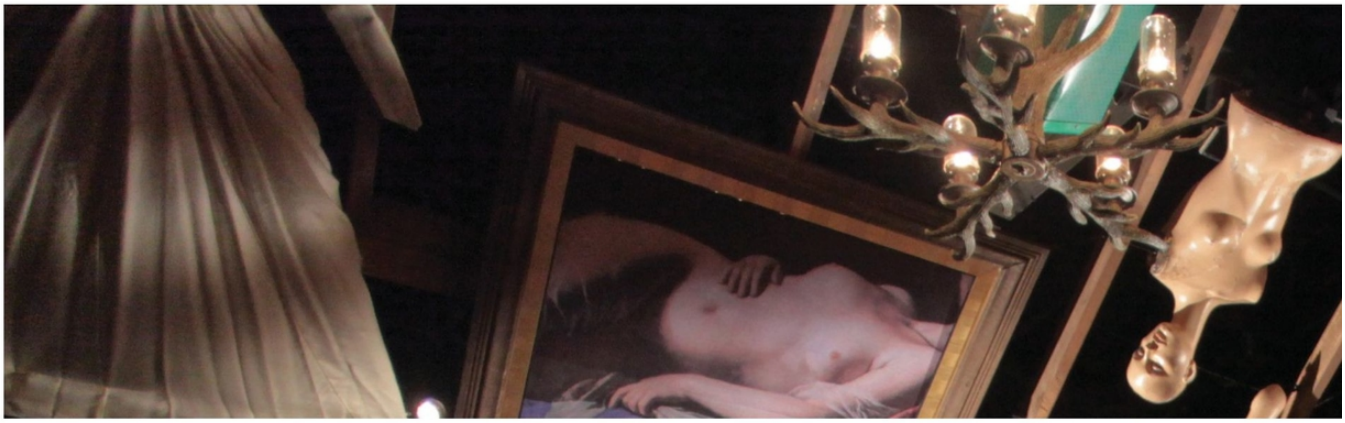
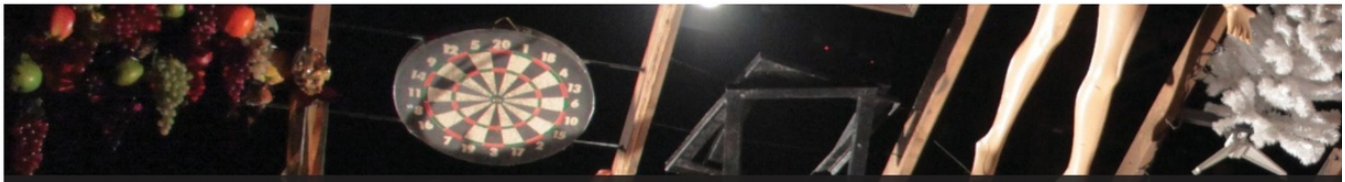


CIRCULAR DESIGN AND PRODUCTION



As theatre designers and their organizations take steps to reduce the environmental impact of their work, opportunities emerge for reusing and reimagining existing materials in ways that encourage innovation while supporting sustainability

BY SANDRA GOLDMARK

A moment from Barnard College's production of L. M. Feldman's *The Egg Layers*. This was the first design at Barnard that used found objects as both a storytelling tool and as a conscious, production-wide choice to reduce the environmental impact of the design. Photo by Stephen Yang/Barnard College.

Since 2013, students, faculty, and staff in the Barnard College Department of Theatre have been collaborating to track and quantify reuse in theatre design and production with an emphasis on scenery, props, and costumes. A practice already deeply embedded in theatrical production, reuse is a surprisingly powerful tool for both social and environmental impact.

Barnard has sought to develop metrics that make the case for large-scale, systematic implementation of reuse in the arts, and to provide tools for practical application. Components of the project include a carbon footprint assessment of reuse, a materials purchasing guide, and a series of classroom assignments that explore the concept of circular design. This exploration of circular design and production through

reuse considers the impact of design choices on the people and communities who create the work, and the natural environment. Reuse in the theatre has application outside the walls of the theatre; our work onstage, and backstage, can serve as a model for creating change offstage as well.

Many designers, producing organizations, and shops around the world are taking steps to reduce the environmental impact of their work. But by and large, there are not widely accepted systems in place for considering constraints other than the familiar big three: time, space, and money. For each of these, theatre artists use tools that are familiar to anyone in the industry. The limits of the space are reflected in the architectural drawings of the theatre, in the careful allotment of stage space between scenery, lights, backstage travel paths, quick-change booths, fire aisles, and in the hundreds of other negotiations that ensure that the space constraints are respected. Time and money are typically tracked with carefully planned schedules, labor budgets, and materials budgets. And as many a frustrated theatre artist knows, if you don't respect these constraints—and use the tools that will help you to do so—you can very easily wind up over budget, behind schedule, or with a set that doesn't fit into the theatre.

