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Oscars vs. Ozone: The Motion Picture Industry's Impact on Climate Change and What They Are Doing About It

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Abstract

Human activities, primarily the combustion of fossil fuels, have drastically altered Earth's environments, via warming, habitat loss, and loss of food and water security for the peoples and animals living in its biosphere (Intergovernmental Panel on Climate Change, 2023). The oft cited culprits for these changes are industries such as energy, transport, and agriculture (Intergovernmental Panel on Climate Change, 2023). One that frequently escapes public discourse on this matter is the motion picture industry. This thesis will focus on demonstrating that the motion picture industry, which includes, but is not limited to, film and television production (and, as such, will also be called 'the film and television industry'), has notably contributed both historically and currently to the global effects of climate change. Such contributions can stem from the industry's emissions (Sustainable Production Alliance, 2021) and waste (Victory, 2015), with examples including travel for cast and crew (Sustainable Production Alliance, 2021), energy use for production equipment and soundstages (some of which run on diesel) (Victory, 2015), and disposable physical sets and costumes (Environmental Media Association, 2014). It is somewhat common for film companies or productions to keep track of and occasionally share these statistics (Swart, 2023) but it is difficult to find research that has taken a broader approach and examined these characteristics of this industry as a whole. Endeavors that have are older (Corbett & Turco, 2006) and therefore their data is not accurate to present-day levels, which is an obstacle to accurately depicting the impacts of the industry today and how they have changed over time.

The goal of this thesis topic is not to be pessimistic and only disparage the motion picture industry for its activities and the harm they cause; pessimism is not usually a useful rhetorical tool for encouraging behavioral changes**.** Instead, the intention here is to give an accurate picture of the current practices of productions and share examples of progress occurring in the industry that are combating the negative impacts of these practices in the hopes of reducing (or altogether eliminating) them. This will hopefully demonstrate that there exist already proven successful methods that can be used to minimize or even reverse the motion picture industry's harmful impacts without significant changes to budget or efficiency.

It is impossible to find information on all types of productions, therefore most of the information utilized in this thesis is about "tentpole" productions, which are the largest in budget, billing, and release, making them the most reported on and most highly visible to those outside the industry. Other than having readily accessible data on their operations, using tentpole productions will allow the audience of this thesis to identify at least with the kind of media being analyzed, even if they are unfamiliar with the more complex processes within the motion picture industry that are known only to people within this industry or industries closely related to it. In summary, the goal is to make the issues and progress in this industry understandable to the average stakeholder (in this case, examples could include all consumers who participate in this market and, more generally, people who are affected by climate change) because currently there is a gap in up-to-date, comprehensive, academically and journalistically informed research on this timely topic.

One of the major findings of this research was that there are two big contributors to a production's negative environmental impacts: its energy consumption, both as production utilities and fuel for travel and equipment, and waste, such as props and sets but also single-use plastic from catering. There have long been sustainability-focused roles at major production companies, but several industry individuals have confirmed in sources used in this thesis that there is an underlying fear at these companies of bringing the 'wrong' kind of attention to the industry if major changes were made that suddenly show how poorly environmental issues were handled before they were enacted. This has led to a lot of talk and not much action, such as the founding of prominent multi-company alliances that focus on researching and educating about how to be 'greener' on set but do not enforce these practices on their own sets. As a result, third-party organizations and nonprofits have stepped in to help ease the transition and success of increased sustainability on set, providing services like set and general waste recycling, advising on facilities and equipment changes to reduce energy use, and connecting with local communities to donate unused meals or materials. However, convincing productions that these changes are necessary and to foot the bill for their services (often very small in comparison to the budgets of the productions they are

working on) is still something these consultant companies struggle with, according to some of the groups doing this work. One way productions are taking it upon themselves to improve is through the development and adoption of new technologies, which they can then use to generate profits by allowing other companies to utilize them, a promising avenue for sustainable change in the industry. Many notable production companies have also set goals for renewable energy use, net zero carbon and greenhouse gas emissions, and electric vehicle use within the next few decades, all of which seem increasingly attainable as even more technological development occurs in this fast-paced, ever-changing industry and the ones closely related to it. While it is by no means close to perfect, the research for this thesis finds that there are multiple innovative and quickly spreading options for lowering and eliminating a production's impacts within the motion picture industry, and there are a few ways they could become even more widely embraced.

One such way is through legislation, such as California's recently passed Advanced Clean Cars Program, which mandates that all new passenger cars, trucks and SUVs sold in California be zero emissions by 2035. Fuel is a huge component of the motion picture industry's carbon footprint, particularly from travel, so enforcing this law in other states highly utilized by the film and television industry could help minimize this component of a production's impact. Another example is through the creation of a tax credit, a huge factor in a production deciding where to film, that rewards sustainable behavior for productions. This would give a portion of a production's spending back to it, so long as it was on eligible sustainable measures determined by the issuing film commission or state government. An additional option could be a strategy mentioned previously: the enforcement of 'greener' practices on the sets of motion picture companies who are members of an industry group (such as the Sustainable Production Alliance) that has determined exactly how and where certain practices could lower a production's footprint. Any or all of these ideas could help advance the motion picture industry even further in its journey to do less harm to the environment in its work. Further research on this topic could involve comparing the sustainability goals of various production companies and evaluating their progress

and setbacks in reaching them. Alternatively, a line of research explored somewhat but not in depth in this thesis is how a production's footprint changes based on where it films; a more thorough comparison of state-by-state or even country-by-country differences could be enlightening to productions who want to factor in how 'green' they can be when deciding what location to film in. This industry is a highly visible and therefore a hugely influential one when it comes to establishing and spreading more sustainable ways to work, and the goal of this thesis is to show the necessity of and options for doing so.

Climate Change

The Science

Author Andrew Hoffman wrote in his acclaimed book *How Culture Shapes the Climate Change Debate* that "The United Nations Intergovernmental Panel on Climate Change (IPCC) [is] an organization of thousands of scientists that summarizes the vast body of climate science and presents conclusions in "consensus statements"...these consensus statements by the IPCC have been endorsed by nearly two hundred scientific agencies around the world." The IPCC wrote, in their sixth Assessment Report published in 2023, that "Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850–1900 [levels] in 2011–2020" and that, in turn, "Human-caused climate change is already affecting many weather and climate extremes in every region across the globe. This has led to widespread adverse impacts and related losses and damages to nature and people (high confidence)" (IPCC, 2023). This group uses qualifiers like "____ confidence" within their statements to show how statistically certain what they are saying is, based on data from around the world and their thousands of scientific contributors. Those two statements alone are cause for concern, but the IPCC gets much more specific in their writing to ensure readers feel the necessary sense of alarm from these truths, via analysis of the data and patterns that led them to make these statements. They describe how almost half (42%) of historical net CO_2

emissions occurred in just the thirty years between 1990 and 2019, primarily due to fossil fuel (such as oil and coal) combustion and other industrial processes (IPCC, 2023). The scientists also state that the sectors of energy, industry, transport and buildings accounted for about 80% of global greenhouse gas emissions in 2019, and about 20% came specifically from agriculture, forestry and other land use (abbreviated AFOLU) (IPCC, 2023), showing that there are sizable negative impacts from how those industries are doing business-as-usual. Other papers about the topic give hard numbers on the science: "The estimated global annual emissions of CO_2 were about 5 billion metric tons in 1950, increasing to 22 billion metric tons by 1990, with the most recent estimate (2019) reaching over 36 billion metric tons. This amounts to greater than a sevenfold increase in annual atmospheric CO_2 emissions in 70 years, while the world population rose only threefold in that same time frame" (Chapman & Ahmed, 2021). They also show exactly who is to blame: "As early as 2004, the United States and China emerged as the top emitters, accounting for nearly 40 percent of the world's total" (Posner & Sunstein, 2008). The IPCC has a goal of warming no higher than 1.5 degrees Celsius above 1850-1900 temperature levels to minimize the impacts of climate change as much as possible, given the damage already done, and uses models to show how this path (1.5 degrees) and other plausible temperature increases (such as 2 degrees) could occur in its report (IPCC, 2023). The specific temperature values modeled are based on theorized 'Shared Socio-economic Pathways,' meaning ways in which the world could develop in the time spans modeled, given current technologies and growth and potential increases/changes in them (IPCC, 2023). The scientists found that if annual CO_2 emissions from 2020-2030 were the same amount as emissions in 2019, nearly all of the carbon "budget" (total amount that can be emitted) for keeping warming at 1.5 degrees Celsius would be gone, and more than a third of the carbon budget for staying under 2 degrees Celsius would also be depleted (IPCC, 2023), making these minimally-detrimental pathways much more difficult to achieve. Additionally, they write that "assuming [carbon] policies that were implemented by the end of 2020 [are accomplished], projected [global] emissions…lead to a warming of 3.2 degrees, with a range of 2.2-3.5 degrees Celsius (medium confidence)" (IPCC, 2023), a much higher number than is ideal for ecosystems

and livelihoods to continue existing as they are now. Indeed, climate change is already and will continue to wreak havoc on global communities in a variety of ways if not dealt with decisively.

The Impacts

The Intergovernmental Panel on Climate Change is very clear in its writing of the sixth Assessment Report what will happen (and what already has) due to climate change: "Climate change has caused substantial damages, and increasingly irreversible losses, in [land and water-based] ecosystems (high confidence). Hundreds of local losses of species have been driven by increases in the [severity] of heat extremes (high confidence) with mass mortality events recorded on land and in the ocean (very high confidence). Impacts on some ecosystems are approaching irreversibility such as the impacts of…the retreat of glaciers…[and] permafrost thaw (high confidence)," (IPCC, 2023). In addition, they note that climate change has affected food and water security globally, two basic human rights, and that even when they are available, "the occurrence of climate-related food-borne and water-borne diseases (very high confidence)…have increased" (IPCC, 2023). Because of these issues and other "climate and weather extremes," populations are being displaced from Asia, Africa, and North America (IPCC, 2023), with one paper finding that "over the next 30 years, the global climate crisis will displace more than 140 million people within their own countries and drive many more across national borders," (Chapman & Ahmed, 2021). The latter source also detailed that UNICEF estimates there are one billion children who are "at extremely high risk of the impacts of the climate crisis," due to their increased vulnerability to disease, famine, and temperature extremes (Chapman & Ahmed, 2021). It is primarily poorer nations who will feel the brunt of climate change impacts, despite often contributing much less overall and per capita to greenhouse gas emissions that caused it (Chapman & Ahmed, 2021). A 2008 article details why: "The wealthy nations, including the United States, are in a much better position [to handle climate change] for three independent reasons: First, they have much more adaptive capacity. Second, a smaller percentage of their economies depend on agriculture, a sector that is highly vulnerable to climate change. Third, the wealthy nations are generally in the cooler, higher latitudes, which also decreases their vulnerability,"

(Posner & Sunstein, 2008). This does not mean there are not still dangers to these countries arising from climate change; the IPCC writes that they are highly confident that waiting to act will further cement the use of high-emissions infrastructure as the norm, leading to higher risks of stranded assets and costs for the industries reliant on them (IPCC, 2023). Stranded assets are those that turn out to be less profitable than expected because of changes caused by the climate crisis, such as natural disasters that destroy them, technological requirements/regulations that make them obsolete, and/or market shifts in cost or price that makes them undesirable to produce or consume. Climate change, if not combated swiftly, is certain to cause socio-economic problems to some degree worldwide, which is why it will take international cooperation, especially from the worst emitters, to avoid such problems.

How This Concerns the Motion Picture Industry

One could argue that the general welfare of peoples and ecosystems is enough of an argument to make the motion picture industry concerned about climate change. But if those reasons do not suffice, there are several other impacts that could be particularly damaging for this industry. The risk of stranded assets was mentioned previously, and the concentration of major film hubs along the coast (Los Angeles, New York City, etc.) means they are likely to be susceptible to this risk. The IPCC report asserts that climate change effects will include heatwaves and drought more frequently and in conjunction with each other as temperatures rise, leading to higher likelihood of wildfires, and stronger tropical storms and more flooding are also likely, particularly in “coastal and other low-lying cities and regions” (IPCC, 2023). Droughts are already negatively affecting California more and more frequently, as well as wildfires; flooding and stronger storms like hurricanes have impacted New York and southern states like Georgia, a rising favorite location for Hollywood, in increasing numbers in recent years. These weather extremes make ‘business-as-usual’ much more difficult to accomplish, and in an industry so focused on time management in order to minimize spending, more frequent climatic interruptions will lead to major setbacks. One way to demonstrate how these risks could create stranded assets for the motion picture industry is through the concept of an outdoor soundstage (such as the massive “ranches” found in

California). If temperatures are hitting higher highs and lower lows and there are more frequent instances of wildfire, storms, and flooding/landslides, it may become impractical to shoot outdoors and therefore this stage will become useless, making it a liability rather than an asset for the company that owns it. There is also the issue of sea level rise which will create "risks for coastal ecosystems, people and infrastructure" (IPCC, 2023), a category that encompasses places like New York and Los Angeles where filming often occurs. The IPCC warns that they have high confidence that once-a-century extreme sea level events will occur near annually in many coastal areas by 2100, and average yearly rates of sea level rise have tripled from 1901 to 2008 (IPCC, 2023), indicating that by the next century the industry may need to relocate to more climatically stable locations as L.A. and NYC are slowly overcome by the oceans that border them. These truths demonstrate why even an industry so seemingly disconnected from the issues of science and pollution needs to pay attention to and do their part in solving this multinational problem.

