Evaluating the Environmental Impacts and Sustainability Initiatives of NBA Arenas

Arinjay Pratap Singh

Abstract

As major sources of entertainment and community engagement, NBA basketball arenas draw millions of fans annually—but their environmental footprint extends far beyond the court. This research project aims to evaluate the environmental impact of NBA arenas and their efforts to mitigate it. The study will first identify the primary environmental impacts associated with these venues, focusing on the most significant sources and effects. Next, it will analyze the sustainability targets set by these arenas, assessing how many have established goals and the relative ambition of these targets compared to others. Finally, the project will estimate the potential impact of these sustainability initiatives if successfully implemented. The findings will be compiled into a research paper, providing critical insights into the role of professional sports venues in addressing environmental challenges.

Introduction

Sports and sustainability—these might seem like two unrelated concepts at first glance. However, as sports grow in popularity and attract larger audiences, the need for sustainability within this industry has become increasingly important. In recent years, sustainability in sports has emerged as both a major trend and a critical concern (Monton). High-profile events like the FIFA World Cup and the Olympics have come under scrutiny for their environmental impact, and rightly so, as these events draw hundreds of thousands of fans and leave substantial ecological footprints. For example, at the most recent FIFA World Cup in Qatar, eight brand new stadiums had to be built, contributing to a large part of the 3.6 million tonnes of carbon dioxide generated for the tournament (Fant).

In addition to major international competitions, which occur only once every four years, there are thousands of sports leagues worldwide where games are held multiple times each week, amplifying the cumulative environmental impact. For instance, in the United States, Major League Baseball (MLB) conducts an extensive 2,430-game season, while the National Basketball Association (NBA) hosts 1,230 regular-season games each year (Wilson). Overseas, England's Premier League, one of the world's most-watched soccer leagues and widely regarded as the best, holds 380 matches every season ("List of Premier League seasons"). These leagues, in addition to all the others, draw millions of fans to stadiums and arenas, consuming energy, water, and resources on a massive scale. The sheer volume of these recurring events, coupled with the high demands of sports facilities, highlights the critical importance of integrating sustainable practices to manage waste, reduce emissions, and conserve energy across the entire sports industry.

Focusing on the United States, basketball is one of the most popular sports in the country. According to the Sports & Fitness Industry Association (SFIA), there are 28.1 million Americans, ages six and above, who play basketball (Broughton). This popularity continues to grow, driving millions more to both play and watch live games. The National Basketball Association (NBA), with its extensive schedule of games nearly every day over a 5-6 month season, sees each of its 30 teams play a long 82-game season. Each team hosts games in its

arena, with an average stadium capacity of 18,790 seats (Pimentel). The NBA's popularity is evident from the 2023-24 season statistics, setting records in attendance and sellouts. Across the season, 22.5 million fans attended NBA games, and the average attendance per game was 18,324. Additionally, 71% of games were sellouts, with 12 teams achieving a sellout of every home game ("NBA breaks all-time records").

The millions in attendance annually not only demonstrate the NBA's popularity but also underscore the increasing environmental impact, as arenas consume energy, generate waste, and require lots of resources throughout the season. This rise in popularity emphasizes the need for sustainable practices in arenas, from managing energy use and waste to reducing emissions and conserving resources. However, the environmental impact these arenas are having is still very unclear and not commonly discussed. In this paper, I investigate the environmental footprint of NBA arenas. The two research questions I address are:

1. How do NBA basketball arenas affect the environment today as they host numerous games each year?
2. What are the NBA arenas' current sustainability goals and their impact?

By addressing these questions, this paper aims to clarify the environmental impact of NBA arenas today and highlight the effectiveness of their current sustainability initiatives through qualitative and quantitative analysis.

Data and Methods

While researching for this paper, I encountered many sources, each offering different perspectives and information. After careful reading and analysis, they were filtered down to a select few that were most relevant and aligned with the focus of my paper. These sources provided the most valuable insights, allowing me to build a well-supported argument. I used research papers, primary sources, and secondary sources for most of the information. The National Basketball Association has a webpage with general information and statistics about what each team in the league is doing to be environmentally sustainable. Additionally, each arena has a website with a more in-depth look into what their sustainability goals and practices are. Secondary sources include news articles from local news stations in the city where the arena is located or larger media companies like Discovery that did stories and made videos about several NBA Arenas. For instance, Discovery Education made a video about sustainability in the NBA and more specifically at Chase Center in San Francisco ("Discovery Education & the NBA"). This video provided a comprehensive report of the sustainability efforts at Chase Center and included videos of special access to equipment rooms and interviews with the arena's sustainability manager and general manager. This information is not readily available on normal articles and websites so that greatly increased my understanding of the people and technology behind the sustainability efforts.