Charles Eames said that "design depends largely on constraints." Theatre artists are used to accommodating, and (on a good day) even embracing the limits of time, space, and budget to not only define but inform, expand, and ultimately strengthen the design. So, when a team learns it has 2 hours to load a full set into the theatre, or that all of the elements have to break down into component parts small enough to fit through the eye of a needle, the team takes it in stride. Designers and technical directors recognize that limits often fuel creative solutions; innovations may improve the design, rather than diminish it.

If a good design is fueled, and not limited, by constraints, then what happens when theatre artists begin to consider the environmental and social impact of design choices as another "constraint," like a budget, or a tight load-in schedule? Just as a healthy budgeting process can help identify excess in a design, or a strange architectural feature can inspire a creative solution, quantifying and respecting social and environmental constraints will ultimately strengthen the work.

Rethinking the Creation to Disposal Model

Outside the theatre, humans largely operate in a linear system of extraction, production, consumption, and disposal. As Annie Leonard says, it's a "take, make, waste model" where "99 percent of the stuff we harvest, mine, process, transport—99 percent of the stuff we buy is trashed within 6 months." This pattern of consumption contributes to widespread global environmental degradation and rising carbon emissions. And for those in theatre who drive material consumption (scenery, props, and costumes), it's another fun kick in the gut to know that "stuff" can represent as much as 27 percent of our individual carbon footprint (http://footprint.wwf.

org.uk). Finally, as western consumers in a digitized one-click world, Americans are largely disconnected from the production of that stuff, very rarely making or even knowing very much about the things used on a daily basis.

In many ways, this linear, wasteful, and disconnected model exists inside the theatre, too. The quick turnaround from creation to disposal is all too familiar to theatre makers, who regularly design and build shows that wind up in the dumpster after a matter of months or weeks. And one-click shopping is a basic tool of design and production today. But in other ways, theatre makers also maintain a different set of practices. Reuse is coded into our theatrical DNA; since the Greeks, we've been repainting old periaktoi, storing props and costumes, and making magic out of scraps. And of course, theatre people still make things by hand—a lot. People in theatre possess habits and skills of reuse, of craftsmanship, and of repair and maintenance that can be valuable as our larger society struggles to transition from the linear "take-make-waste" to a more circular and sustainable model.

Barnard College's Department of Theatre started thinking about circular models of design, production, and teaching in 2012 as we were producing a new play, *The Egg Layers* written by Lauren Feldman and directed by Barnard faculty Alice Reagan. Student actors, stage managers, and assistant designers worked on the show for course credit, and a large number of students worked on the production as work-study. In addition to students, the production was supported by our small department staff.

I was the set designer on the show, which would be produced in Barnard's Glicker-Milstein Theatre. At that point in time, I felt that I had designed—and trashed—enough scenery for one person's lifetime. After designing dozens of shows in New York and around the country, many of which ran for only weeks and then largely went to landfill, I couldn't stomach being responsible for even one more dumpster.

The play was a challenging and moving target, with a lot of opportunity for a designer to have fun with the material. It was set, sort of, in an attic, where a confused writer unexpectedly laid eggs and encountered a hedgehog, a swan, and various other figures animal and human ranging from mythology to family. The wide-ranging and darkly humorous play opened up the possibility of an eclectic design that could leverage the department's prop stock and the students' inventiveness.

The design that emerged was of a raftered attic space, filled with fun, strange, sad, and powerful objects and imagery inspired by the stories spun by the egg-laying writer. The team populated the space with almost the entire contents of the department's prop closet, plus a carefully curated collection of ephemera purchased at thrift stores. This was the first design at Barnard that used found objects as both a storytelling tool and as a conscious, production-wide choice to reduce the environmental impact of the design.

While the department was not surprised to find that pulling a large percentage of the material for a design from the prop closet reduced the amount of waste sent to the dumpster at strike, the team was surprised at how changing the approach to materials also affected the design process. When building new, materials are "spec'd," or specified, on the drawings. Many decisions can be made well ahead of time, in the design studio or technical drawing phase. When focusing on found materials or objects, a designer can only make recommendations or guidelines on the drawings or in the model—much depends on what is found during the actual build process.

So, a larger number of students were much more involved in the design process for *The Egg Layers* than if the design team had simply ordered the materials new ahead of time and asked them to hang them up. Students were more engaged in making design choices and in creating the story, simply by the

How to Price Stock

To calculate the prices of stock scenic items, Barnard looked at the component parts of each and then found the average cost to build each item. For example, a 4x4 stress skin platform costs $58 to build based off the plywood and pine needed to make one. Stock prices do not reflect labor costs, only materials.