The Motion Picture Industry and Climate Change

Pivotal Publications

In 2006, the first wide-ranging study on the motion picture industry in California's contributions to air pollution and emissions was published by the University of California at Los Angeles' Institute of the Environment, a study they completed at the request of the California Integrated Waste Management Board (abbreviated CIWMB). In the paper, the authors write that "The objectives of the study were to identify existing environmental best practices within the industry, based on interviews and case studies…[and] throughout, the "motion picture industry" includes film and television production. The focus of the study was exclusively on the production side of the industry, not on distribution or on content," (Corbett & Turco, 2006). They also outline that "CIWMB selected the motion picture industry due to its high visibility: environmental best practices uncovered while studying the motion picture

industry are more likely to attract interest from and to be implemented by other industries," (Corbett & Turco, 2006). The report's contents are largely quoted, directly or indirectly, from industry individuals who shared their perspectives/opinions with the authors about the topics they were researching (Corbett & Turco, 2006). In terms of the data they included on the industry's activities, the research team used a tool called the "Economic Input-Output Life Cycle Assessment (EIOLCA)" that researchers at Carnegie Mellon University developed. They also utilized the publicly available Toxics Release Inventory information that the U.S. Environmental Protection Agency requires companies who create harmful toxins in their operations to report (Corbett & Turco, 2006). Using findings from 2003-2005, they created several charts comparing the footprint of the motion picture industry in L.A. to California and the United States as a whole by "identifying several other industries which are relevant in California as a basis for comparison: aerospace, petroleum refining, apparel, hotels, and semiconductor manufacturing…[these sectors were] chosen to include a benchmark that is thought of as highly polluting, such as petroleum refining and a benchmark that is thought of as clean, such as hotels, and a few other sectors which have significant presence in Los Angeles and in California, such as apparel, aerospace, and semiconductors," (Corbett & Turco, 2006). They analyzed common "criteria" (they use "conventional") pollutants like nitric oxide and carbon monoxide that are monitored by air pollution regulations across these categories, and stress that "[the] findings reported [in the resulting charts] should be interpreted, at best, as indications of relative orders of magnitude rather than precise estimates of impacts," (Corbett & Turco, 2006). The first chart they constructed shows a comparison of the level of pollutants from these industries in the L.A. metropolitan area. It demonstrates the finding that "within the Los Angeles metropolitan area, the size of the motion picture industry makes it the largest contributor to conventional air pollution of the five sectors for which we can determine the total emissions associated with their activity in the Los Angeles area," (Corbett & Turco, 2006).

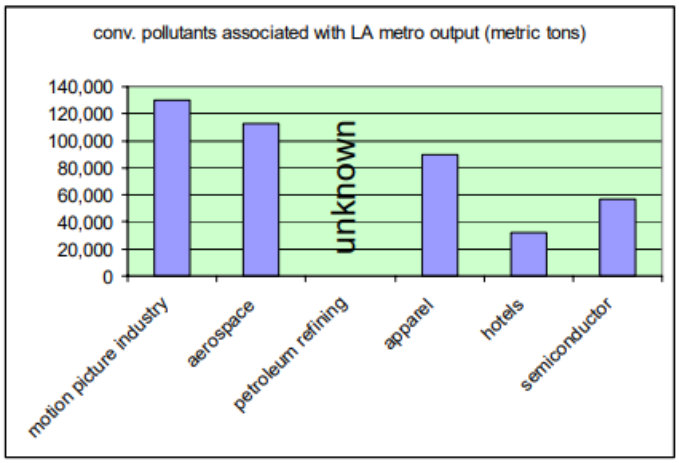


Figure 1. Metric tons of conventional pollutants associated with the motion picture, aerospace, apparel, hotel, and semiconductor manufacturing industries in the Los Angeles metropolitan area. Source: Corbett & Turco, 2006

The second and third charts, seen below, expand the comparison of these industries to the whole of California and the entire United States. In California, the considerable size of the film and television industry in the state leads to it having pollutant levels of the same magnitude as more high-polluting industries like semiconductor manufacturing and aerospace (Corbett & Turco, 2006). Across the U.S. the motion picture industry is much less prevalent than the other sectors studied, causing its pollutant levels to diminish considerably in comparison to the more widespread industries (Corbett & Turco, 2006).

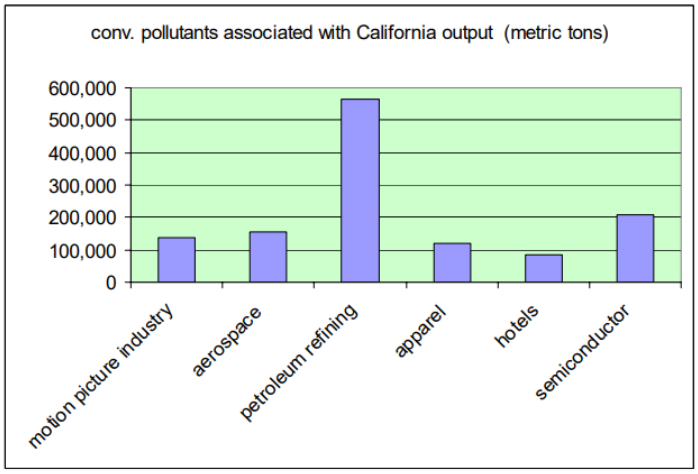


Figure 2. Metric tons of conventional pollutants associated with the motion picture, aerospace, apparel, hotel, and semiconductor manufacturing industries in the state of California. Source: Corbett & Turco 2006

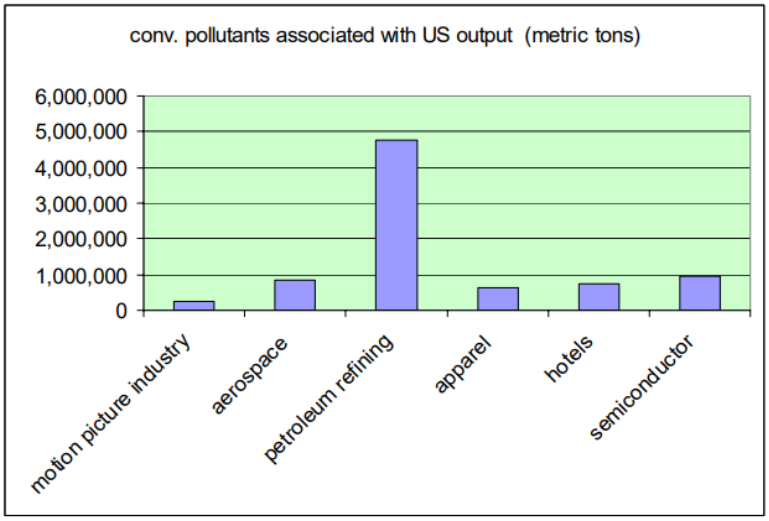


Figure 3. Metric tons of conventional pollutants associated with the motion picture, aerospace, apparel, hotel, and semiconductor manufacturing industries in the United States. Source: Corbett & Turco 2006

The findings for each sector's greenhouse gas emissions were very similar: the motion picture industry only trailed aerospace in emissions in the L.A. metro area, had a similar amount of emissions as hotels and apparel across California, and had a significantly smaller amount of emissions as compared to the other industries across the entire U.S. (Corbett & Turco, 2006).

Emissions and pollutants are not the only indicators of the lack of sustainability initiatives on set. There is also massive amounts of physical waste from discarded single-use items, props, and sets, with one interviewee telling the researchers that "It is usually cheaper for the art department to throw sets away rather than dismantle and reuse them, and indeed, most projects do not recycle sets because it is easier and more cost-effective to simply throw them away," (Corbett & Turco, 2006). There is also the matter of what these sets are built from: in addition to plastic products with long decomposition timetables like Styrofoam, the industry highly favors a material called lauan, found in tropical rainforests, in set construction. The authors write, "The environmental implications of using lauan include tropical forest destruction which in turn threatens indigenous cultures and habitats and contributes to global warming …despite their best efforts, [designers] find [lauan] substitutes inadequate, as one can make lauan look like anything else, to a degree that has not yet proven possible with other materials," (Corbett & Turco,

2006). Scripts are another massive source of waste, particularly on TV shows where they are constantly being edited and reprinted: one 2004 TV show used 1,255,000 sheets of paper in six months (Corbett & Turco, 2006). Even if a production using a soundstage in California implements recycling and other waste diversion practices, there is still the issue of what to do when they move to shoot "on location," meaning outside of the well-equipped studio lots.

Because of the sheer size of productions in the twenty-first century, shooting a production on location often means transporting dozens of people and tons of equipment to a site that may not be physically able to handle such intrusion. Authors Corbett and Turco (2006) detail how "To prepare for this army's arrival, the production may have to pave roads and prepare support services, such as restrooms, holding areas, meet other special needs that various departments may have, get the props ready, and prepare for craft services to offer catering and trash collection." Productions also have huge energy demands for all the lighting, cameras, trailers, and other equipment utilized, and providing enough of it outside of a studio lot often means the use of diesel generators, which create noise and air pollution (Corbett & Turco, 2006). It is also rare that all members of the production "army" are needed at once, giving those who are not required for a scene ample time to wander the location and damage the environment around the set (Corbett & Turco, 2006). Examples of this have occurred with many big-name films: a 2019 article from Kyle Fitzpatrick at *Vice* detailed how "Crew on 2017's *Pirates of the Caribbean: Dead Men Tell No Tales* allegedly dumped chemical waste while filming in Queensland, Australia, potentially tainting local water; 2015's *Mad Max: Fury Road* damaged sensitive areas on the African Atlantic coast while filming, endangering local reptiles and cacti; a contractor hired during *The Expendables 2*'s production damaged a protected bat habitat in 2011…[and] 2000's *The Beach* led to the ruin of Maya Bay Beach in Thailand." When considering these issues through the lens of present-day progress and knowledge, it may seem like most of them could be easily avoided if certain strategies were implemented. So why were they not?

Corbett and Turco found several common threads in their interviews with industry professionals as to why productions had not undertaken sustainability initiatives. The primary reason seemed to be that, in the motion picture industry, there is a "constant tension between creative and financial pressures…[constant] conflict between wanting to do things right but always needing to do things fast" (Corbett & Turco, 2006). One example of this can be seen in an article from *The Independent,* which described how a director shared with them her preference "to have all the lenses in a truck outside, so that when I needed a lens, I could just ask for it, rather than the night before having to make plans and check that the specific lens was ordered and delivered," (Aftab, 2007). This meant there was "an enormous truck that would follow her from location to location or sit idling at a studio" (Aftab, 2007), releasing emissions as it went, even though its presence could be easily avoided with minimal planning ahead by the creative team. There is also the fact that the industry is highly decentralized, comprised of thousands of contractors and small businesses. This leads to a "focus on short-term, everchanging production teams rather than long-term physical supply chains…[which] stand[s] in the way of its adopting many of the environmental programs that are common in more traditional industries," (Corbett & Turco, 2006). The authors write, "An additional challenge is that the studios do not make money operating sound stages, and thus they prefer to rent space from another studio if it is cheaper than using their own. As a result, studios have limited ability to encourage environmental behavior by the production crews on the sound stages, as a studio that is perceived as being too difficult to work with will not be able to rent out their sound stages" (Corbett & Turco, 2006), further emphasizing the prioritization of profits above all else. Even though some environmental practices might save a production money, it would have to be a savings of at least six figures to convince a larger set, which often spends that on just one filming day, to change its behaviors (Corbett & Turco, 2006). There is also fear of the wrong kind of attention that stops motion picture companies from pursuing sustainable measures. That same high visibility that made the CIWMB interested in enlisting UCLA to create their report is a reason that filmmakers do not want to change their behavior, as it may make their audiences aware of the fact that how they were working before was environmentally problematic (Corbett & Turco, 2006). This made it exceedingly difficult for the

researchers to get any “official”/concrete answers and access to the data and practices of the motion picture industry. This fact was reinforced in a deep dive into a decade of industry publications that the authors conducted. They identified that from 1991 to 2004, “motion picture and TV industry…demonstrated significant interest in environmental issues, both in the early 1990s and again since 2002, but…the bulk of this interest manifests itself in environmental content of shows and films and in environmental activism and philanthropy of celebrities, rather than in industry operations” (Corbett & Turco, 2006). They conclude their seventy-page report with a poignant statement: “From the environmental impact estimates, greenhouse gas emissions are clearly an area where the motion picture industry can be considered a significant contributor. From the interviews, it is clear that very few people in the industry are actively engaged with greenhouse gas emission reduction, or even with discussions of the issue,” (Corbett & Turco, 2006). Although this document was published in 2006 and much has changed in the film and television industry and public opinion since, similar issues still exist on the sets of present-day productions.