I also analyzed publicly available data on NBA sustainability efforts provided by the U.S. Green Building Council ("U.S. Green Building Council"). It was founded in 1993 and is a private non-profit organization that promotes sustainability in building design, construction, and operation. The organization also rewards Leadership in Energy and Environmental Design

(LEED) certifications, the world's most widely used green building rating program. As of 2023, there were over 105,000 LEED-certified buildings across the globe. This rating system is what I used as my primary dataset to objectively analyze the NBA arena's environmental actions. LEED has 4 levels of certification: Certified, Silver, Gold, and Platinum. They evaluate buildings based on various criteria, including energy efficiency, water conservation, and material use, while scoring them based on a certain scorecard.

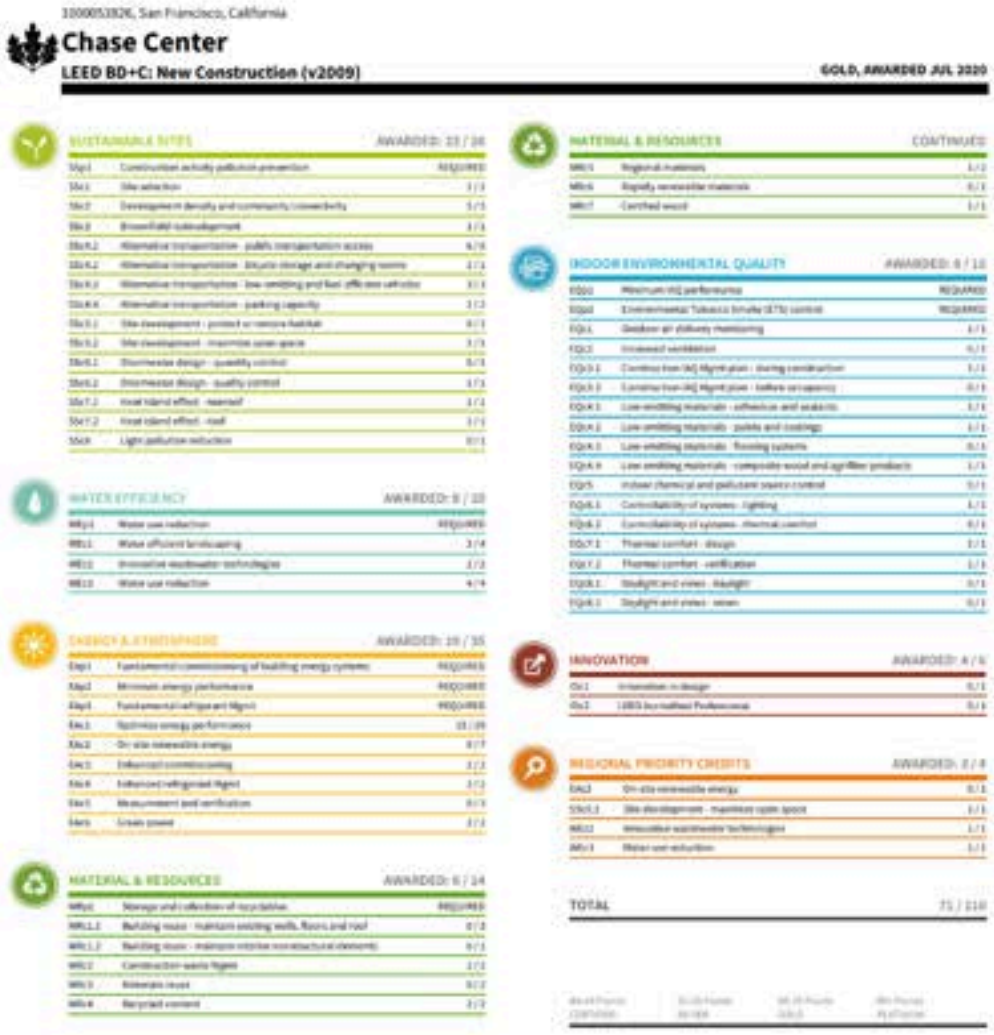

***Figure 1**. Example LEED certification scorecard data for the Chase Center in San Francisco, CA. In this project, I analyze LEED certification data for NBA arenas.*

Figure 1 shows an example of a LEED Scorecard. This scorecard represents the LEED certification assessment for Chase Center in San Francisco, CA. The scorecard is divided into various subcategories within broader categories, each assigned a specific point value. Some categories, like Energy & Atmosphere and Sustainable Sites, offer more points than others.