Example Stock Item Calculation

ITEM	UNIT PRICE	UNIT	QTY	SUB TOTAL	TOTAL
4' x 4' Stress Skin Platforms					
5/8" plywood	$44.80	each	1	$44.80	
5/4 x 6 pine	$1.10	LF	12	$13.20	
					$58.00

Calculating the cost of props and costumes was a bit more complicated due to their significant variation in price. One cheap bracelet might cost $3 and a winter coat might cost $300. To determine an average stock price per item for props and costumes, Barnard divided the budgets for all of the shows in a previous season by the number of props and costumes purchased or rented to get an average for each.

Props Total 2015-2016

# of Items	Total Cost	Avg Cost per Item
114	$3,160.88	$27.73

Costumes Total 2015-2016

# of Items	Total Cost	Avg Cost per Item
211	$5,686.85	$26.95

nature of the process of choosing materials. By changing the nature of the process, the collaboration with the crew was enriched, and the traditional parameters of "artistic staff" and "technical staff" were blurred and melded.

The common divide between "design" and "production" is blurred. Reuse promotes a deeper level of collaborative design, where both responsibility for screw-ups and artistic input are more evenly distributed. Changing the perceived "constraints" for choosing materials not only reduces waste, but can begin to change the social and labor dynamics of the work.

Tracking and Quantifying Reuse

The department quickly realized that in order to replicate the design approach for *The Egg Layers*, regardless of the emotional state and environmental leanings of a given designer, the institution would need a better system for tracking and measuring materials. The first step was to divide the "materials" line in the budgets into two lines, one for new material and one for used, reclaimed, stock, or salvaged. The second was to begin putting a dollar value on the stock. These simple steps were radical and critical to any long-term attempt to prioritize reuse on all productions. A third step was to determine how to measure the carbon emissions benefits of reusing material.

Prior to starting this process, reuse was often, as it is in most theatres, a fallback when the materials line was not sufficient for the desired effect. So, if a designer dreamed of 10 Philippe Starck ghost chairs, he or she might wind up with 10 old IKEA chairs from our stock painted silver instead. Or if a design called for a full-stage seamless voile drop in the color "pearl" but the dollars just weren't there, they could always use the old natural scrim instead. Stock, at Barnard and at many theatres, is often seen as "less than," a second-fiddle collection of has-been props and tired flats that aren't as good as the new and shiny version. This second-tier status was reflected in the fact that the department didn't budget the stock. All purchases of new items were carefully tracked, but there was no "count" of what was already in stock.

Of course, as with most goods and materials produced today, the budget for new materials never took into account the true cost—the externalities—of all those new-bought things. What is the environmental impact of a bleached and flame-treated cotton drop? What is the social implication of a lot of H&M shirts purchased cheap for a show (and sewn on the cheap overseas)? Similarly, the former system did not measure the true value of our stock. Those tired has-been chairs and flats represented many dollars of materials, many hours of human labor. When the department stopped considering them as a fallback, without value, and started putting a price on them, it was then able to track and quantify all materials, both new and used.

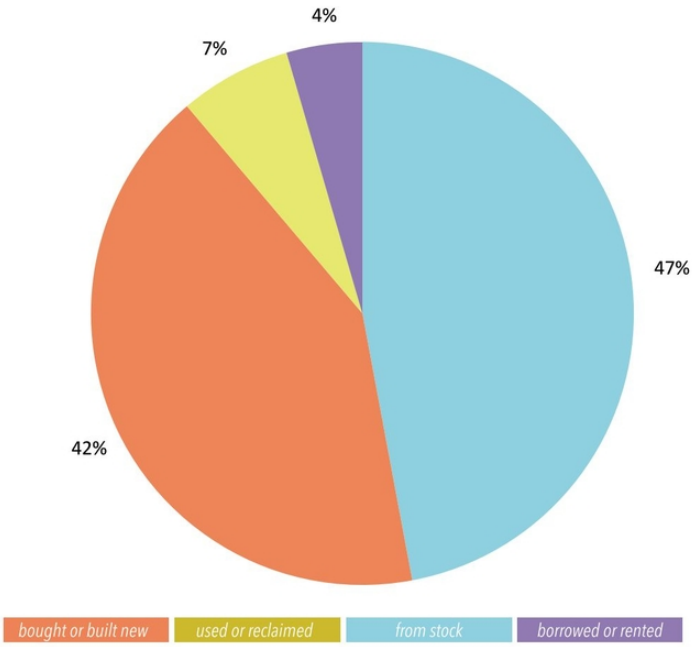
During the 2015-16 academic year, Barnard employed a student, Lhana Ormenyi, to define a system for quantifying our stock of props, costumes, and scenery. She determined the material cost, if built or purchased new, for each item in the stock of scenery (flats, drops,

platforms, hardware, etc.) and a price, based on average expenditures, for all of the items in the stock of props and costumes, which was thousands of items.