In 2015, Jonathan Victory authored an article titled "Green Shoots: Environmental Sustainability and Contemporary Film Production,” and it provides a useful update on where the motion picture industry was ten years after the UCLA publication. Victory (2015) starts by pointing out that sustainable advancements made in the industry could have a ripple effect on the other industries that work with and/or are influenced by motion picture companies, a point also made in the UCLA paper. He references an earlier Canadian report that detailed how energy consumption is a huge part of each segment of the production process, from offices used in pre- and post-production work to the building, operating, and lighting of sets during shooting (Victory, 2015). Victory (2015) acknowledges that thanks to innovations in technology, “the more widespread digital post-production process conducted entirely through computer equipment can be potentially powered by clean energy sources,” and uses that to explain why “[his] paper shall focus primarily on the pre-production and production stages of the feature film production process as they arguably comprise the most energy-intensive part of film production and [are] the part where

reducing consumption and minimizing environmental impact remains the most challenging." He then identifies lighting and the use of generators as the two most problematic on-set issues that he plans to discuss. For film lights, the issue arises in that their design historically has led to them putting out more heat than light, wasting much of the massive amount of energy they require (Victory, 2015). However, filmmakers are resistant to switching to more energy-efficient lights like LED because of their significantly distinctive look from traditional lights (Victory, 2015). One cinematographer told Jonathan Victory how "different types of lights can affect the color temperature of a shot: 'Basically because there are lots of different bulbs used to create one LED panel, you get weird color temperatures off them; they are not the same as the tungsten or daylight color temperatures which are the standard settings on most cameras,'" (Victory, 2015). This effect can be combated with the use of color gels, but LED lights still look "softer" and less like the usual direct light of tungsten bulbs (Victory, 2015). In addition to the uncomfortably hot environments film lights create, the use of on-set generators (often needed for location shoots with no electric grid connections) can lead to "particulate emissions, air quality [problems], and smog formation," which harm not only the actors and crew in the immediate vicinity but also the Earth's atmosphere as a whole (Victory, 2015). Making swaps to reduce these problems comes down not only to aesthetic and ease of use, but also manpower. Victory (2015) writes that, "Efforts to maximise the environmental sustainability of film sets will be difficult to implement and hard to measure without assigning a specific person or team of people to organise them." He contends that the unit production manager has the oversight to do such, but this would be another burden on their "already considerable workload" (Victory, 2015). He debates the potential of "Production accountants…[being] tasked with some kind of auditing of a set's waste production, energy consumption and carbon footprint," but comes to the conclusion that "implementing the environmental measures necessary to mitigate these is most likely outside the skill-set of accountants," (Victory, 2015). These questions are likely also being raised in the offices of production companies, and with no clear answer to them, it seems the environmentally harmful practices of film sets will continue to go unchecked.

In addition to analyses done by parties outside of the motion picture industry, several publications have been released by industry groups that are concerned about the footprint of their sector. One such report is the Screen New Deal, an ambitious plan to revolutionize how motion picture production works. The authors analyzed nineteen "tentpole" productions, which have the largest budgets, in order to "highlight the maximum potential impact of a single given production" (albert et al., 2020). They found that "transport has the largest impact in terms of carbon emissions, accounting for just over 50% of total emissions for tentpole productions" and of that, "70% is associated with land transport, and 30% with air travel" (albert et al., 2020). The next biggest culprit for emissions is energy, primarily as electricity and gas consumption; this comprises 34% of these productions' total emissions (albert et al., 2020). Interestingly, the authors noted that the "wide use of diesel generators accounts for 15% of total carbon emissions" (albert et al., 2020), further corroborating the discussion of their detrimental impact in earlier sections of this paper. The authors created the chart below detailing the breakdown of an average tentpole production's carbon emissions, as reported by the production using the Production Environmental Accounting Report (PEAR), a tool resulting from the collaboration of two film and television industry groups, the Sustainable Production Alliance and the Producers Guild of America's PGA Green Initiative.

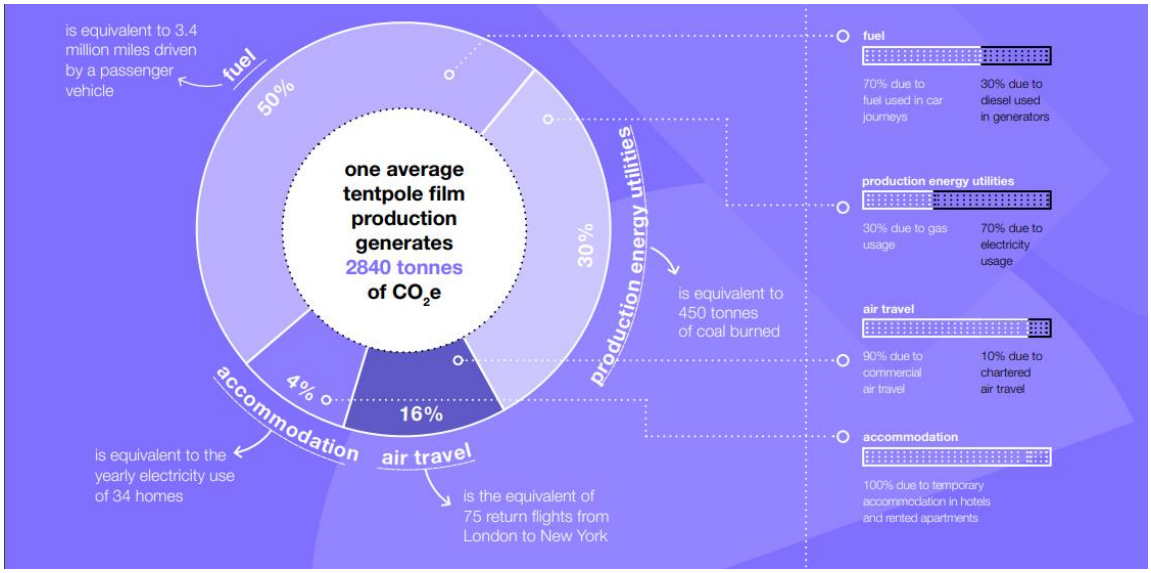


Figure 4. Data analysis of the carbon emissions resulting from an average tentpole film production.

Source: albert et al. 2020

The Sustainable Production Alliance, whose members include "Amazon Studios, Amblin Partners, Disney, Fox Corporation, NBCUniversal, Netflix, Participant, Sony Pictures Entertainment, ViacomCBS and WarnerMedia," released a similar report (Sustainable Production Alliance, 2021). The report, titled "Carbon Emissions of Film and Television Production," shares "industry-wide production carbon emission averages for SPA's member company productions in the years between 2016 and 2019…[including] 161 feature films, ranging from tentpole movies to medium and small films, and 266 television series, from single and multi-camera TV series to scripted and unscripted shows, shot…around the world." The carbon emissions data was collected with the use of PEAR, the same reporting structure used in the Screen New Deal's analysis. The results are shown in the following charts, which show average emissions per feature/episode and classify them by category, separating the type and size of productions for added insight into the differences between various kinds of sets.

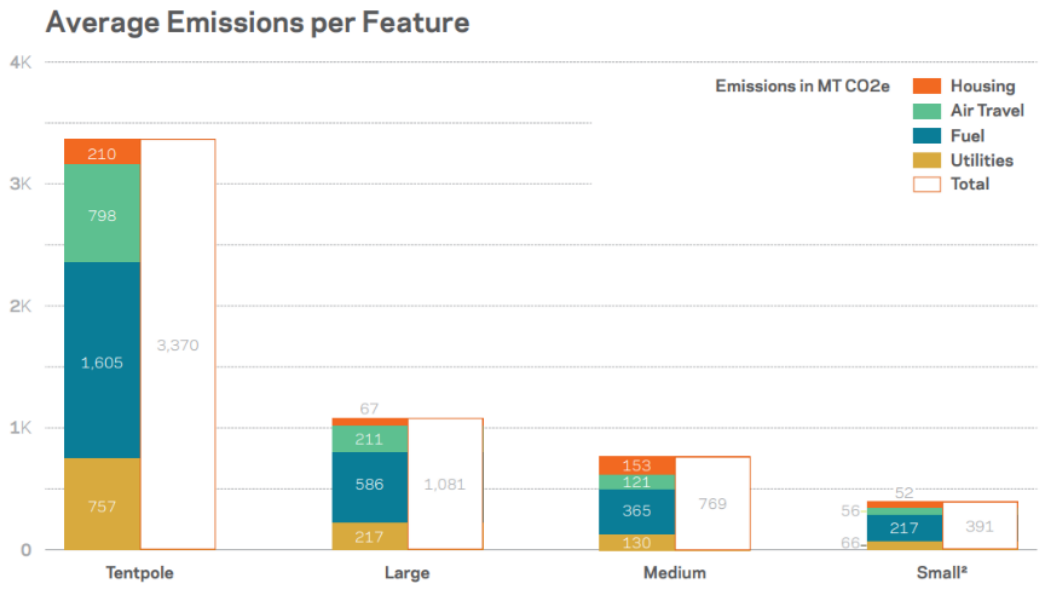


Figure 5. Average carbon emissions for feature-length films, categorized by the size of the below-the-line budget for the production. A tentpole has a budget of USD $70 million and above; a large production is between USD $40-70 million; a medium production is between USD $20-40 million; and a small production is USD $20 million and below. Source: Sustainable Production Alliance 2021

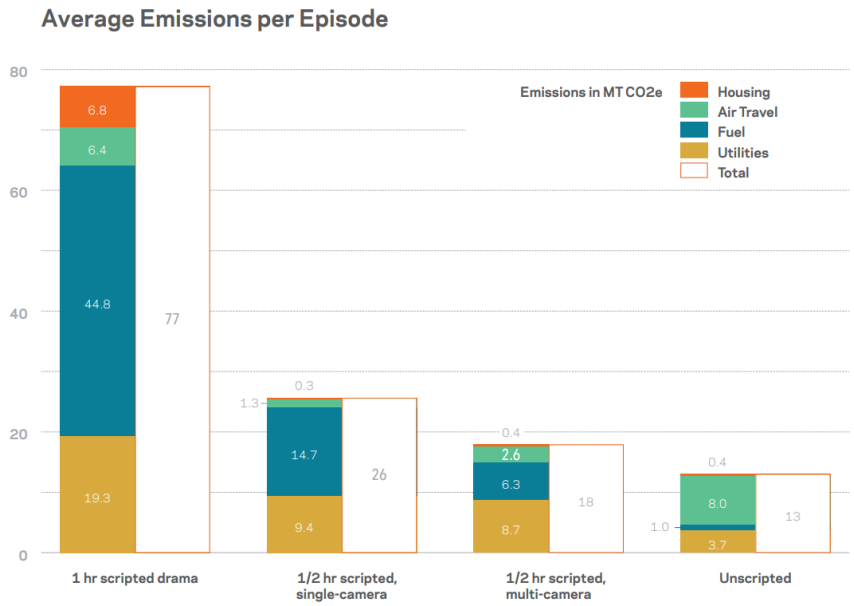


Figure 6. Average carbon emissions for television series, categorized by the format of production. Source: Sustainable Production Alliance 2021

The report gives context to some of the disparities between emissions levels, noting "Differences in these averages are not only because of the length of the show. In general, one-hour scripted dramas film on location more often than 1/2 hour scripted single-camera shows. Additionally, 1/2-hour multicamera shows are faster to film than 1/2-hour single-camera shows and are mostly filmed on stage with very little, if any, location shooting," (Sustainable Production Alliance, 2021). These results are still striking: even the "smallest" feature film emits carbon emissions in a quantity equal to seventy-six homes' yearly electricity use, and unscripted television episodes emit the equivalent of driving three gasoline-powered passenger vehicles for a year (Environmental Protection Agency, *Greenhouse Gas*). Considering there are hundreds of productions larger than these in this study alone, the implications of it are that there is massive, detrimental environmental impacts occurring due to the operations of these companies.

Another crucial factor to consider is that film and TV creation has become an activity not limited to the borders of California in recent decades. A publication by film students at Columbia University in New York City details how productions filming there struggle to be sustainable. They write, "often,

throwing away old sets, furniture, and costumes is the cheapest and most logistically manageable option for New York productions for the short-term," (Stalter et al., 2018). Additionally, "productions in New York City rarely have control over emissions from utilities…because productions lease sound stages, which are operated and maintained by companies or individuals that are independent of the productions" (Stalter et al., 2018), indicating that any changes productions would like to see in terms of utilizing clean energy sources are completely out of their control, unlike on studio lots or soundstages owned by the production companies. Even when sets in the Big Apple pursue sustainable practices, it often comes with little financial gains to justify them: "Productions spend an average of $44,500 to implement sustainable initiatives on-set. However, these initiatives save them an average of $44,000," (Stalter et al., 2018). These disparities among regional filming locations and their respective footprints are even larger across states like Georgia and California, who have become two of the most competitive sites for motion picture productions in recent decades.

Location, Location, Location: Regional emissions differences

Why California?

"Hollywood" has been a word that conjures images of celebrities, blockbusters, palm trees, and glamour for many decades, but it was not always the movie mecca it is today. Through the turn of the nineteenth century, bigger, more well-established cities like New York and Chicago served as the locations for what little moving image productions there were (Roland, 2017). However, as the ability to make longer films became possible, directors needed more reliable weather than these cities boast, and cheaper labor than they were currently paying (Roland, 2017). A 2017 Hollywood history recap from PBS of Southern California detailed how, "Los Angeles was also known at the time [1910s] as the capital of open-shop, non-union labor, where businesses could exploit cheap workers in large numbers…wages for carpenters and other service personnel were 25-50% cheaper than on the East Coast." Another reason for filmmakers' escape to California was that it was far from the extremely litigious Thomas Edison and his company, Motion Picture Patents Company, a.k.a. "the Trust," which "held patents on motion picture

processing and projection equipment" and made "aggressive and intimidating demands for licensing fees" of those who used them (Roland, 2017). Once there, though, motion picture makers found even more reasons to stay, like the diverse geography and largely available (therefore cheap) land on which they could build the studios of their wildest dreams (Roland, 2017). California then became a popular filmmaking destination, but it was World War One that cemented its status as the movie capital of the U.S. Roland of PBS SoCal writes about this transition, explaining that "films were needed to replace European products; more efficient production facilities were needed to make them; more money was needed to finance them; and more theaters were needed to show them. It was only at this point that "Hollywood" began to designate the entire movie-making machine." The rest is (cinematic) history.