Additionally, certain points, such as those for water use reduction and minimum energy performance, are mandatory to achieve LEED certification due to their importance. In this case, the arena earned 71 out of a possible 110 points, qualifying it for LEED Gold certification—a highly prestigious rating.

In this paper, I visualized LEED certification assessment data for NBA arenas using histograms, which provide a clear picture of how well certain NBA arenas are doing to minimize their environmental impact. Essentially, I collected and tabulated all the scorecards like that in Figure 1 and visualized them using histograms. By analyzing these histograms, I was able to gain an objective view of what the NBA arenas are doing well in their sustainability goals and where they may need to improve.

Results

Section 3.1: How do NBA sports venues affect the environment today across the numerous events hosted each year?

Over 22 million people go to arenas each year to attend games and events, which require substantial resources and produce a large amount of waste ("NBA breaks all-time records"). As discussed in the Introduction, each NBA arena hosts 42 games a season. However, in addition to these games, arenas also host concerts, other sports events such as college basketball, cultural events, performances, and even hockey games for the National Hockey League (NHL). This means that in reality, most arenas are hosting well over 42 events a year. Because of all of these events hosted throughout the year, the principal environmental impacts of NBA arenas today are water usage, electricity usage, and solid waste produced.

First, arenas consume vast amounts of water to facilitate the smooth operation of events. Thousands of gallons are used daily across various functions. In the bathrooms alone, water is used for flushing toilets, washing hands, and maintaining cleanliness. In the kitchens, significant amounts of water are required to wash food and cook meals for the thousands of spectators and staff members. Water that is used in sinks, showers, and other non-toilet systems, is referred to as graywater. While it's not clean enough for drinking, greywater is less contaminated than sewage or blackwater, and with proper treatment, it can be reused for non-potable purposes like irrigation and sink water.

Secondly, arenas consume a substantial amount of electricity to power their operations. Lighting is one of the most significant energy demands, with thousands of lights needed to illuminate the court, seating areas, concourses, and exterior spaces. High-intensity lighting is essential during events, especially for broadcasting purposes. In addition to lighting, heating and cooling systems are vital to maintaining a comfortable environment for fans, athletes, and staff. These HVAC systems use a lot of electricity to regulate the temperature across large arenas and often operate continuously during events. In addition, electronic displays, including scoreboards, jumbotrons, advertising screens, and digital signage, are another major contributor to energy consumption. All arenas have numerous massive screens to display information and enhance the fan experience with real-time information, replays, and interactive content. In addition to screens inside the arena, some arenas have massive screens on the outside. For instance, Chase Center in San Francisco has a screen with a height of 74 feet and a width of 42

feet outside the entrance. However, they also operate for extended periods and require significant power to run efficiently. Electricity coming from a non-renewable source can increase the carbon footprint of the arena.

Lastly, one of the most significant environmental impacts of NBA arenas is the sheer amount of solid waste generated during games and events. For context, an average NBA game may produce 10-15 tons of waste (Moffatt). This accumulates quickly to about 12,600 - 18900 tons of waste produced by all the arenas in one season. Remember, this is only NBA games, and doesn't include other events. With thousands of spectators attending each event, the amount of waste that accumulates is substantial. This includes a wide variety of materials, such as leftover food, disposable packaging, plastic bottles, cups, wrappers, and promotional items. During just one event, the amount of waste produced can be massive. Concession stands generate considerable amounts of food waste from unsold items and leftovers. For example, State Farm Arena in Atlanta composted nearly one million (939,917) pounds of food and organic material in 2023 (Atlanta Hawks). This leads to a rough estimate that the entire league would produce approximately 28.2 million pounds of composted food and organic material annually, which is a lot. Additionally, the packaging used for food and beverages—made from plastic, paper, or styrofoam—contributes heavily to the waste produced. In addition, the large number of single-use items, like plastic cutlery, straws, and napkins, adds to the waste amounts.