Next, Ormenyi tracked the materials used in each show in 2015-2016—a more difficult process than it seems because, at the time, the department was still not accustomed to tracking new and used material separately. Like most theatres, stock was simply pulled at will, not considering cost or value of the items pulled. After a bit of detective work, she determined that, across four productions and in the areas of scenery, props, and costumes, Barnard averaged 42 percent bought or built new, 47 percent from stock, and 11 percent borrowed, rented, purchased used, reclaimed, or salvaged.

Assessing the Environmental Benefit

Having determined a baseline of reuse and assigned a value to our stock, the department began the process of assessing the environmental benefit of reuse. Barnard Theatre worked with energy consultants from Gotham 360 to create



Production Materials Overview

BARNARD COLLEGE DEPARTMENT OF THEATRE
2015-2016

a greenhouse gas (GHG) inventory for the first show of the 2016-17 season, a devised piece based on the works of Vaclav Havel called *Some Hero*.

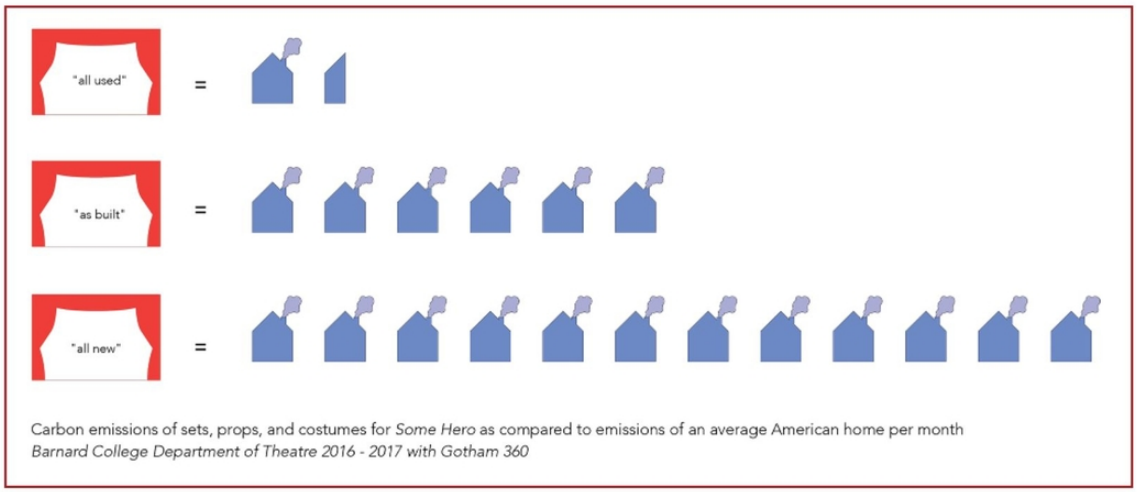
Gotham 360 assessed the carbon footprint of *Some Hero* under three scenarios. First, the team calculated the carbon footprint of the show "as built," i.e., approximately 50 percent new materials and 50 percent reclaimed. Second, the hypothetical carbon footprint of the same show was determined as if it had been built entirely from all new materials. Finally, the carbon footprint of the show was calculated as if built entirely from all used materials, including stock, used, reclaimed, or salvaged.

The results were striking. *Some Hero* was a relatively small production; the combined budget for scenery, props, and costumes was only $8,000. But the carbon footprint of the show "as built" totaled 4.59 metric tonnes of CO2 (not including the energy from lights, sound, shop tools, etc.). This is roughly equivalent to the emissions from one average American home's use of energy for 6 months.

The carbon footprint of the show if it had been built all new would have been approximately 9.9 metric tonnes of CO2, or a 115 percent increase from the 50 percent new/50 percent reclaimed scenario, and the same as the energy emissions from an average American home for an entire year. To offset this amount of carbon over one year, you would need to plant 9.4 acres of forest.

The theoretical footprint if the show had been built with all used material was just 0.13 metric tonnes of CO2, or roughly equivalent to the emissions from one home's energy use for a month and a half. The emissions from this scenario result from the purchase or shipping of used items, although the carbon footprint of these reclaimed objects is lower than if the same objects had been purchased new.