Why Georgia?

California rested on its laurels for many years, unchallenged as the most desirable place to create a film in the U.S. In the past couple of decades, however, many states have worked to present themselves as viable locations for motion picture making to invest its large budgets. A hugely successful example of this is Georgia, who in recent years has become so prolific in filmmaking it has earned the nickname "Y'allywood" or the "Hollywood of the South." The latter phrase appears on a page from the New Georgia Encyclopedia (2007) website that also stated, "In the five years spanning 2013 through 2017, more projects filmed in Georgia than in all previous decades combined." A variety of factors made this possible for the Peach State, but there was one major selling point for Hollywood: one of the most generous tax credits in the country.

Being on the East Coast and a fairly populous and history-rich state, Georgia had been an attractive location for films since the beginning, but it was the 1972 film *Deliverance* that put the state on the movie map (Dominey, 2007). Craig Dominey (2007) of the *New Georgia Encyclopedia* writes about the topic, "*Deliverance* was locally controversial in its perceived depiction of mountain residents as backwoods hillbillies. But the production was an economic boon to the state, a fact not lost on then-governor Jimmy Carter. He established a state film commission in 1973 to market Georgia as a shooting

location for future projects." Several successful movies were made in the following years, but nowhere near as many as Hollywood was producing in the same period. This started to change with the creation of a production tax credit by Georgia in 2005, which "produced a $475 million economic impact to the local economy, an increase of 283 percent from 2004" (Klowden et al., 2010). Hoping to capitalize on this, Governor Sonny Perdue raised the credit even further in 2008, and the Georgia Department of Economic Development (2008) released a press statement that said the following: "'We know that our excellent talent base and outstanding locations make Georgia a very desirable place to film,' said Governor Sonny Perdue. 'This legislation puts in place the economic cornerstone that will encourage producers to convert that desire into action.'…'The new incentives will put Georgia among the top five states in the U.S. in terms of financial competitiveness for entertainment projects,' said Ken Stewart, commissioner of the Georgia Department of Economic Development (GDEcD)." The 2008 legislation made it so that the "potential [tax credit] total of 17 percent [increased] all the way up to an eye-catching 30 percent on all qualified film-related spending in Georgia. The current tax credit includes a 20 percent base credit for filming, post-production work, and video game development and animation with a minimum expenditure of $500,000 in a single year. An additional 10 percent credit called the Georgia Entertainment Promotion is available if filmmakers include a Georgia logo or similar placement in the final project" (Klowden et al., 2010). These are similar rules to other states, but Georgia sets itself apart by not mandating an end date on when qualified productions must fulfill and claim it by (Dockterman, 2018). A *Bloomberg* article by Gregory Zbylut (2023) compared how the Georgia program sized up to its biggest competitor, California, writing, "Georgia's film credit applies to any production, be it game show, talk show, film, or episodic television. By contrast, California excludes commercial advertising, music videos, talk shows, game shows, sporting events, awards shows, reality television programs, documentaries, variety programs, daytime dramas, [and] half-hour episodic television shows…In addition, Georgia requires that production companies spend at least $500,000, whereas California requires a minimum $1 million." It is not just the tax credit drawing in studios, though, as cost savings can be found in other areas of production too in Georgia: "Georgia's relaxed labor rules mean employees don't have to belong to a union, though

major studios and production companies usually use union crews. The union salary for a "grip" who works with a camera crew can start at nearly $38 an hour in California. The same position, unionized through the local chapter, pays about $26 an hour in Georgia. Taking into account union and pension contributions, labor costs for that position in Georgia are about 25% lower than in California," (McWhirter & Schwartzel, 2015). Hollywood lawyer Stephen M. Kravit (2016) explains why the generosity from Georgia in *The Movie Business Book*, stating, "For a local economy, a visiting production can mean a substantial boost, as millions of dollars can be spent during shooting," (Kravit, 2016). And the benefits for the state do not stop when the cameras quit rolling; one town in Georgia has taken on a new life after *The Walking Dead* filmed there, bringing in year-round tourism revenue despite the show ending years ago (Dockterman, 2018). It is easy to see why Georgia has worked so hard to encourage deep-pocketed producers to choose their state over all the rest for their next blockbuster, and in many, many instances in the past dozen years, it has worked.

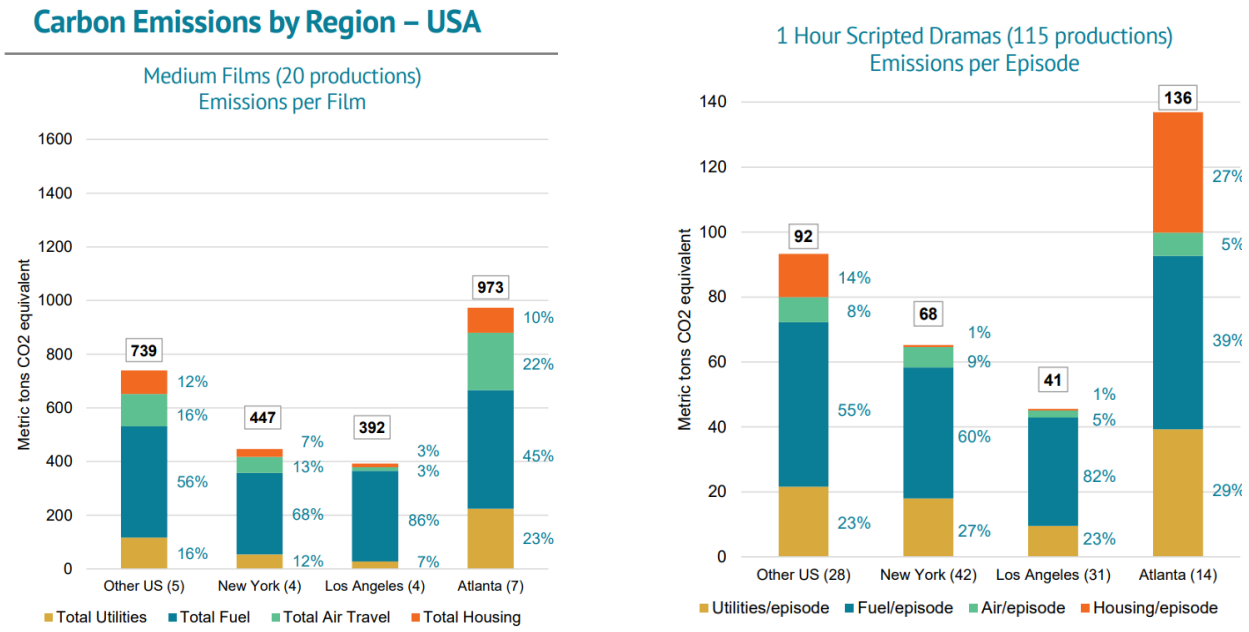
The Rise of "Y'allywood"

Georgia has had several feet in the door of the media industry for years, including being home to "the Turner empire, which includes CNN headquarters, TNT, and the Cartoon Network," and the well-known status of Atlanta as a major center for hip-hop music (Klowden et al., 2010). The 2008 tax credit hike has exponentially increased the presence of this industry since its creation, so much so that "In 2016, more major feature films were made in Georgia than in California, according to data from the Los Angeles film office" (Dockterman, 2018). "Superproducers" like Tyler Perry and studios like Marvel have put down major roots in the Peach State, building massive soundstages and even mini-towns for crews to live in (Dockterman, 2018). In an article titled "How Georgia Became the Hollywood of the South," Eliana Dockterman (2018) at *TIME Magazine* writes that, "In 2007, the film industry spent $93 million on productions in Georgia. In 2016, it spent over $2 billion. In the past decade, the tax perk has attracted the *Hunger Games* franchise, the *Fast and Furious* movies… television hits like *Stranger Things*, critical darlings like *Atlanta* and reality series like 'The Real Housewives of Atlanta'." Georgia had over 450 tax

credit-qualified TV and film productions take place in fiscal year 2018, each of which spent at least $500,000 in the state to earn this designation (Ho, 2018). Rodney Ho of *The Atlanta Journal-Constitution* wrote in an article (2018) that "The Governor's office said there was $2.7 billion in direct spending in the state from these productions, which ranged from "The Walking Dead" and "Ozark" to "Tag" and "Mile 22,"…the same amount as the previous year, when some big-budget extravaganzas such as "Black Panther" and "Avengers: Infinity War" were in production. Overall, it's [a] ten-fold increase from 2008 before the tax credits were [increased]." The numbers of productions and dollars spent have certainly only continued to tick higher; it seems Georgia's hope to make the "Y'allywood" moniker true is undoubtedly being realized.

Challenges to 'Greener' Sets

Another major difference between California and Georgia, and the one of most note for the topic of this paper, is that the environmental footprint of each state as it relates to the operation of the film and television industry is vastly different. The Sustainable Production Alliance created the following charts as a more specific look at regional carbon emissions, with the numbers drawn from the same dataset used for the 2021 report "Carbon Emissions of Film and Television Production".



Carbon emissions by region and production type. Overall, data was collected from 75 film and 242 TV productions in the USA, and 22 film and 39 TV productions in Canada. The following summary shows total and percent average emissions sources by region based on the production type with the most data per region. For medium-sized films, being Atlanta-based results in about 2.5 times more emissions than being L.A.-based. For hour-long scripted dramas, Atlanta productions create over 3 times more emissions than L.A. ones.

Source: Sustainable Production Alliance 2022

Housing and total utilities have some of the largest discrepancies in metric tons of CO_2 emitted across the two regions, likely because of the dissimilar sources of energy in each region. Georgia is home to three of the top fifty dirtiest power plants in the United States; California has zero power plants in the same list (Hope, 2022). Environment Georgia (2022) writes on their page that, “In 2020, the 10 most climate-polluting plants in Georgia were responsible for 91.5% of global warming emissions from the power sector [in the state] despite only generating 56.5% of total electricity.” Air travel is also much higher in the Atlanta region, as stars, executives, and even sometimes crew members (if Georgia cannot provide enough of them, due to their lack of a longstanding motion picture-related talent base) must be flown into the area repeatedly if they do not have a residence there to stay in throughout filming and post-production/reshoots. The filming locations across the Atlanta region are also more scattered than in L.A.,

due to increased available space to build on (Dockterman, 2018), causing even more travel for those working on productions there, further raising the emissions of each one. This, in combination with the general population growth of the area, has resulted in worsening air quality conditions for the region, in some years becoming so poor that they have barely met EPA standards (Lutz, 2022). According to data from the U.S. Energy Information Administration (January 2023; April 2023), Georgia consumes seven times more energy from coal than California, despite the latter having a population four times the size of the former. In terms of electricity generation (which may be exported for use to other states), Georgia generates eighty times more coal-fired power than California (U.S. Energy Information Administration, January 2023; U.S. Energy Information Administration, April 2023). In contrast, California generates thirty-two times more hydroelectric power and six times more nonhydroelectric renewable power than Georgia, specifically as electricity (U.S. Energy Information Administration, January 2023; U.S. Energy Information Administration, April 2023). The Energy Information Administration (*Coal explained*) shares on its website that "Several principal emissions result from coal combustion…[leading to] acid rain and respiratory illnesses…smog…haze…lung disease…[and] both neurological and developmental damage in humans and other animals," and that "in 2021, CO_2 emissions from burning coal for energy accounted for about 20% of total U.S. energy-related CO_2 emissions and for nearly 60% of total CO_2 emissions from the electric power sector." Coal-firing is a massive contributor to greenhouse gas production, resulting in exacerbated climate change effects that, as previously discussed, are wreaking havoc on global communities and will only worsen unless the world significantly reduces its collective emissions. Hydroelectric power, on the other hand, only potentially creates large emissions if fossil fuel-burning power sources are used to produce the concrete and steel used to make it (U.S. Energy Information Administration, *Hydropower explained*). However, the EIA (*Hydropower explained*) points out that "given the long operating lifetime of a hydropower plant (50 years to 100 years) these [initial] emissions are offset by the emissions-free hydroelectricity." Other renewable energy resources also may have some emissions associated with them in the short term, but given their ability to be utilized multiple times, unlike coal or other nonrenewable sources, it is likely that net emissions from their use will be zero or

negative. Because energy use is typically one of the biggest components of a production's emissions, studios and stars concerned about the environmental impact of their operations should take into consideration the grid cleanliness of the states that are trying to draw them in with generous tax credits and lower labor/living costs.