If not properly managed, substantial amounts of waste will end up in landfills, where it contributes to environmental degradation. Landfills take up valuable land space and also produce harmful greenhouse gasses like methane, which aggravate climate change. The environmental footprint of an arena can increase significantly if solid waste is not addressed, leading to long-term ecological consequences.

To conclude, the principal environmental impacts of NBA arenas stem from their high water and electricity usage along with the large amounts of waste they produce. Sports continue to grow in popularity, and as more and more people are able to afford to go to games, this impact will grow.

Section 3.2: What are the NBA venues' current sustainability goals to reduce these impacts?

Many NBA arenas are making significant strides in sustainability as they adopt a range of green initiatives. These efforts are driven by a growing emphasis on environmental responsibility and sustainability. Common practices include implementing energy-efficient technologies, such as LED lighting and high-efficiency HVAC systems, which reduce energy consumption and lower costs. Additionally, arenas are increasingly investing in renewable energy sources, like solar panels, and incorporating water conservation measures to further minimize their environmental impact. I found that there have been a few arenas that stood out as being clear leaders in NBA sustainability and overall in sports sustainability. Arenas across the league addressed the 3 principal environmental impacts in similar and different manners.

Section 3.2.1 - Water Usage

Firstly, one of the three principal environmental impacts of NBA arenas I identified is water usage. To run and manage sports arenas, an immense amount of water is needed for bathrooms, irrigation, and cleaning. Many arenas have implemented their own solutions in order to reduce the amount of water they have to pump in. These include more widespread solutions and also very niche solutions.

One arena that exemplifies the varied efforts taken to reduce water usage is the Chase Center in San Francisco. The arena collects the gray water (water from washing hands or taking showers; can't be used for drinking or showering) and sends it to a cleaning system on site. This water is cleaned and then sent back to the bathrooms in the arena for flushing toilets. This reuses the water the arena is taking in, reducing the overall amount of water needed to be pumped in. In addition, rainwater that falls on the roof is collected, cleaned, and pumped into bathrooms as well. Two-thirds of the rainwater that hits the roofs and plaza areas – 303,000 square feet of impervious surface, which is roughly equivalent to about five and a half football fields, – is collected, stored, and treated to provide over 2.6 million gallons per year of alternative water supply that is used for non-potable toilet & urinal flushing and irrigation (San Francisco Public Utilities Commission).

Another arena that has a range of initiatives to minimize its water usage is the Golden 1 Center in Sacramento. They have installed ultra-low flow plumbing to capture gray water which is used to irrigate an open plaza outside the arena. This allows the arena to use a whopping 45 percent less water than required under California regulations ("Golden 1 Center Unrivaled in Sustainable Design"). Now, these have been relatively simple ideas to reduce the amount of water waste an arena produces.

Lastly, the Footprint Arena in Phoenix has implemented two innovative methods to reduce the amount of water they use. Firstly, they have decided to use xeriscaping in the landscape around their arena. Xeriscaping is the process of landscaping that reduces or eliminates the need for irrigation. In addition, the arena is saving water in ways most have never heard of. They are changing the way they defrost frozen food. Footprint Center thaws frozen food using Boss Defrost, a powerful pump that leads to a 98.5% reduction in water used to thaw frozen food ("Sustainability"). The arena expects to save about 72,000 gallons of water each year by using this technology.

Section 3.2.2 - Electricity Usage

Secondly, the next principal environmental impact I identified that arenas are striving to address is reducing electricity use, especially electricity coming from non-renewable sources. Extensive use of electricity, especially from coal, natural gas, and other fossil fuels, contributes significantly to greenhouse gas emissions, which accelerate climate change. The reliance on non-renewable electricity also depletes finite natural resources, which can create long-term sustainability concerns. By addressing this issue, arenas can play a role in reducing their carbon footprint and mitigating the harmful environmental effects associated with excessive energy consumption.

There are a few practices that are implemented to more efficiently use electricity and use renewable energy when possible. For example, Delta Center in Salt Lake City, Utah renovated the arena in 2017 and replaced all lighting with LED fixtures, which reduced power usage by 75 percent, and officials installed more than 6,000 solar panels as well to help produce some of the electricity needed (NBA). Just through a simple renovation like this, the arena was able to dramatically cut down on electricity needed, demonstrating that it is not a difficult task to become a more sustainable venue.