Barnard's single production of *Some Hero* is, of course, small potatoes when compared to the scale of emissions globally from industry, agriculture, household consumption, etc. However, in the United States alone, approximately 1,800 regional theatres put on 22,000 productions a year (TCG, 2013). This does not count Broadway, touring productions, and academic productions. Many of these shows have a much higher budget than *Some Hero*, and therefore purchase many more goods and materials. While building one show out of used stuff might be small, a systematic change in the way theatres, shops, and producers approach consumption would add up. Of the 22,000 shows tallied annually by TCG, if each of these shows produced approximately 10 metric tonnes CO2, just a 50 percent reduction in emissions (equivalent to the reduction achieved in the *Some Hero* "as built" scenario) would prevent the emission of nearly 120,000 metric tonnes of CO2 annually. As theatres and performing arts institutions across the country think about ways to reduce their carbon footprint, re-thinking our approach to material choices as we design, build, and teach should be a central piece of the puzzle.



Carbon emissions of sets, props, and costumes for *Some Hero* as compared to emissions of an average American home per month
Barnard College Department of Theatre 2016 - 2017 with Gotham 360

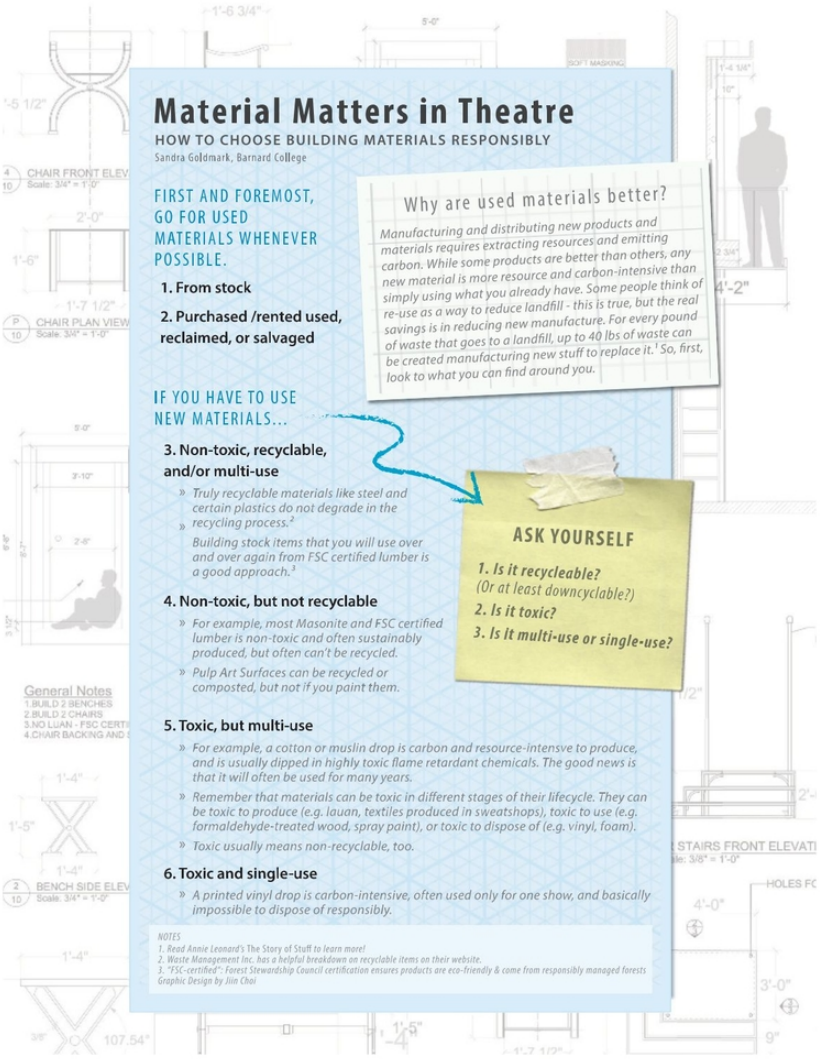
Long-Term Implementation

As anyone working to change any set of ingrained patterns knows, it's easy to identify a goal or a new way of operating, and it's another to actually put it into practice. So after building a rationale for promoting reuse, and a system for tracking it, Barnard needed a set of tools to facilitate systematic adoption of the practice.

The first step was getting buy-in from everyone involved along the entire chain of design and production, including producers, directors, designers, production managers, technical directors, costume shop managers, prop teams, etc. The team at Barnard is small and close-knit, so these practices developed communally, slowly and over time. The department had to focus on getting guest artists, usually directors and designers, on board. The reuse initiative is introduced early, before the designer is even hired, and the department tries to work with the designer throughout the process to figure out how to conceive and realize the design sustainably. Outside of an academic setting, a freelance designer might have to focus on early communication with the producer, production manager, and theatre director—again, before signing a contract—to invite the organization into a conversation about reducing the environmental impact of the design. The designer can become familiar with the theatre's stock, the other shows going up in the same season, and other resources in the community. As with reuse in general, these are all good practices in which many designers already engage; the difference is consciously foregrounding and naming the work as part of a strategy for more sustainable theatre.

