In total, three different vehicles were used to transport sets, props, lighting, and costumes: a 2011 SEAT Ibiza ECO with a diesel engine,[47] a Fiat Ducato[48] van with a diesel engine, and a 2010 Hyundai i10[49] with a gas engine. The three vehicles travelled 707 km during the six-week production process. Their CO2 emissions totaled 543.23 kg.

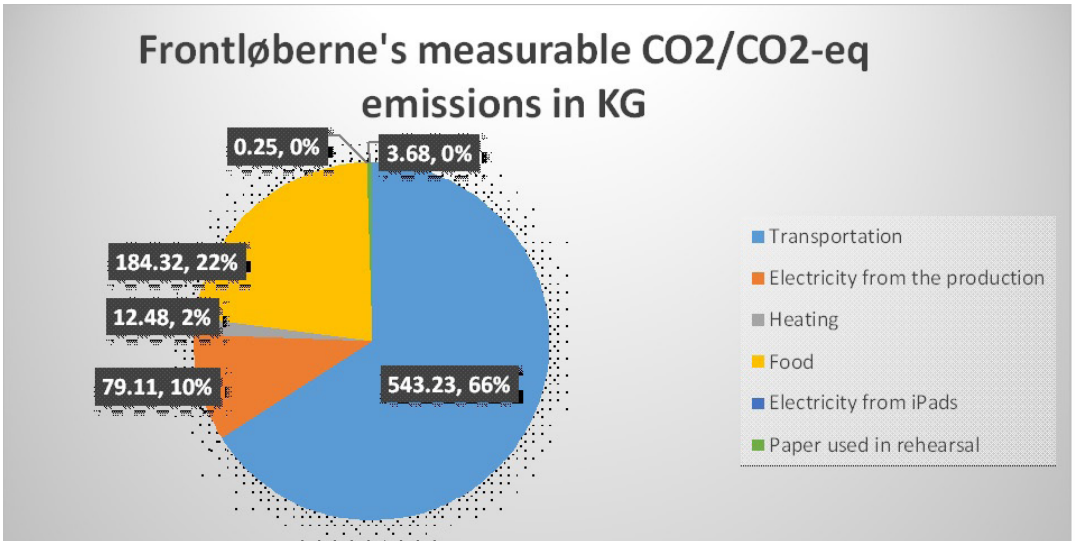


*Figure 3: Frontløberne's measurable CO2/CO2-eq emissions in KG*

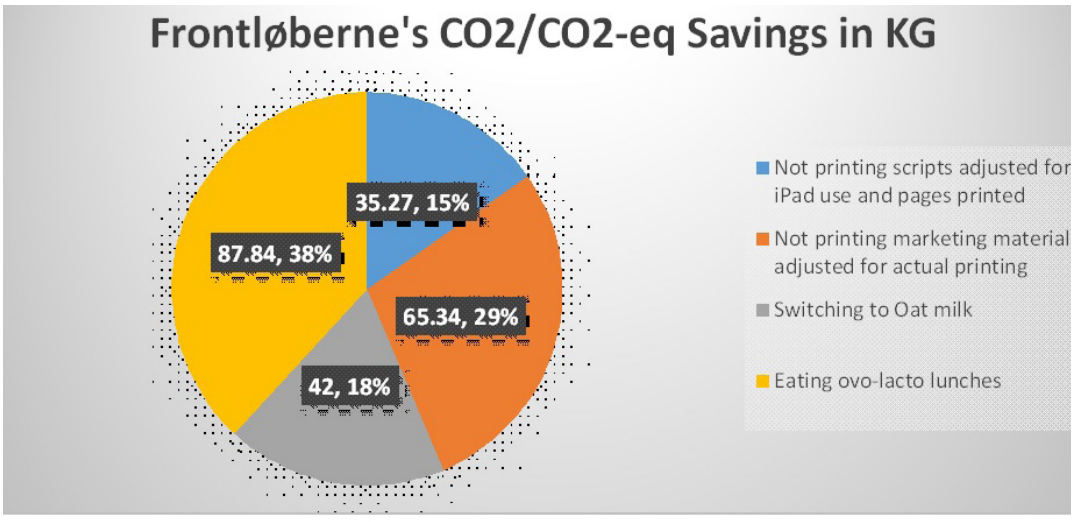


*Figure 4: Frontløberne's CO2/CO2-eq. Savings in KG*

47 Next Green Car n.d.
48 Commercial Fleet n.d.This van was rented, and no other specific information was available, so the figures are based on an average of the data available for Fiat Ducato vans.
49 Emissions Finder n.d.