Industry Roles, Research, and Reactions

And productions have been worried about the environmental impact of their operations, as evidenced by the creation of groups to research and calculate just how big of a footprint their work creates. As early as 2003, Corbett and Turco (2006) found that "environmental manager" was a role at several major studios, including Twentieth Century Fox and Warner Bros., and that these managers "share information about their environmental practices freely with each other, and…meet regularly." *The Hollywood Reporter* published a "Sustainability Issue" in June 2022, and one article was about the environmental executives at major film companies and what their motivations were today. Lisa Day, manager of environmental sustainability at The Walt Disney Co., repeats the sentiment of twenty years prior when it comes to sustainability on set, saying, "We [entertainment companies] can be as competitive as we want to at the box office, on our linear channels and our streaming services, but this [environmentalism] is an area where we really need to be cooperative and not competitive," (Chuba, 2022). Jennifer Lynch, senior VP of corporate social responsibility and internal communications at Paramount Pictures, also chimed in on the topic, sharing her perspective that "Someone that might be working on *Mission: Impossible 7* for us this year, when they go to work…for Warner [Bros] next year, they bring with them that sustainable expectation and behavior….Then it doesn't just become a studio-by-studio initiative — but an industry-wide one," (Chuba, 2022). Warner Bros./Discovery's director of sustainability, Mike Slavich, added to the conversation as well, stating "For a lot of us, looking back and seeing how quickly and how effectively the industry mobilized to address the challenge of the pandemic and come up with solutions that we could all agree upon and implement quickly on that scale, is a great lesson for sustainability…I think that you can apply those learnings and say, 'OK, let's apply those same

resources, that collective effort to solving some of these other problems,'" (Chuba, 2022). There are still several major roadblocks within the industry, with Slavich noting that "Fuel still remains the biggest impact area of our production…because of the heavy-duty vehicles that we're using and the generators that are required to power our sets…On the vehicle side, there just isn't inventory yet [of] the alternatives [like electric or hybrid vehicles] in place to be able to purchase those vehicles. With generators, as well, there isn't an inventory of mobile batteries that can replace the power needs that we have," (Chuba, 2022). This has not stopped the studios from trying to curb the problems that they can, though. *The Hollywood Reporter* article (2022) outlines the various ways each one is stepping up to the challenge to lower their impacts: "Disney has a 2030 goal for achieving net zero greenhouse gas emissions for direct operations; Sony aims for 100 percent renewable electricity by 2030…Paramount is part of the U.S. Department of Energy's Better Climate challenge, committing to a 50 percent greenhouse gas reduction in 10 years; NBCUniversal aims at being carbon neutral by 2035; Netflix projects it will achieve net zero greenhouse gas emissions by the end of 2022; and Amazon has a 2040 net zero carbon goal and says it's on track to powering its operations with 100 percent renewable energy by 2025. Across the board, the companies have pledged to focus on water conservation (via artificial landscaping and water refill stations), energy efficiency (via renewable energy sources and conservation), waste minimization (via reusing, recycling, and composting), low emission transportation (via electric vehicles) and sustainable building design (via LEED certifications)," (Chuba, 2022). While this list is by no means exhaustive of everything the industry is undertaking, it shows the across-the-board commitment of these companies to do a little more good.

This commitment can also be seen in the industry organizations formed to learn about and combat the negative side effects of filming. One such organization is the Environmental Media Association, which began a "Green Seal" program in 2003 because they "wanted to be able to work behind the scenes with productions to teach people how to be more sustainable," according to EMA's Chief Executive Officer, Debbie Levin. The EMA website describes the Green Seal program as a "recognition program honoring progress in sustainable production for movies, television shows (animated and live action)

filmed commercials and print advertising," (Environmental Media Association, *EMA Green Seal*). The program operates on a 200-point scale, with a minimum of 75 points required to receive EMA Green Seal recognition (Environmental Media Association, *EMA Green Seal*). In recent years, some projects have done enough to earn 125 points or more, and for them the EMA awards a Gold Seal of recognition (Environmental Media Association, *EMA Green Seal*). The award ceremony is highly publicized and often has several notable celebrities present as recipients or presenters, which furthers the prestige and therefore appeal of earning a Green or Gold Seal. Another example is the Producers Guild of America's (a trade association for producers dating back to the mid-1900s) establishment of their 'PGA Green' committee, which went on to establish the Production Environmental Accounting Checklist or PEACH that provides scores for films applying to the EMA Green Seal program. In 2010, PGA Green partnered with the Sustainable Production Alliance, a "consortium of the world's leading film, television, and streaming companies dedicated to accelerating the transformation of the entertainment business into a more sustainable industry," (The Credits, 2020). Together, they created the *Green Production Guide*, which would eventually publish the "Carbon Emissions of Film and Television Production" report discussed earlier in this paper. This report concluded with a look at the future endeavors of the SPA as it related to the findings of the study. The authors wrote, "Given that emissions from fuel use are most often the primary contributor to a production's carbon footprint, SPA has prioritized finding solutions to transition the fossil fuels used in film and television productions to clean, renewable energy solutions…electrical grid tie-ins reduce the need for diesel generators…When tie-ins are not available, emerging developments in battery generator technology promise [can be] clean, portable power alternatives…Powering… with battery generators directly improves air quality on set while also eliminating noise pollution, improving human health while reducing overall carbon emissions for the production," (Sustainable Production Alliance, 2021). The GPG continues to research and report the environmental impacts of the motion picture industry, as well as develop and share tools and methods to help reduce them.

The interviews done by the UCLA study also yielded similarly interesting avenues for affecting change in the motion picture industry. Interviewees stressed their experiences that the industry was based on systems of seniority and mentorship, and therefore changes would have to be made by the more well-connected and influential figures to stick (Corbett & Turco, 2006). The authors wrote, "When asked how environmental best practices could best be implemented within film production, these interviewees agreed that the production hierarchy within the motion picture industry must become the vehicle for implementing any "green" production strategies, and that, furthermore, it is crucial to first "educate and influence the influential." Each interviewee further recommended that the unions within the industry would be significant resources for helping to educate the "influential" - directors and producers - about green practices and that the DGA and PGA would be the most effective unions to do so," (Corbett & Turco, 2006). This statement proves that the later decision by PGA to develop a committee dedicated to sustainability with the goal of publishing and disseminating information and tools about "green" production was a wise one. Interviewees also referenced the success of the American Humane Association (AHA) Film and Television Unit when theorizing how new practices could be enforced on set (Corbett & Turco, 2006). The AHA got involved in film in the 1940s and continued to be vocal about animal rights on set until they successfully obtained an agreement with the Screen Actors Guild (SAG) and the Alliance of Motion Picture & Television Producers (AMPTP) in the 1980s (Corbett & Turco, 2006). Ever since, the "No Animals Were Harmed..." disclaimer has become so commonplace in the end credits of films it is hardly noteworthy, a major victory for the AHA advocates. The research team writes that "during our conversations with individuals within the motion picture industry, the animal welfare analogy was raised several times as a model towards which the environmental production guidelines should strive. The encouraging conclusion one can draw from this is that an outside organization such as the AHA can be effective in ensuring widespread adoption of better practices," (Corbett & Turco, 2006). The paper goes on to identify the Leadership in Energy and Environmental Design (LEED) "green building rating system" and the ISO 14001 "environmental management systems standard" as two potential outside organizations that could help increase the sustainability of sets/studios. According to the authors, LEED is

a “complete framework for assessing building performance and meeting sustainability goals…[that] emphasizes state of the art strategies for sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality,” (Corbett & Turco, 2006). Warner Bros. had already used LEED standards for a remodel of one of their buildings at the time of the study’s publication in 2006, and LEED’s popularity has only increased since. ISO 14001 is not as popular in the United States but is well-known and utilized internationally, which creates the opportunity for U.S.-based productions that “[don’t] yet have an environmental management system in place” to have a “framework provided by ISO 14001 [as] a reasonable place to start” (Corbett & Turco, 2006). Additionally, the global popularity of it means that “holding [a production] company to this internationally recognized standard allows it to compete more effectively in today's global marketplace” (Corbett & Turco, 2006), potentially leading to greater profits for a company willing to invest the money, time, and energy in adhering to these standards. In an industry so fixated on finances and fame, any route to improved sustainability that reputable individuals or organizations endorse and/or results in reduced costs is one they just might be willing to try out.

In the twenty-first century, more and more productions are willing and able to adjust their standard practices to make themselves a little ‘greener.’ One example is Christopher Nolan’s 2010 film *Inception*, which utilized solar power for the base camp of its set, a component that requires “about 10%-20% of the power that the set requires” (d’Estries, 2010). The two sequels to *The Matrix*, both released in 2003, had at least 12,000 tons of materials utilized in their sets, but the production worked on “a joint project between Warner Brothers, the city of Alameda [filming location], the Alameda County Waste Management Authority, and The ReUse People [non-profit recycling organization], [through which] 97.5 percent of all the set material was recycled,” (Corbett & Turco, 2006). Jordan Peele’s 2022 film *Nope* pursued several sustainability initiatives on set, including “[working] closely with their fuel vendor to obtain renewable diesel fuel, which has approximately 80% less lifecycle carbon emissions than standard diesel…[using] LED set lighting, which use 70% less energy than conventional counterparts…avoiding

the use of over 170,000 plastic water bottles by using reusable and aluminum bottles…and [donating] 2,200 meals from excess catering to those in need in the Los Angeles area," (NBCUniversal, 2022). *Nope* earned a Gold Seal from the EMA as a celebration of their numerous efforts to reduce their environmental impact. As impressive as all these accomplishments are, there are some organizations and innovations going above and beyond even these high benchmarks to "green" the habits of Hollywood.

Case Studies

Earth Angel: "Strategy, Staff, Stuff and Stats"

Founding

Emillie O'Brien attended New York University's film school and realized quickly after graduating that she wanted to focus on the intersection of sustainability and filmmaking. In a 2021 interview with *Atmos*, she shared that she "was shocked by the sheer amount of waste on film sets," adding, "Film is also a circus-like industry. We come in, we set up camp, and then we leave. But it requires a ton of power, transportation, and diesel generators," (Demasi, 2021). This paper has previously discussed the damage caused by these processes at length, and O'Brien knew she wanted to help further along the elimination and improvement of these environmentally unfriendly ways of doing business. She told *Huffpost* in 2017, "I felt compelled to use my environmental activism and knowledge of production to help advance [sustainability on set]. I took my first job as an Environmental Steward on a Big Beach movie back in 2011, where I spent approximately 16 hours per day digging through set trash. It was on that job that I earned the nickname Earth Angel," (Dong, 2017). Her exposure and reputation from working on that first film led her to booking two more blockbusters, Darren Aronofsky's *Noah* and Sony's *The Amazing Spider-Man 2* (Dong, 2017). After her success in both "greening" these sets and demonstrating why it was important, she decided to transform Earth Angel from a nickname to a business (Dong, 2017).

Process

The Earth Angel website (*Services Overview*) has a section titled "Our Model," which outlines how their "on-set sustainability experience [has] resulted in identifying the four key areas that have to be addressed when implementing sustainable production practices: Strategy, Staff, Stuff and Stats. Simply put: it's all about the 4 S's." Speaking to Reana Johnson (2021) of *Refinery29*, founder O'Brien emphasized that "sustainability efforts have to be just as easy and obtainable as other methods: '[Sustainable options] have to be part of the infrastructure. It has to be just as easy as picking up the phone and calling that one vendor that they used to call all of the time. And it will show up tomorrow. It's got to be like that.'" Jennifer Sandoval, current director of business development at Earth Angel, was kind enough to answer a few questions for this thesis about how the company is introduced to and strategizes with productions, along with what goals and challenges they often have. She said the usual way they are approached to work with a production is by "either a studio, production company or producer…mostly above-the-line person. However, we have been really lucky to work with incredible department heads and crew that may have had some influence with the production in hiring Earth Angel," (J. Sandoval, personal communication, November 8, 2023). In terms of how they get things done, she said, "Our main areas of impact are waste management, clean energy, fuel reduction and sustainable sourcing. Together with our Strategy Manager, we come up with a customized plan that is approved by the production. Because the supply chain and infrastructure are not the same in every region, and because each production is unique, the production goals may vary from one project to the next. So, we really make our recommendations based on the informed decisions of the client," (J. Sandoval, personal communication, October 25, 2023). She got into the specifics, sharing "If productions are kind of starting out with their sustainability efforts, we usually start with a basic waste management plan where we encourage multi-stream collection and sorting all of the production waste on site. Our on-the-ground Eco Reps, who are part of the crew, are absolutely critical in assisting with these efforts as it is not always very straightforward. Having waste vendors that understand the specific needs of the film and television industry and providing the productions with the right equipment to be able to sort properly will generally lead to higher diversion

rates. After awhile, the crew will get the hang of what goes where and we can see better outcomes," (J. Sandoval, personal communication, October 25, 2023). O'Brien echoed this sentiment this year in a conversation with Sharon Swart of *The Hollywood Reporter*, stating, "When productions sign Earth Angel on to a project, they'll have up to seven specialists that will be working on the project throughout the process, including experts in analytics, material recovery, waste and energy strategy, education, industry relations, as well as a project supervisor and on-set eco-coordinator. We're a sustainability department. We are working every single day on-set along with our fellow departments." When asked if they are ever successful enough on a set to change behaviors so that they don't need to be rehired, Sandoval replied, "Because Earth Angel's services cover all aspects of sustainability, it is difficult for productions to really take on the work themselves as they simply do not have the time and capacity to do what we do. We have an entire "back of house" team that supports our Eco Reps and Eco Coordinators. They help with everything from budgeting, to strategy, to finding and providing fully trained Eco Reps, to sourcing green vendors and also data collection and reporting. Our services are very comprehensive so until this work can someday be fully integrated into other crew roles, or until productions hire their own sustainability departments, productions can rely on Earth Angel to do this work for them, sort of like an outsourced Sustainability Department," (J. Sandoval, personal communication, October 25, 2023). O'Brien has also pointed out the benefits of having such well-trained consultants to reporters before: "There's a lot of different actions that you can take, and I think it can feel overwhelming to people, but [by] really dialing in on: Okay for this project, we want to focus on eliminating single-use plastics for this project. We want to focus on getting as many hybrid and [electric] vehicles as we can onto this project, like really zoning in on what's available to your project, [sustainability can work]," (Wilson, 2022). However, coming up with relevant 'green' solutions is only half the battle: Earth Angel still must convince the productions to undertake them.