As discussed in Section 3.2.1, there are multiple examples of NBA arenas investing in and using largely uncommon and innovative technology to help make their sites more sustainable, displaying how the NBA is one of the leaders in sports sustainability. In this case, the arena using this uncommon technology is Crypto.com Arena in Los Angeles. They installed a 500 kW bank of Bloom Energy fuel cells, which generate electricity on-site ("Environmental Sustainability"). Bloom Energy fuel cells are solid oxide hydrogen fuel cells. These offer a solution for reducing greenhouse gas emissions and dependence on fossil fuels. Hydrogen fuel cells produce electricity through an electrochemical process with the only byproducts being water and heat. This process significantly reduces air pollutants, such as carbon dioxide and nitrogen oxides, which contribute to global warming and air quality issues. The arena has said that in the lifetime of the fuel cells, they have avoided a total of 2,257,655 lbs. of CO2 emissions ("Environmental Sustainability"). This is the equivalent of avoiding burning 797,922 pounds of coal and removing 213 cars from the road for a year. Not many companies or businesses in general use hydrogen fuel cells, so to see this technology being adapted by an NBA arena represents a rare and significant step toward innovation in clean energy solutions. This adoption showcases the potential for reducing carbon emissions in large sports venues and demonstrates how some arenas are doing a lot to reduce their environmental footprint.

Crypto.com Arena can be considered a leader when it comes to sustainability in the NBA, but arguably the NBA Arena doing the most to become more sustainable is the Golden 1 Center in Sacramento, as I will explain in this section and in Section 3.3 and the Conclusion. The arena has numerous practices and features in it to reduce the amount of electricity used and ensure what electricity is used is used efficiently. Firstly, the arena is powered during the day solely by solar panels on the building's roof, significantly reducing its reliance on traditional energy sources. These solar panels convert sunlight into electricity, providing a renewable and clean energy supply for the arena's daily operations when an event is not going on. In addition, the arena has five six-story tall aircraft hangar doors at the entrance to the arena that open the arena to natural cooling during concerts and entertainment events. This has allowed the arena to use 30% less energy than required under California regulations, which is outstanding considering it is a massive venue that needs large amounts of electricity to operate.

Section 3.2.3 - Solid Waste Production

Lastly, the third and most important environmental impact I identified that the majority of arenas are attempting to reduce is solid waste. This includes leftover food, plastic bottles, cups, packaging, compostable materials, recyclable items like aluminum cans, and general trash. Large events, such as sports games and concerts, generate enormous amounts of waste, most of which traditionally ends up in landfills. As NBA arenas host events multiple times a week for

months at a time, extremely large amounts of waste are produced over time. The decomposition of waste in landfills produces methane, a significant greenhouse gas that significantly contributes to global warming. Additionally, improper disposal of plastics and other materials often leads to environmental pollution, affecting local wildlife and ecosystems. In order to reduce the amount of waste arenas released into our environment, they have implemented many simple and innovative ideas.

To begin with, there are a few basic practices that many arenas have implemented to reduce waste and support local communities. One of the most impactful is donating leftover food. At sports events, large quantities of food are prepared in advance, including items like chicken nuggets, pizza, nachos, hot dogs, and other fast, convenient meals to meet the high demand of customers. However, predicting the exact amount of food needed for an event is nearly impossible, and as a result, there is often excess food that is perfectly edible but can't be saved for future games due to spoilage concerns. Without intervention, this surplus food would end up in landfills, contributing to the growing issue of food waste and methane emissions from decomposing organic matter.

To tackle the production of excess food, many arenas have partnered with local food banks and shelters to donate leftover food from game days. For example, State Farm Arena in Atlanta and Chase Center in San Francisco work closely with community organizations and food banks. This practice not only diverts food from landfills but also provides food to populations that could use it, creating a positive social and environmental impact. By implementing such initiatives, arenas are taking meaningful steps toward reducing waste and supporting their communities. For example, Chase Center has a zero-waste initiative and aims to send 10% or less of all their waste to the landfill, and State Farm Arena reused or donated 752,868 pounds of materials like food, electronics, clothing, crates, and more (NBA).