**The baseline and conclusion**

Based on the emissions that were monitored for *Frontløberne,* the CO2/CO2-eq. figure Mærkværk can use as its future baseline is 823.07 kg of CO2/CO2-eq. (See Figure 1) This baseline figure would have been 1053.52 kg without the dietary changes and the paperless performance. Those changes reduced *Frontløberne's* carbon footprint by 22%. (See Figure 2)

Calculating the absolute CO2/CO2-eq emissions for any production is nearly impossible because data gathering methods are limited and insufficient to encompass all eventualities. With *Frontløberne*, the targets set by the team were a mix of elements that could be measured, like electricity use, mileage, and using oat milk, and elements that could not be measured, like buying a costume or recycling trash. The team committed to the environmental policy and environmental action plan including the specific underlying behaviors, and the 4 Rs which clearly reduce a production's CO2 emissions. However, the team's results showed varying degrees of success.

Transportation for the scenography was the biggest contributor of CO2 emissions. Some of this travel could have been avoided if the scenographer and director had agreed on the scenography earlier in the process. For example, 20% of the total kilometers came from trying to find a fishing net at a commercial harbor. This net was ultimately not used and was driven to a recycling center. Part of one of the original environmental policy objectives was to reduce transportation in general, but this objective was at odds with this devised theatre's scenographic process. If transportation is to be reduced in future productions, there must be alignment between the scenographic process of devised theatre and the environmental action plan. Furthermore, the scenographer and the director must agree on the scenographic frame much earlier in the production process.

The grant from *Sportsgoodsfonden* was fortuitous. The grant enabled a significant reduction in the amount of paper used for marketing *Frontløberne* and resulted in a savings in CO2-eq. emissions. Now that Mærkværk has some concrete CO2 emissions figures for its marketing material, it can continue to reduce those numbers in the future. Anything not essential that can be removed will lower the CO2 emissions.

The lighting designer adhered to the 4 Rs and successfully implemented his lighting design based on the equipment already in stock, reducing the number of lighting instruments needed, and using as many LED instruments as possible. An area that Mærkværk should consider if it wants to reduce its CO2 emissions is phasing out the sunstrip instruments. The sunstrips use halogen bulbs, and halogen bulbs require approximately five times the energy consumption of LEDs.[50] Switching entirely to LED instruments will reduce energy consumption and lower CO2 emissions. If lowering the carbon footprint is the goal, then switching entirely to LED instruments must happen.

One of the original targets was to re-use existing scenography or re-use existing material, and the majority of the scenography was re-used. The items that were purchased were incorporated into Mærkværk's stock to be used in future productions. The costumes could not be included in the emissions calculations although their manufacturing and transportation contributed greenhouse gasses to the environment. If decisions had been made earlier in the production process, the potential for sourcing costumes from renewable sources or finding used clothing that could have been adapted would have been possible. The late decisions left limited options, and a fast fashion, non-eco-friendly decision was made simply to solve the problem.

The target of using less electricity proved more difficult to quantify than originally anticipated when the target was set. The team committed to taking behavioral action to reduce electricity, but insufficient data collection methods made accurate calculations impossible. Calculating CO2-eq. emissions proved to be far more complex than originally thought. More robust data collection methods will need to be developed in the future, as well as more stringent monitoring if actual numerical values are to be calculated and added to the baseline.[51]

As a proof of concept and as a pilot project, *Frontløberne* showed a range of results, most of which were positive. Everyone involved with the production was enthusiastic about working

50 Spar energi n.d.

51 A color-coded list of the targets and their success or failure appear as an appendix.

with sustainability and using the environmental policy and environmental action plan to reduce CO2. Rather than seeing sustainability as a hindrance to the creative process, it was seen as a new creative frame within which to work. All productions have frames within which production teams must work. Whether they are budget, time, space or staffing, frames exist, but they do not need to constrain creative processes. Sustainability as a creative frame was eagerly adopted and explored in *Frontløberne*.

The behavioral wedges that were introduced during *Frontløberne* have nudged people to change mindsets and have created long-term behavioral changes. Since *Frontløberne* closed, Mærkværk has continued to work with sustainability. It received a grant from the Danish Arts Foundation to continue its sustainable theatre journey in 2021. In its latest production, *Min Krop, Dit Blik* [My Body, Your Gaze], 72% of the scenography was either reused or from sustainable sources, and 65% will be reused in future productions. For transportation, a cargo bike was rented, which slashed transportation CO2 emissions by 98%. The actors continue to use iPads in rehearsals and only print scripts near the end to memorize lines. With *Min Krop, Dit Blik* fewer scripts were printed than for *Frontløberne.* Mærkværk is in the process of planning its next two productions, and it has decided to use the same scenography for both productions. The goal with these productions is that minimally 50% of the materials for the scenography are either reused or from sustainable sources. Mærkværk continues its sustainable theatre journey, and sustainability will inform Mærkværk's future theatrical practice. As the majority of people working on *Frontløberne* were freelancers, they quickly moved on to other projects. A future part of this research will be to interview the production team to see how sustainability has informed their work since *Frontløberne.* The hope is that as they move on to other projects, their sustainable mindset and behavior will have a ripple effect on their future productions and theatre in Denmark will become greener.