The support of the director is critical. While some directors might initially worry that embracing sustainability as another constraint will limit or diminish the design, it can be useful to point out that ethical considerations are important to our work as artists, and that it is possible, indeed necessary, to make work in a way that reflects our values. So, just as a director would conduct a casting process in a way that supports a diverse and equitable community, making theatre that is healthy and sustainable for people and planet is important as well. In all cases, the goal is to start a conversation and be open and sensitive to the needs of the individual, production, or organization.

Once you have established a shared willingness to take steps to reduce emissions, a set of concrete tools for tracking reuse is helpful. Barnard adapted existing practices, rather than introducing a new calculator or tracking system. So the first stop was the budget. As previously described, the department had already "valued" the stock in order to track reuse, assigning dollar values to every piece of stock scenery, and an average value to every prop and costume owned. From there, the show budget, an estimate prepared for each show before the build begins, was assessed. Typically, a budget is divided into materials and labor. The department decided to split the material line further—into new materials, stock materials, and used/reclaimed materials. The budget included a new line for additional labor, to reflect the fact that obtaining and constructing with salvaged materials can sometimes be more time consuming. Barnard established a new goal of reducing new materials use by 50 percent. So, a show that originally might have had a $3,000 budget might now have a $1,500 new materials budget, a $1,000 reclaimed materials line, and a $500 line for transporting salvaged lumber. The stock line would not



have a limit, but would be counted just the same, to keep a sense of the overall scale of the production.

This method makes it possible to limit the use of new materials on a show, and provides a clear template for transferring money that would have been spent on those new materials to local labor, or local reuse markets. It doesn't allow for real-time emissions calculations, but as learned through work with Gotham 360, promoting reuse is a great way to slash emissions.

This brings us to a second major tool for implementation, which is to create an institutional rationale, or culture, to support this type of emissions reduction through reuse (or any other emissions reducing behavior). The department realized that not only could it say that it aimed to reduce emissions, but it could also argue that it valued local labor and preferred to spend money on people, not stuff. Theatre joined the larger campus—and the city—in consciously supporting sustainability, emissions reduction, an inclusive process, and local jobs. This enabled the theatre to make sustainability considerations part of the hiring process. The department now informs potential designers of our commitment to this work, and emphasizes that working here means joining in the effort.

Finally, acknowledging that it is sometimes necessary to purchase new materials, the department created one last tool, a materials purchasing guide that outlines the preferred steps when purchasing new: 1. Pull from stock. 2. Buy used. 3. Buy new but "green." 4. And lastly, buy new. This guide also allows crews to identify certain materials that the department tries at all costs to avoid in the shop— including lightweight theatrical mainstays such as lauan (plywood made from tropical hardwoods that is often discarded) and foam (which unfortunately never biodegrades).

Student Experimentation with Sustainability

Throughout this investigation into reuse and sustainability at Barnard, the faculty worked with students on productions and in the classroom to develop and amplify the initiative. Faculty challenged student designers in the spring Thesis Festival to work with a limited palette of materials, with a focus on used materials. Course materials were adapted to reflect this study, including, for example, a materials life cycle analysis project into a design course called "Problems in Design." Finally, design assignments reflect "circular" design thinking, as opposed to a linear process.

In 2014 and 2015, the design approach to the Senior Thesis Festival changed significantly. Historically, the Festival consisted of three shows performed in repertory, which means that each show performed on a given night. A 10- to 15-minute changeover period between shows allowed for the switching out of scenery, and backstage storage was incredibly limited—just the kind of "constraints" Eames was talking about. Nevertheless, for many years the students had developed complete, distinct designs for each of the three shows in the festival. Through the magic of theatre, and by virtue of many years of experience and expertise on the part of the production team, crews managed to break down and store those sets backstage, in nearly the blink of an eye. The process was taxing, however, on the team and on the environment. The department was building a lot of scenery, moving it around way too many times, and most of it went in the trash after only four performances.