Challenges

Sandoval admitted in her interview that "Probably the most difficult thing is trying to get production to cover the sustainability costs," (J. Sandoval, personal communication, October 25, 2023). O'Brien has also stated that as a hurdle, telling Swart (2023) that "One of the largest contentions to bringing us on a project is creating a new line item in the budget, [though] more and more productions are seeing the value." She shared that Earth Angel's overall services average around $30,000-$40,000 per project, but also pointed out that if productions were able to find funds to meet the COVID crisis, the climate crisis should be met with a similar urgency (Swart, 2023). However, it is not easy convincing an industry that focuses so heavily on the bottom line to change business-as-usual, especially if it comes at an added cost. Discussing her early experiences with promoting Earth Angel's mission, O'Brien described how "I started a business for a previously non-existent service. That in itself is our biggest obstacle. The fact that this is uncharted territory and that most production budgets do not even include line items for sustainability means that I often have to fight just to be able to do my job," (Dong, 2017).

Another challenge is time: Sandoval and O'Brien have both emphasized that the earlier Earth Angel is brought onto a project, the more likely it is that they can identify where improvements can be made and incorporate the costs for doing so into the budget before principal photography begins (J. Sandoval, personal communication, October 25, 2023; Swart, 2023). As time goes on and more concern for the climate crisis grows, the industry is warming up to making sustainable changes, but making them happen is still particularly difficult in the U.S. Swart (2023) writes, "Production execs who have worked with Earth Angel note that part of the issue that's working against greener sets is that there isn't one vision for sustainability on a national scale in the U.S. Sets tend to be greener overseas because there's much more existing infrastructure, as some countries are already ahead in terms of eco-mindedness. Luckily, Earth Angel is still finding ways to move Hollywood forward in the fight for sustainable sets.

Success Stories

In 2019, CBS' *Evil* contracted Earth Angel to help lower their set's carbon footprint (Low, 2019). Some of the ways they did so included "no paper scripts or call sheets, only hybrid cars for transportation to set, biodegradable eating utensils, water stations on set in lieu of single-use plastic bottles, untouched food [was] donated to food banks or nonprofits, [and] when the production [wrapped], set decorations and furniture [were] given to organizations like Habitat for Humanity," (Low, 2019). Jennifer Sandoval shared that "If we are fortunate to be hired to work on a television series, we tend to get invited back for subsequent seasons as the crew may be more receptive and everyone has a better understanding of what is possible and tend to want to do better," (J. Sandoval, personal communication, October 25, 2023). This certainly does not mean movies are any less interested in contracting Earth Angel's services: Fox 2000's 2019 film *The Woman in the Window* also hired Earth Angel for 53+ shoot days in New York City (3BL Media, 2019). Over the course of eight weeks, their set avoided the use of 57,600 plastic bottles, recycled 13 pounds of electronic waste and 17 pounds of textiles, donated 86,371 pounds of materials, and avoided 24 metric tons of CO_{2e} using hybrid vehicles (3BL Media, 2019). In addition, 47% of all lumber purchased was certified by the Forest Stewardship Council, the Sustainable Forestry Initiative, or the Programme for the Endorsement of Forest Certification (PEFC), and the Wardrobe Department purchased 25% of the movie's costumes from thrift stores, rather than new from retailers (3BL Media, 2019). Another recent partner of Earth Angel is the critically acclaimed 2022 film *The Whale*, directed by Darren Aronofsky, an earlier admirer of founder Emillie O'Brien's work (they previously collaborated on *Noah* in 2014) (Swart, 2023). On *The Whale*, Earth Angel was able to help the crew "divert 5.4 tons of materials from landfills and recover an additional 2.1 tons of donations during its wrap, achieving an overall diversion rate of 82 percent," (Swart, 2023). Some of the materials were donated to a local performing arts academy and over a thousand meals were donated to local food banks (Swart, 2023). As impressive as these numbers are, they are a mere fraction of what Earth Angel has been able to accomplish since its founding in 2013.

Impact

The Earth Angel website has an entire page dedicated to "Our Impact," and the numbers do not lie: they are making a difference. In their 2022 report, they share that they worked on 32% more projects than 2021 and 49% more than 2020 (Earth Angel, *Our Impact*). The forty-one 2022 productions included four feature films, 19 television shows, and 8 commercial productions; across all of them, 5,042 metric tons of carbon dioxide were avoided, the equivalent of 567,346 gallons of gasoline not being consumed or 981 homes' energy use for one year (Earth Angel, *Our Impact*). Aggregating across all their years of operation, Earth Angel has diverted 19 million pounds of waste from landfill, recovered 241,000 meals for food banks and those in need, avoided 16,016 metric tons of carbon dioxide, saved 901 trees, avoided nearly 3.9 million plastic water bottles, and donated 365,372 pounds of material (Earth Angel, *Our Impact*). Perhaps most importantly to their clients, they have saved $1.2 million for the productions they have worked on (Earth Angel, *Our Impact*).

As previously discussed, consensus on the need for action to avoid the worst dangers of climate change is all but universal among scientists; as the same becomes true for industries, they will be looking for more innovative ways to reduce their own impacts and lessen the likelihood of dire global consequences from climate change. For the motion picture industry, working with a company like Earth Angel is a great place to start.

The Amazing Spider-Man 2: "We compost in the kitchen, which is disgusting, but we do it."

Partnership

As mentioned in the previous section, one of Earth Angel founder Emillie O'Brien's first major films that she worked as a sustainability consultant on was Sony's 2014 blockbuster *The Amazing Spider-Man 2*. Emillie shared about that gig in an interview with Trina Dong (2017), saying "Spider-Man was the hardest job I've ever done. I even gave myself tendinitis from lifting garbage day in and day out. But it

proved the success of the model of having a designated sustainability representative on the production to make these achievements possible." Her work would help make this film "the most eco-friendly blockbuster in Sony Pictures' history," (at least, at the time) (Dong, 2017), as well as a recipient of a Green Seal from the Environmental Media Association, an organization mentioned earlier that scores a film's self-reported sustainable practices and awards those that go above and beyond in their pursuit of 'greener' sets. Debbie Levin, president of the Environmental Media Association, told the Hollywood Reporter a simple truth made evident by Earth Angel's collaboration with Spider-Man: "At the end of the day, for the cost of an eco-manager's salary, you could be saving thousands of thousands of dollars and saving obviously unbelievable resources for the environment," (Girkout, 2014). Indeed, through O'Brien's efforts, *The Amazing Spider-Man 2* saved around $400,000 (Girkout, 2014), ten times how much Earth Angel's services typically cost. This is obviously a huge achievement for one production, especially one the size of this film, and the production team was not shy about sharing how and why they turned a beloved red-and-blue superhero a little more green.

Saving Another Kind of 'Green'

The main source of information for how ASM2 accomplished its sustainability goals is a promotional reel put together with members of the crew (Environmental Media Association, 2014), who each share a little about how their respective departments did their part to help reduce their production's environmental impact. Mark Friedberg, production designer, shared that "We have…stores of walls from old sets that we are constantly reusing…We're gonna have a lot of steel to give back, we're gonna have a lot of glass to chop up and give back" (Environmental Media Association, 2014). In total, over 49 tons of materials were recovered or donated, which the video (2014) states is equal to 142 NYE balls. John Frazier, special effects supervisor, described that "All the snow we used is totally biodegradable, [the] atmospheric smoke is all water-based…which makes it less harmful for the atmosphere and the actors," (Environmental Media Association, 2014). In a similar vein, stunt coordinator Andy Armstrong said that they used biodegradable material to recover spilled oil and other byproducts from their car crash stunts,

ensuring these fluids did not get into drains of where they were filming (Environmental Media Association, 2014). O'Brien shared that they began a textile recycling program for all the loose fabrics left over in costumes, which they would then take to weekly farmers markets to sell (Environmental Media Association, 2014). She also stated that they were able to donate leftover food after lunch in the amount of 5,861 meals, all going to a local shelter, which was the equivalent of 7,620 lbs. (Environmental Media Association, 2014). The team also conserved almost 200,000 plastic water bottles, enough to surround the island of Manhattan, and diverted 755 tons of the set's total waste stream, equal to 3 Statue of Liberty's (Environmental Media Association, 2014). Costume designer Deborah L. Scott described how in her department, "We use eco-friendly detergents, we use mostly cold water" and added that "We compost in the kitchen…which is disgusting, but we do it" (Environmental Media Association, 2014). The latter statement shows that even if people may be resistant to change in 'business-as-usual,' the collective buy-in of the whole production can make these changes easier to embrace, as they become the new norm for 'business-as-usual.' O'Brien recognized this early on, telling Trina Dong at *Huffpost* in 2017 that "From sorting food waste on the catering truck to instructing actors on proper recycling procedures to making refillable water stations readily available at video village, our day is mainly about making the Earth Angel system easy, convenient and consistent for all cast and crew to adjust to…Being in the trenches alongside them before call time, and even after the cameras are off, is the way that we've earned our industry's respect." Of course, a little positive reinforcement never hurts, and that is one method O'Brien utilized while on set with ASM2. She shared in the YouTube video (2014) that "We did a Green Crew Member of the Week, and they would get some kind of a prize, be it a Sony t-shirt or free movie tickets or Blurays. People got really into it!...My problem right now is I have too many people I want to reward, which is a great problem to have!" This further reinforces the idea that getting *everyone* excited and willing to participate in these sometimes-tedious activities is a crucial part of success. E. Bennett Walsh, executive producer, echoed this sentiment: "Because it's on the set, because it's in the office, everybody just started to get the habits of it, and it has an impact," (Environmental Media Association, 2014). And the impact is not contained just to the set of *The Amazing Spider-Man 2*; makeup

artist Howard Berger stated that, after seeing the massive benefits of 'greening' the Spider-Man set, "Working on this movie, I'm going to go back home to LA and implement a little bit more stricter policies in terms of being green and recycling," (Environmental Media Association, 2014). This domino effect is the ultimate goal of Earth Angel when working with a production, and it is safe to say the *Amazing Spider-Man 2* crew passed with flying colors.

Amazing ~~Spider-Man~~ Social Media!

Emillie O'Brien did not stop at tasking the crew members to be more sustainable in their everyday lives through her work on *The Amazing Spider-Man 2*. She, with the endorsement of Sony, also took to Twitter, creating the handle @EcoSpidey and providing exclusive content like "factoids on production-based measures (such as: "755 tons were diverted from landfill or reused while making The Amazing #SpiderMan 2—that's the same as 3 Statues of Liberty"), shout-outs to "Green Crew Members of the Week," photos of the stars' involvement in community activities such as tree planting or bike riding, and posts linking the film to environmental cross-promotions" (Ashe, 2019). This helped ASM2's sustainability messaging reach a much wider audience than just those working on the Sony lot where filming occurred. The Twitter campaign encouraged users, Spidey fans or not, to "step up 2 the challenge of being sustainable" and referenced Spider-Man's iconic "#withgreatpowercomesgreatresponsibility" mantra as motivation to join the ASM2 team in efforts to be 'green' (Ashe, 2019). EcoSpidey also did cross-promotion with the organization Earth Hour, created by the World Wildlife Fund, which sponsors a one-hour turn off of all lights and non-essential appliances at events across the world (Ashe, 2019). The two organizations did a "co-joined publicity tour and online campaign with several videos featuring Spider-Man and its cast endorsing the event," leading to total funds raised for WWF of $60,000 (Ashe, 2019). With far-reaching and inventive methods like this, it is easy to see why activists praise *The Amazing Spider-Man 2* so highly, even to this day, for its accomplishments in sustainability.

The Volume: "The culmination of over a decade of innovation in the virtual production space"

The Filmmaking Revolution that Began with a Roar

In 1991, Steven Spielberg's *Jurassic Park* made a revolutionary leap forward with its use of computer-generated graphics for its dinosaurs. At the time, it was an unsanctioned experiment by the digital artists working on the film. Time was of the essence, as per usual for films working on tight budgets, but it was also their greatest challenge when trying to design these programs from scratch. Digital artist Jean Bolte has said that "it took a long time, I think it was six months to paint one dinosaur" (Kasdan, 2022), and the film had plenty more than one dinosaur in it. Painting them to look realistic was only half the battle: they also had to roar and run realistically. Steve Williams, special effects artist and animator, shared in a documentary about the movie's making that "It took me four months to figure out that [the first T. rex running] animation" (Kasdan, 2022). However, although the initial CG learning curve was steep, it was not long before the special effects team got the hang of it. Williams stated that "The last shot I animated was the Rex chasing Jeff Goldblum…by that time, you know, it took me just five, six days to animate that shot," (Kasdan, 2022). Director Steven Spielberg recounted that upon watching the first animated T. Rex running shot, "I had a kind of religious experience, and probably the greatest epiphany I've ever experienced in my own world of making movies. That was the moment that I suddenly saw that everything was going to change…and we're never going to go back," (Kasdan, 2022). He was right. Ed Catmull, computer graphics artist, summed it up well: "Now suddenly…these projects that George [Lucas] has initiated, in the video editing…in digital audio, in the computer graphics, all of them come together, and the industry changes in about a three, four year time span," (Kasdan, 2022). And the world of filmmaking was never the same.