**Epilogue**

In the two years since Bæredygtig Scenkunst NU started its pilot project with *Frontløberne*, its work and influence has grown. It has held several industry wide meetings to explore issues surrounding creating sustainable theatre. It has developed strategies and action plans, and done workshops and seminars for several theatres including the Danish Royal Theatre, Nørrebro Theatre, Folketeatret, Malmö Opera, Østerbro Theatre, and Betty Nansens Theatre, all of which have their own theatres and all of which do larger or large-scale productions. Additionally, it has worked at the organizational level in the three Scandinavian countries to help Assitej Norway and Sweden, Dansk Teater, and the Københavnsk Teatersamarbejde [Copenhagen's Theatre Collaboration],[52] implement sustainable practices. It has developed a CO2 calculator and a new online platform for the performing arts industry available at https://rethinkscenekunst.nu/da [Rethink performing arts now]. The calculator allows the individual theatre to register and monitor its CO2 emissions at both an operational and performance level to reduce CO2. It is also working with Theatre Green Book in the UK to create a common standard for making theatre sustainable at production, building, and operational levels. Additionally, BS NU was the driving force behind the inclusion of CO2 calculator on the Danish Arts Foundation's website, which is the largest arts foundation in DK. BS NU is in ongoing dialogue with the arts foundation to make the calculator more user friendly for all areas of the culture sector.

Since its inception in 2020, BS NU has fought on a national and local political level to make sustainability in the performing arts a recognized part of the political agenda. It is advocating for a communal storage facility for pieces and costumes, so theatres without storage facilities do not have to make everything from new every time. In cooperation with WorldPerfect, they are in the prototype phase of delivering a communal storage solution facility for theatres in Aarhus, Denmark's second largest city. With Dansk Teater, it has created a Declaration of Intent that forty-two theatres have signed. This declaration recognizes the climate crisis as the burning issue of our time, and in signing, theatres commit to sustainable practices

52 Assitej is an association for professional theatres for young audiences. Dansk Teater is the unifying actor for the Danish performing arts- industry, which ensures that the performing arts have a clear voice in the public debate and among decision-makers, authorities, and stakeholders. Københavnsk Teatersamarbejde is an independent institution that supports the operation of theatre in the Copenhagen area.

because they not only have a responsibility to do so, but also because they have the potential to influence audiences and the public debate. BS NU has lobbied to get decision makers to recognize the importance of having a unified center for culture that can support the necessary sustainable transition in the cultural sector through CO2 calculations, knowledge sharing, and climate literacy. It has fought for a center that will present the new narratives (nudging) that can motivate the necessary behavioral changes (wedges) that must be done in order to meet the Paris Agreement. On 22 September 2022, its hard work finally bore fruit when the political majority of the Danish Parliament gave 3 million DKK to create a Center for Sustainability in Culture to strengthen the role of culture in the green transition ensuring that Bæredygtig Scenekunst NU's work will continue.

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# Appendix

## Assessment of Targets

The targets that were met appear in green. The targets that were not met appear in red. The targets that were unable to be declared a success or failure are in blue.

- Reducing and sorting trash
    - Introduce recycling and sorting of trash in the rehearsal space
    - Establish a box for the reuse of used paper before being recycled
- Personnel
    - No plastic bottles, bags, or single use plastics in the rehearsal space
    - Meatless lunches in the rehearsal space
- Self -produced electricity on stage
    - Install a bicycle on the stage that can produce electricity
- Paperless production
    - Minimize the use of paper in conjunction with developing the script, tickets, posters, etc.
    - Paper should be from recycled or sustainable sources.
- Lighting
    - Research alternative electrical sources/ generate own electricity on the stage
    - Calculate energy use for lighting and sound equipment.
- Scenography
    - Reuse existing scenography
    - New re-used material should be from sustainable sources
    - Reduce the weight of the set in relation to the tour
- All costumes should be reused or from sustainable sources
    - Use the 4 Rs of reuse, reduce, recycle, repurpose as a frame for making or procuring costumes.
- Reduce electricity use
    - Turn off computers, lights, printers, lights, etc. when not in use