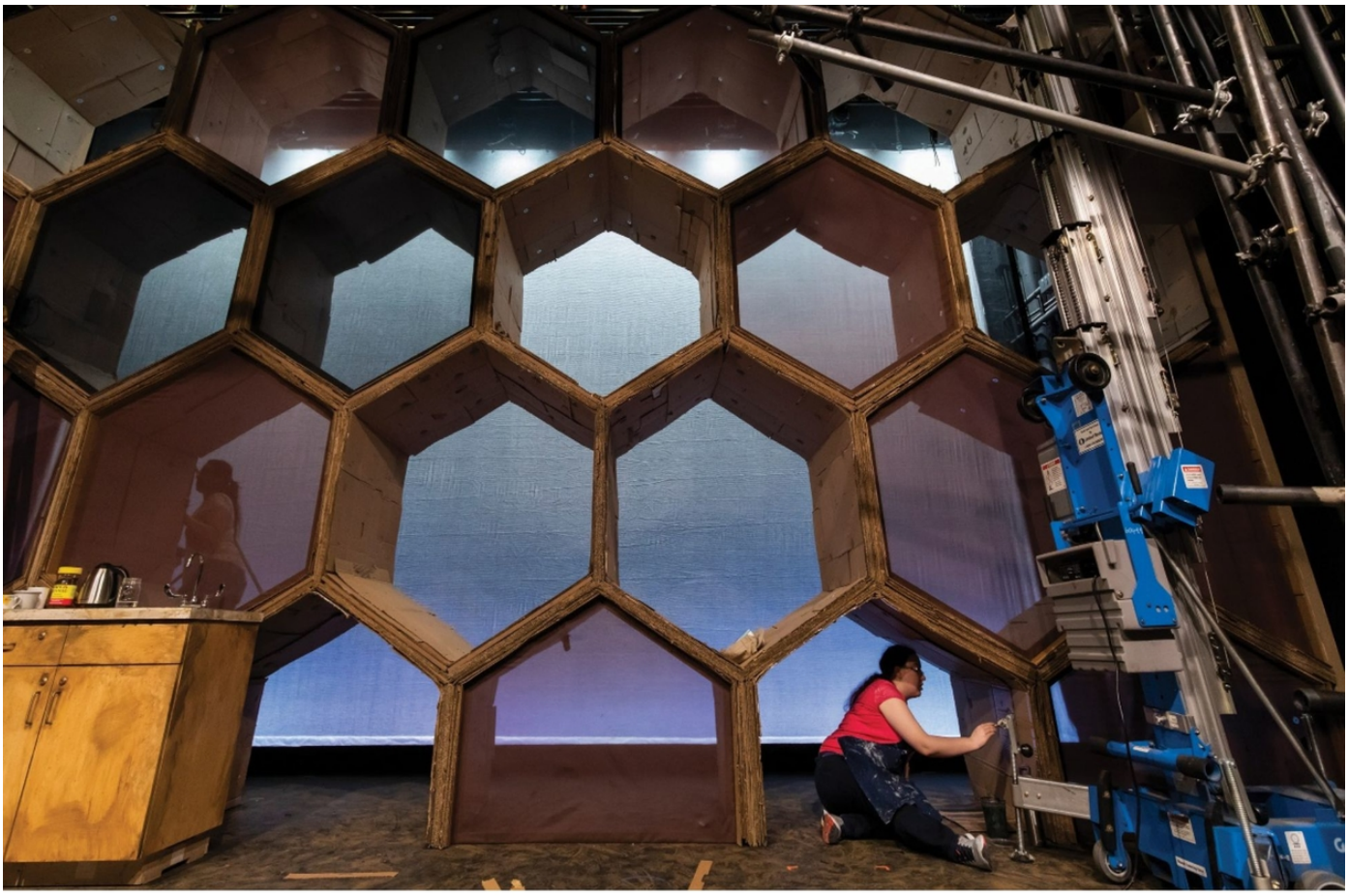
After *The Egg Layers*, students received a different set of constraints. While the sky was still the limit artistically, students could only work with a lim-

ited range of materials. For the first year under this approach, faculty designed a set of four mobile towers, which each student could use as they chose. The next year, faculty allowed students to develop their designs using only a selected a set of materials and structures from the theatre's stock. The key is to begin to think about the amount of new materials as a firm constraint, just like the budget, the time allotted for build, the size of the theatre, or any other hard and recognizable limit.

Yvon Chouinard, the founder of Patagonia, once wrote that "90 percent of the waste in a product is created in the design phase." This means that, if you want to reduce waste, or emissions, it is not enough to try to make something in a "green" way; you have to intentionally design it that way from the very start. Barnard takes this to include all parts of the design process—initial meetings with the director, the work of the actual designers, and the detail and specificity gained during the technical design phase. To have the greatest impact, sustainability needs to be considered by all of the stakeholders at each step. But how do you teach that?

Graduate schools sometimes teach designers that the sky is the limit when imagining shows. Students are encouraged not to limit their thinking just because they aren't sure how something would be built or whether it was even possible. They certainly weren't encouraged, in the early phases at least, to consider materials, much less whether those materials were toxic or environmentally sound. In the earliest stage of the design, students are often encouraged to rid themselves of as many constraints as possible. The result was a lot of exciting designs, but also a lot of dumpsters filled with scenery.