How It Works

A couple of decades later, a new pioneer in this field emerged: actor, director, and producer Jon Favreau. Favreau directed the live-action 2016 remake of *The Jungle Book* and wanted to use the

opportunity to improve the possibility for interactive light on sets and actors while filming a blue/greenscreen-heavy film; his goal was to accurately capture the "things that you cannot fake later effectively" (Baruh & Bestenheider, 2020). He was able to improve but not perfect this process and pushed the envelope further on the 2019 live-action *Lion King*. For that film, he utilized virtual reality to stage the shots planned for the film, from which he could then practice and analyze camera and light placement in the VR space to make sure light and shadow were captured accurately when actually filming (Baruh & Bestenheider, 2020). This meant less reliance on CGI (computer-generated imagery) in the post-production process to fix any inaccuracies that occurred during day-of filming, saving time and money for the production. Just a few short years later, Favreau's dream to avoid post-production headaches from day-of filming's mistakes would make lightyears of progress in being realized, with the creation of "The Volume."

To hear Favreau put it, the creation of The Volume is not particularly impressive: "The technology was there. Using newly available hardware, these fast video cards for gaming, these really good screens, and motion capture technology, so you had positional data on the camera. We made what we call the Volume. Because that's what they call a motion capture volume. It wasn't like we coined it, we were just using that term," (Kasdan, 2022). But just like those first CG dinosaurs in 1991, this tool's use is likely to forever change the way of filmmaking. Industrial Light and Magic (ILM, for short), the company that began under George Lucas in 1977 and created the revolutionary special visual effects of *Star Wars*, *Jurassic Park*, *Casper*, and *Rango*, was also the company that built The Volume. Chief Creative Officer of ILM, Rob Bredow, said about their development process, "The basic idea is, what if you had a perfect screen that surrounded you almost 360 degrees, above you and all of your sides, and you could make any digital environment that you wanted to create on that wall. It's thousands of these small patches that make up this seamless wall, and it's really kind of amazing…It's just a continuous surface to your eye and to the camera," (Kasdan, 2022). Technically speaking, The Volume is a "20' high by 270-degree semicircular LED video wall and ceiling with a 75'-diameter performance space, where…practical set pieces [are]

combined with digital extensions on the screens," (Industrial Light and Magic, 2020). How it works is that digital artists take real photos of locations or set pieces and manipulate/expand them to fill the entire wall of screens, at a level of detail that actor/director Taika Waititi has said "Sometimes you'd walk into that Volume and you wouldn't even realize where the screen were…even to the human eye, you'd get deceived and you wouldn't quite be able to figure out where the practical stuff ended and where the LED screen began," (Baruh & Bestenheider, 2020). Julie A. Turnock, author of *Empire of Effects*, described it as "a functional equivalent of rear-screen projection…a kind of real-time compositing," demonstrating how ILM managed to take pieces of old processes and new ones to develop this new means of making media. This "wall of screens" allows everyone on set to see effects and backdrops while they are shooting, rather than being surrounded by blue or green sheets for months and hoping everything looks right in post-production. This was exactly the goal at ILM, and an extremely impressive one at that. Tom Grater (2021) at *Deadline* wrote in an article about The Volume, "The…giant LED screens…display high-quality digital backdrops that encircle a production stage and move as the camera moves, creating a real-time, dynamic landscape. Rendered via gaming software, these photo-real images effectively remove the need for green screen." The effect of the walls "moving as the camera moves" is a phenomenon called parallax, which means the position or direction of an object appears to differ when viewed from different positions; this is what the use of positional camera data accomplishes. It is the same concept as in first-player video games, wherein what a player views as they move throughout the game changes with their position. These various digital advancements had been steadily improving and growing more accessible in the twenty-first century, but the major feat of ILM was, as Jon Favreau puts it, "[combining them] in a way nobody's done it before" (Baruh & Bestenheider, 2020). For filmmakers, actors, producers, and executives who have been fortunate enough to work with The Volume, it has made a galaxy of difference.

Rave Reviews

The Volume's first major use was on the Disney+ series *The Mandalorian* in 2019, and it got rave reviews from all parts of the production and the greater film and television industry for how seamless it

made creating such a complex and highly anticipated series. Janet Lewin, co-producer on the show, said about The Volume that it "allows filmmakers unparalleled creative control and collaboration during prep and shoot, which is a game-changer on a huge visual effects driven series like *The Mandalorian*" (Industrial Light & Magic, *Stagecraft*). For a series as beloved and expansive as Star Wars, fans have lofty expectations for worldbuilding and visual effects. This feeling was shared in a quote from Chris Bannister, ILM's Executive Producer of Virtual Production: "One of the things that made virtual production a perfect fit for *The Mandalorian* is that they had to create an entire series worth of Star Wars landscapes at the same cinematic quality that the franchise has always embraced," (Grater, 2021). The Volume was able to deliver that. Jon Favreau, who created, executive produced, and directed parts of *The Mandalorian*, said that "What [George Lucas] was able to achieve with a lot of time and money with the [*Star Wars*] prequels, we were able to do on a TV schedule and budget because we were afforded all of that through the technological innovations that had happened since he had done that," (Kasdan, 2022). As previously discussed, budget is the end-all, be-all in motion picture making, so finding ways to reduce it is always a goal in the forefront of everyone's mind. *The Mandalorian* season one was able to entirely avoid location shoots thanks to the use of The Volume, a huge source of savings for the production. Rob Bredow, CCO at ILM, has described how The Volume can make it so "you can be anywhere in the world…if you want to be in Iceland one day, and you want to be in the desert the next, you can literally change between those locations with a button click back at the computer that's controlling the Volume," (Kasdan, 2022). Dave Filoni, executive producer and director of *The Mandalorian*, seconded this: "We could change the Volume within the half-hour to be a completely different set" (Baruh & Bestenheider, 2020). Bredow explained that this massively increased the location possibilities for the show, sharing, "You can bring these locations — these amazing desert locations, these amazing buildings that you would probably never be able to take a crew of 100 or 200 people to, because they just might not be suitable for that big of a team," (Lee, 2020). Co-producer Janet Lewin noted similarly that "Rather than relocating the cast and crew from one location to another, *The Mandalorian* team shot half of the series on one Stagecraft [general name for The Volume] that provided more than 60 backdrops," (Lee, 2020). The

biggest benefit of the Volume by far, though, was the freedom and control it gave back to the creatives using it. This includes actors like Carl Weathers, one of the stars of *The Mandalorian*, who said "I found it [The Volume] as liberating as anything I've ever worked on, because…you didn't have to pretend anymore" (Baruh & Bestenheider, 2020), and directors like Rick Famuyiwa, who has done several *Mandalorian* episodes and shared that "I found that what it did was that it…put me back in a set…the freedom of that was invaluable," (Baruh & Bestenheider, 2020). Additionally, technical crew got out of it the ability to capture "as-if-shot-on-location lighting aesthetic" (Turnock, 2022), to "shoot more quickly on the day, and acquire many in-camera finals, [reducing] VFX shot costs…a major benefit considering today's compressed post schedules" (Industrial Light & Magic, *Stagecraft*), and to "see everything come together in real-time on a monitor on set; if a particular effect isn't marrying well with your backdrop, you can make an adjustment there and then," (Grater, 2021). As wonderful as the time and cost savings from such a versatile tool are, executive producer Kathleen Kenedy put it best when discussing the root of why The Volume works so well: after many years of polka-dot pajama "costumes" and massive blue and greenscreen "sets", "I think we're getting back to real filmmaking" (Kasdan, 2022).

Lights, Camera, Less Impact

The benefits The Volume brings to the creators of motion pictures are notable and exciting, but if those were the only ones it had, it would not be a worthwhile inclusion in this paper about the motion picture industry and climate change. Luckily, The Volume's innovative traits also greatly improve the sustainability of the productions using it, not just their bottom line. As mentioned earlier, its use completely negated the need for location shoots in *The Mandalorian* season one, saving emissions from travel and energy use in the places they might have traveled to without it (Industrial Light and Magic, 2020). *The Hollywood Reporter* wrote in its 2022 Sustainability Issue that "The studio [Disney] reported that the technology [The Volume] reduced the show's carbon emissions by an average of 30 metric tons for each shooting location eliminated" (Chuba, 2022), which is the same carbon emissions from over 3,000 gallons of gas consumed, according to the Environmental Protection Agency's Greenhouse Gas

Equivalencies Calculator (2023). The Volume also required only about half the set to be physically built, as the rest could be "extended…off into the distance digitally," (Kasdan, 2022). A massive room of screens may seem like an electricity bill nightmare, but Janet Lee (2020) at *Variety* wrote in an article "the team used LED-powered lights that use 70% less energy than the equivalent incandescent light." Rob Bredow, ILM's Chief Creative Officer, expanded on this, saying: "There's a lot of construction that can't be reused after a big production. You save on all of that with virtual production—you can use these LED walls for years. It does draw some power, but they're quite energy efficient. You can also re-use backgrounds. We have generic locations from all over the world where people have commonly shot movies, such as Iceland. All you need to do is layer your own production design and set dressing," (Grater, 2021). And this is just the beginning for The Volume and technology like it.

Drawbacks

While there are many notable upsides to utilizing technology like The Volume, there can also be negatives to production relying on it. The primary concern arising from a shift to virtual production tools is how they alter and potentially eliminate the workflows and job roles present on a set. The film and television industry operates on a "line" system, wherein "the 'line' refers to the separation between worker categories. Workers hold specific legal privileges and distinction by whether they are identified as being a "creative" (above-the-line) or "technical" (below-the-line)" (Hendricks, 2022). Tech like The Volume could disrupt the usual divisions that help determine pay, seniority, and time on set for workers in this industry, and this may cause problems for the unions and guilds that are organized around specific above-the-line and below-the-line occupations (Hendricks, 2022). Some of the roles that have been eliminated historically on virtual production projects include "production designers, set dressers, hair stylists, make-up and costume designers, special effects technicians, and boom operators," and a producer on the tech-heavy film *Avatar* (2009) described how "When we are on a live-action set you'll have more than 100 people. When we're on a [motion] capture-set, we will maybe have 15 people," (Hendricks, 2022). Jobs that still do exist are experiencing a change in responsibilities, with one study finding that

“Cinematographers are losing the ability to claim sole authorship of cinema images as visual effects artists and other authors now participate in the design and creation of each shot of a Virtual Production film narrative,” (Hendricks, 2022). There is also the key challenge of learning these modern technologies that makes their adoption harder, as it will require additional time and money for a production to either find or train a workforce to be proficient with new virtual tools (Hendricks, 2022). This is in addition to the cost of purchasing or accessing the tools in the first place if the production company does not have their own systems to work with. While virtual productions are becoming more ubiquitous as advancements occur and disseminate more rapidly, there are still “traditionalists” like directors Martin Scorsese and Francis Ford Coppola who remain opposed to the use of heavy visual effects. Prominent Hollywood figures like these two men hold much sway over the opinions of the rest of the industry (Hendricks, 2022), presenting further challenges to the widespread use of these “extended reality” tools like The Volume, despite their cost-effectiveness and lower environmental impact. A lot of doubt still exists among film and television creators about the merits and drawbacks of virtual productions, but that is not stopping companies like Industrial Light and Magic from continuing to innovate and improve these tools.

The Future

As outlined earlier, this technology has been the result of a steady march forward in digital innovation for over three decades. Industrial Light and Magic only hopes to continue pushing it farther. Lisa Day, the manager of environmental sustainability at The Walt Disney Co, outlined to *The Hollywood Reporter* that “It's still in its infancy, obviously, and we're doing a lot of work to try to figure out where the line is,” (Chuba, 2022). It might not make sense to do every piece of media in a mostly digital environment, but if it can save time, money, and the environment, Day believes it is worth it to experiment (Chuba, 2022). The Volume’s technology has already been used for feature films, episodic series, music videos, and commercials (Industrial Light & Magic, *Stagecraft*), demonstrating its versatility. ILM writes on their website, “With 3 purpose-built StageCraft volumes located in the greater

Los Angeles area and one in Vancouver, British Columbia available for hire for all types of work…For those filming elsewhere in the United State or in Europe, we can build a mobile, or pop-up, bespoke volume designed to meet your project's specific needs when and where you need it," (Industrial Light & Magic, *Stagecraft*). Director Taika Waititi, who worked with The Volume when he directed episodes of *The Mandalorian*, employed a pop-up version in Sydney, Australia for his Marvel film *Thor: Love and Thunder* (Grater, 2021). The ILM team also does not want cost to be an issue for those wanting to try out The Volume for whatever media they are making. In a recent article from *Deadline*, Tom Grater (2021) wrote that, "The Stagecraft team are keen to note that, while the majority of fully-fledged virtual production shoots to date have been blockbuster-level projects, their vision is for the tech to become viable for all levels of filmmaking. 'Our target pricing has been to achieve a Stagecraft day for less than the price of what it takes to move a production across the same town,' [Rob] Bredow [CCO of ILM] explains, 'It can work out creatively and economically favorable. We find crews commonly shoot 30-50 percent more pages or coverage per day, depending on how they want to use that efficiency. It opens up the possibility for Stagecraft to be used on a wide variety of productions.'" It seems the sky is not even the limit for Industrial Light and Magic, seeing as they have already conquered solar systems. One thing is for certain: movie magic is getting a lot more eco-friendly with the use of tech like The Volume, a positive change that could not come too soon for the motion picture industry and the global communities it affects.