Start with the idea of reuse from the start. Here, a bag of model pieces from stock help physicalize the concept at the very first design meeting for *Book of Will*. Photo courtesy of Barnard College.



Syeda Anjum (left) and Aviva Kamens (right) work on cells in the set for Barnard's production of Stefanie Zadravec's *Colony Collapse*. Photos courtesy of Barnard College.

With this linear approach, students feel free to think big, aim high, and push boundaries—all good things that can lead to exciting designs. So how to keep the benefits of the linear model, without the costs? In traditional linear design models, the reality hits the fan during the budgeting process. The impossible visions are made possible, and the constraints of time, money, and space are confronted. We've discussed bringing sustainability into the budgeting process. But what about the design process?

A closer look at the design process outside of the classroom reveals that the linear "think big" model does not entirely reflect what actually happens in the real world. Students might be asked to ignore constraints—and even reality—in theoretical classroom projects, but when designing real productions, most designers consider certain constraints from the very beginning: cast size, for example, for a costume designer, or the capacity of the shop for a set designer. These limits shape the process, and very much inform the outcome. So, if designers are, in fact, already aware of certain limits, even early in the process, then is there a way to include social and environmental considerations in that early background calculus?

At Barnard, I introduced a few classroom practices to bring the idea of environmental and social constraints into classroom design projects, while still maintaining the conditions that lead to big-picture, exciting, envelope-pushing work. The first step is awareness. Students must have a basic understanding of commonly used materials, of stock items, and of certain properties of materials that affect their carbon cost. For example, students learn the difference between soft wood (pine) and hardwood (lauan, oak, etc.), and how different growth rates affect both strength and likelihood that the wood is renewable. Students learn to understand and look for certifications,

like FSC (Forest Stewardship Council) certified wood. They also conduct life-cycle assessments of common theatrical materials, like cotton drops, steel, or goods treated with flame retardants. Additionally, students at Barnard complete hands-on exercises to mimic circular design. Just as guest designers are asked to consider the materials used in other shows during the season, Barnard asks students to look outside of their own models and share materials with their neighbor. First, each student creates a quick design, a "shoebox" model.

Then, everyone passes his or her model to a classmate, and designs a second show using only the materials found in the model they received, plus a small amount of stock materials. This simple exercise is surprisingly powerful, as it is a way to create a kinesthetic, experiential knowledge of the otherwise abstract concept of reuse. And the designs that have emerged have been striking.

Greasing the Wheels

Barnard students have been involved at every step of the process to investigate emissions reduction through reuse, helping to assign value to the stock, creating the purchasing guidelines, digging through stock to make re-use possible, and collaborating in every way in realizing the shows. The exploration has moved from the research/professional work of the faculty into the classroom, into departmental productions, and back again. This type of interplay between classroom, research, and operations successfully exploits the capacities of liberal arts institutions, and can provide a model for larger campus sustainability efforts.

The examination of reuse in theatre at Barnard has also exposed the inextricable nature of social and environmental ills—and benefits. When the department started using less new material, at first to reduce its environmental impact, the department found a concomitant shift in labor practices. Reuse not only benefits the planet; it helps support local artisans and local jobs and fosters a more inclusive design process.

Theatre is a small, strange, and often isolated world. Artists toil away in the dark, pouring their hearts onto the page and the stage, for an often small audience. Theatre's carbon footprint, similarly, is negligible when compared to the vast industries that fuel the real world outside the walls of the theatre. So when theatres cut emissions, teams might feel a bit better and make a marginal impact, but the net effects are limited—constrained—by the scale of the work. The benefit of this relatively small scale is that theatre can serve as a kind of petri dish, a microcosm of the larger world where artists can test ideas, imagine new modes, and model change. Reuse is a necessary component of any sustainable circular economy model, but linear design and production is still far and away the dominant mode. It will take time to change the biggest systems, and the traditional practices, new discoveries, and small-scale piloting in smaller, more nimble industries like theatre can serve to grease the wheels.

A work of art can reflect—and influence—the larger world. We who work backstage can inspire change not just with the art that we make, but with the way we make our art: respecting the constraints of the planet and of our fellow human beings.

Sandra Goldmark is associate professor of professional practice in the Department of Theatre and director of campus sustainability at Barnard College. She is also the founder of Fixup, a social enterprise that promotes sustainable, circular modes of consumption. Reach her at www.sandragoldmark.com

-SUSTAINABILITY IS GREAT BUT NOT ON MY SHOW
-2012 THESIS FESTIVAL- FIRST SUSTAINABILITY PUSH-
- - TOWN HALL SET/COSTUME- BUILDING BLOCKS FOR THESIS
- - - STARTING FROM CONCRETE RATHER THAN THEORETICAL PLACE
FREEDOM WITHIN FORM