Greening or Greenwashing?

While all these advancements certainly are impressive steps for the motion picture industry to take in reducing their environmental impact, much of the 'green' accomplishments and accolades arise from within industry sources and reporting. This creates the potential for a phenomenon called "greenwashing," through which media scholar Toby Miller (2019) says "governments, corporations, individuals, unions, non-government organizations, whatever we consider to be agents or actors in the social world endeavor…to legitimize their activities by saying 'we're pro-environment,' when in fact, this

is a bit of a cloak for other activities." Miller (2019) frames this phenomenon in the motion picture industry as the result of there being more obvious culprits in the climate change debate, such as oil extraction, and therefore little critical attention is given to the comparably harmless operations of the motion picture industry. He says that to get the full picture of this industry's negative impacts, consumers must think about the many sources of labor and materials, and who controls them, to understand the ramifications of business-as-usual (Miller & Suresh, 2019). For example, film cameras can be built with rare metals mined using techniques dangerous both to people and ecosystems (Williamson, 2023), but that is rarely (if ever) discussed as a consequence of the motion picture industry's operation. Although the physical materiality of this industry is shifting with the change in consumer preferences from VHS and DVDs to video-on-demand and streaming, there are still invisible environmental consequences. In 2018, video-on-demand-related internet services created 102 million tons of carbon dioxide emissions (Hoad, 2020), the equivalent emissions of twenty homes' electricity use for one year (Environmental Protection Agency, *Greenhouse Gas*). With the switch to digital, media productions require more data storage both during and after filming, and continual increases in quality/definition are leading to one data executive to state "total market demand for entertainment and media digital storage is projected to more than double" by 2025 (Lan, 2022). One source stated that "larger data centers can consume up to 5 million gallons of water each day" and that they use "up to 50 times as much energy per square foot as a typical commercial office building," with only 10% going to computing and over 40% going to cooling alone (Williamson, 2023). This only scratches the surface of the ripple effect impacts the film and television industry has on the environment, but there are a few other notable greenwashing examples pertaining to the case studies presented here.

In a paper published by Melanie Ashe of Concordia University, she discusses the environmentalist messaging promoted by *The Amazing Spider-Man 2.* She outlines that there were "multiple advertising strategies…launched, some that purposefully stressed the environmental advocacy angle—and others that ignored it entirely," (Ashe, 2019). Ashe (2019) also emphasizes that all the

sustainability marketing done by the ASM2 team was about the production process, entirely neglecting to admit how much of a footprint was generated by post-production activities like the worldwide press tour that required dozens of carbon dioxide-spewing international flights and massive stages for premieres to be built and used for merely one night. This is one example of "greenwashing" within this film, but unfortunately, it is not the only one. A notable achievement shared in the promotional reel about the film stated that through Emillie O'Brien's efforts, the production conserved nearly 200,000 plastic water bottles (Environmental Media Association, 2014). However, ASM2 also ran a media promotion with plastic water bottle company Evian, a video of which has over thirty million views on YouTube alone (Imageworks VFX, 2014), indicating the film/production company is not as anti-plastic as they portrayed themselves to be. Another example of misleading sustainable marketing can be found on the set of Earth Angel partner production *The Woman in the Window*. One of the changes heralded as 'green' on their set was the use of Forest Stewardship Council-certified wood for almost half of the sets (3BL Media, 2019). In 2018, Yale University's School of the Environment published a piece titled "Greenwashed Timber: How Sustainable Forest Certification Has Failed," in which they discussed how there have been accusations made in Russia, China, Peru, and Romania that the FSC had certified companies logging illegally and were slow to rescind or suspend their certifications (Conniff, 2018). The author, Richard Conniff (2018), wrote that "many logging companies appeared to obtain an FSC certification for management practices on one forest, and then use it to cast a halo over their far more extensive dealings in forests elsewhere." The many historical instances of shady business practices from this organization indicate that sustainability advocates should be more cautious about touting their involvement as an environmental 'win' for a production. Given the lack of international regulation on groups like the FSC, it often takes non-governmental organizations conducting their own investigations to determine their legitimacy, and it is likely there are numerous other companies being celebrated as 'green' that are, in actuality, anything but. As corporate environmental activism grows more popular among motion picture companies hoping to win over climate-conscious consumers, it is necessary for said consumers to

critically examine all self-published reports of sustainability for what issues or inquiries may have been left on the cutting room floor.

Conclusion

Anthropogenic climate change is a topic that the vast majority of scientists agree is occurring and is extremely dangerous to global ecosystems and ways of life, yet minimal collective action is being taken to reduce it. There are several common targets for climate activists when lobbying for legislation or mandates related to their contributions to climate change; these include the sectors of energy, transportation, and agriculture. A separate but equally prominent sector is the motion picture industry, but it rarely comes up in conversation with the phrases 'environmental impact' or 'carbon footprint.' However, it makes a sizable contribution to both topics, primarily through its massive energy requirements for equipment and travel, and the enormous amounts of waste it generates from set-building, props, and catering services. There is little up-to-date, comprehensive research available about the overall environmental impacts of this industry, but this thesis aimed to fill in some of the gaps left by scholarly publications with firsthand comments and stories about where the industry's footprint comes from and what they are doing to reduce it. And they are working to reduce it, although often with third-party organizations that are not large enough to cover all the sets that could benefit from their services. There are some initiatives being generated within the industry, though: one thing moviemakers have always done well is pioneer advances in technology, and the same is true for their pursuit of sustainable technological alternatives to how they are doing business currently. Because these technologies can be repackaged for use by other facilities and companies, they present a unique opportunity to both be more sustainable and generate profits, unlike using 'green' consultants on set, whose salaries detract from any savings they might be able to create with their suggestions. Through the research conducted for this thesis, a few other options emerged as plausible paths for the motion picture industry to continue to reduce its negative environment impacts.

The first option is a legislative route, which would be the responsibility of some level of government in the places where filming is taking place to make it applicable to productions. This could take the form of a technology requirement, such as the state of California and the European Union's recent mandates that all new passenger vehicles in their respective boundaries be zero emissions by 2035. Productions use vehicles both on set and to get to it, ranging in number from dozens to hundreds of vehicles per set, so this type of legislation would cut down emissions significantly from travel. The second option is also governmental: adding in a tax credit increase for productions that spend part of their budgets on implementing sustainable procedures on their sets. Tax credits are allotted by local or state governments or film commissions and are already a very familiar and expected part of production planning/budgeting. The availability and size of them often determines the locations in which it films, so providing another means to save money (and one that would also do good) is likely to add to the attractiveness of the location offering it. This is already a route pursued by international film commissions (Green Production Guide), demonstrating its soundness as a sustainable option and the willingness of productions to change their operations to take advantage of it. The third option relates to the oversight of the motion picture company financing a given production, and entails the requirement of a system like the Production Environmental Accounting Report (PEAR), developed by the Sustainable Production Alliance to measure the use and success of sustainable practices on sets, to be used on any production it is deemed relevant to (which, seeing as they all have an environmental impact, should theoretically be all of them). This system can show companies where their operations are lacking or excelling in terms of minimizing environmental impacts, and if they do choose to use the PEAR system, they could be eligible for awards like the Environmental Media Association's Green or Gold Seal simply by recording their day-to-day practices. The final, and potentially simplest, option ties applies to the catering or craft services provided by sets for the crew and actors. It is the reduction, if not elimination, of meat from the menus utilized by these services. Animal agriculture makes up about 18% of all greenhouse gas emissions (Environmental Media Association, *EMA Green Seal*), and cows are a particularly potent source of methane release, the second most abundant human-contributed greenhouse gas after carbon dioxide (Environmental Protection

Agency, *Importance*). Methane is also over twenty-five times more effective at trapping heat in the atmosphere than carbon dioxide, worsening the phenomenon of global warming that is part of and contributes to climate change. These four options are just a few of the ways that the motion picture industry (and others like it) could work to improve their current operations to lessen their contributions to anthropogenic climate change and its globally damaging effects. Although there is still a long journey ahead for the motion picture industry to reach net zero carbon/greenhouse gas emissions, as will be necessary for every industry in order to minimize the negative consequences of climate change, there is already meaningful change being brought about by passionate and progressive individuals and organizations. Moviemakers have always strived to be picture-perfect in their on-camera work; the goal of picture-perfect practices behind the camera is getting closer and closer every day, too.

Appendix

1. Transcript of 10/25/23 and 11/8/23 interviews with Jennifer Sandoval, director of business development at Earth Angel

[ALEXIS SIMPSON] What area of productions is the most frequent thing you make recommendations on for clients? It can be as specific as many sets using Styrofoam containers at craft services or a majority of productions not using recycled materials for sets/recycling the materials they do use.

[JENNIFER SANDOVAL] Whenever we work with productions, we make sure that we understand their needs, goals and budgets. Depending on the level of service the production chooses, we work with our team to provide information about what can be achieved, how much it costs and then we provide a plan of action to help them reach their goals. Our main areas of impact are waste management, clean energy, fuel reduction and sustainable sourcing. Together with our Strategy Manager, we come up with a customized plan that is approved by the production. Because the supply chain and infrastructure is not the same in every region, and because each production is unique, the production goals may vary from one project to the next. So, we really make our recommendations based on the informed decisions of the client.

[SIMPSON] What is the easiest thing to convince clients to change, and what is the thing that gets you the most pushback and is hardest to convince them of?

[SANDOVAL] Change, in any capacity, can be very challenging. If productions are kind of starting out with their sustainability efforts, we usually start with a basic waste management plan where we encourage multi-stream collection and sorting all of the production waste on site. Our on-the-ground Eco Reps who are part of the crew, are absolutely critical in assisting with these efforts as it is not always very straightforward. Having waste vendors that understand the specific needs of the film industry and providing the productions with the right equipment to be able to sort properly will generally lead to higher diversion rates. After awhile, the crew will get the hang of what goes where and we can see better outcomes. Probably the most difficult thing is trying to get production to cover the sustainability costs. However, as mentioned in the first response above, if we are able to meet with the production early enough and establish a budget to cover these costs before principal photography begins, (which isn't always the case) it makes it much easier to implement our strategies and we tend to see much better results. Also, trying to get people to change the way they do things can be very challenging, but as more people learn about the importance of looking at their own impacts and how they affect the overall carbon footprint of the production, we tend to get more engagement and collaboration.

[SIMPSON] Has any general type of production (independent, tentpole, documentary, etc.) or specific company been super receptive to your suggestions and/or that you get rehired by often? Or even better, that permanently changes their processes to not need to rehire you?

[SANDOVAL] If we are fortunate to be hired to work on a television series, we tend to get invited back for subsequent seasons as the crew may be more receptive and everyone has a better understanding of what is possible and tend to want to do better. Because Earth Angel's services cover all aspects of sustainability, it is difficult for productions to really take on the work themselves as they simply do not have the time and capacity to do what we do. We have an entire "back of house" team that supports our Eco Reps and Eco Coordinators. They help with everything from budgeting, to strategy, to finding and

providing fully trained Eco Reps, to sourcing green vendors and also data collection and reporting. Our services are very comprehensive so until this work can someday be fully integrated into other crew roles, or until productions hire their own sustainability departments, productions can rely on Earth Angel to do this work for them, sort of like an outsourced Sustainability Department.

[SIMPSON] I see you have headquarters across the US and Canada, and one thing I'm researching with my thesis is if looser environmental regulations (which often allow for lower costs) have added to the interest and increase of productions moving from California to places like Georgia and North Carolina. Do you see any major or notable differences in similar-sized clients between the two areas in terms of green practices, including how often you get hired in each place?

[SANDOVAL] Successful sustainability outcomes are highly dependent on available infrastructure, environmental regulations and a knowledgeable and sustainable supply chain. These can vary greatly from region to region. For areas that are outside the typical hubs (LA, NYC, Atlanta), Earth Angel does extensive research and vets vendors throughout the "Out of Service" region to help build its strategy, understand costs and execute on its sustainability plan. Generally, our work is focused in the major filming hubs mentioned above, not necessarily because of the available green sustainable production options, but for other economic or labor incentives. We would love to see film commissions and other government bodies create green incentives to entice productions to their areas. And given the crisis on our hands, I envision that we may see some of these types of incentives or rebates sooner than later.

[SIMPSON] Do you ever say no to client requests, and if so, why?

[SANDOVAL] Earth Angel always does its best to provide comprehensive services to productions of all types (long form, short form, live events etc.), however, there have been times that we have had to turn down jobs due to lack of capacity or resources.

[SIMPSON] Is there any recent shining example of sustainability on set that I should look into for another case study topic?

[SANDOVAL] I would refer to the 2022 Earth Angel Annual Impact Report for some interesting information and to better understand our work. Due to confidentiality reasons, we cannot really share any information from any particular productions that we work with, but you can get a sense of the overall impacts from our Annual Report. I would also check out the albert and Green Production Guide websites for some interesting case studies and other great info.

[SIMPSON] How do you find clients/what is the initial process like for getting hired onto a production? From your other answers I've gathered you supply Eco Reps to sets to help monitor the systems you and a client decide to implement after creating a sustainability strategy together, but what department is usually the one who expresses interest in contracting your services? Are they typically above-the-line or below-the-line employees?

[SANDOVAL] Typically, we are initially brought on by either a studio, production company or producer. I would say mostly above the line person. However, we have been really lucky to work with incredible department heads and crew that may have had some influence with the production in hiring Earth Angel.

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