Similarly to water and electricity, there are a few leading arenas that have invested in developing new technologies and pushing the boundaries of environmental sustainability. In this case, Chase Center stands out. The arena has been a leader in sustainability within the NBA, setting an example for other venues across the league. To further advance their environmental efforts, the Golden State Warriors took a big step by hiring the first full-time dedicated sustainability manager in the NBA. This role is crucial in overseeing and implementing innovative strategies, from waste reduction and energy efficiency to water conservation.

One initiative introduced by the sustainability manager at Chase Center is the implementation of an on-site compost bio-digester (“Discovery Education & the NBA | A Slam Dunk Partnership”). After each game, the trash in the arena is carefully sorted by a team to ensure that all compostable materials are separated from other waste. The biodigester can process anything that qualifies as compost, such as food scraps and biodegradable packaging. Inside the machine, the material is heated and constantly turned by paddles, gradually breaking it down into smaller particles. This process significantly reduces the volume of waste, limiting the amount of trash sent to landfills. The bio-digester is capable of handling up to 4,000 pounds of compostable material per day, and the compost created can be used for gardens around the arena, in local parks, or in other community green spaces, further promoting sustainability

efforts. This technology required considerable money and effort and demonstrates how Chase Center is a leader in the NBA when it comes to sustainability.

Figure 2*. Compost Bio-digester Machine inside Chase Center that is used to make compost on site after trash is sorted. The woman in the image is the Sustainability Manager for the arena.*

Lastly, several other practices have been implemented by arenas to further reduce solid waste. One such initiative is the elimination of paper tickets and other small disposable items. The impact of this change is evident at State Farm Arena, which has successfully reduced its annual waste by 365,565 pounds by phasing out paper tickets, individual condiment packets, disposable service ware, and more (NBA). Additionally, State Farm Arena has partnered with Novelis, a global leader in aluminum rolling and recycling. Through this collaboration, the arena now serves beverages in recycled aluminum cups, which remain in a closed-loop system, allowing them to be reused repeatedly. A similar recycling process is applied to cardboard: all cardboard waste is separated and sent to a vendor for recycling into new cardboard and compostable paper products, which are then used by the arena. This approach eliminates the need for additional landfill waste and reduces reliance on external cardboard materials, further contributing to the arena's sustainability efforts.

Another example of an NBA team partnering with a company focused on sustainability is found in Phoenix, where the Phoenix Suns have teamed up with Footprint, a materials science company that designs fiber-based packaging to combat plastic pollution. Footprint's plant-based fiber alternatives to plastic are compostable, biodegradable, and recyclable, making them a key solution to the growing environmental crisis caused by single-use plastics ("Sustainability"). As a result of this partnership, the arena has been renamed Footprint Arena and has completely phased out single-use plastic items like plates, packaging, and utensils, replacing them with Footprint's sustainable, fiber-based products. The partnership with Footprint highlights the Suns' commitment to environmental sustainability, setting a powerful example for other sports teams and venues to prioritize sustainability in their operations.

In conclusion, NBA arenas are making significant strides toward environmental sustainability by implementing innovative practices to reduce energy consumption, waste, and reliance on single-use plastics. From on-site composting and partnerships with local food banks to eliminating paper tickets and collaborating with companies like Novelis and Footprint, these arenas are leading the way in sustainable operations. Through these efforts, they are not only minimizing their environmental impact but also setting new standards for the rest of the sports industry to follow in addressing global challenges like climate change and pollution.

Section 3.3: Analysis of LEED Certification of NBA Venues Through Data

Now, I analyzed LEED Scorecards for the NBA arenas to evaluate their initiatives and level of sustainability. For context, approximately one-third of all NBA arenas are LEED Certified at a level above the basic "LEED Certified" standard. Notably, all six of the newest NBA arenas have earned LEED certification, highlighting how environmental sustainability has become a growing priority for the NBA and its teams over the past few decades. The Golden 1 Center in Sacramento achieved the highest possible certification of LEED Platinum, while three other arenas have attained the second-highest ranking of LEED Gold. This demonstrates the league's increasing commitment to sustainable design and operation in its venues.

To visualize the LEED Scorecard data, I first scaled the scores to 100 for easier comparison and interpretation. This adjustment also accounts for the slight variations in total possible points between older and newer LEED Scorecards. Histograms were then created to help visualize the data clearly and facilitate straightforward comparisons between arenas. With this data, it can be seen which categories the most sustainable arenas are doing well in, and where they may need to focus more of their resources and time on to become a more sustainable arena in the future.

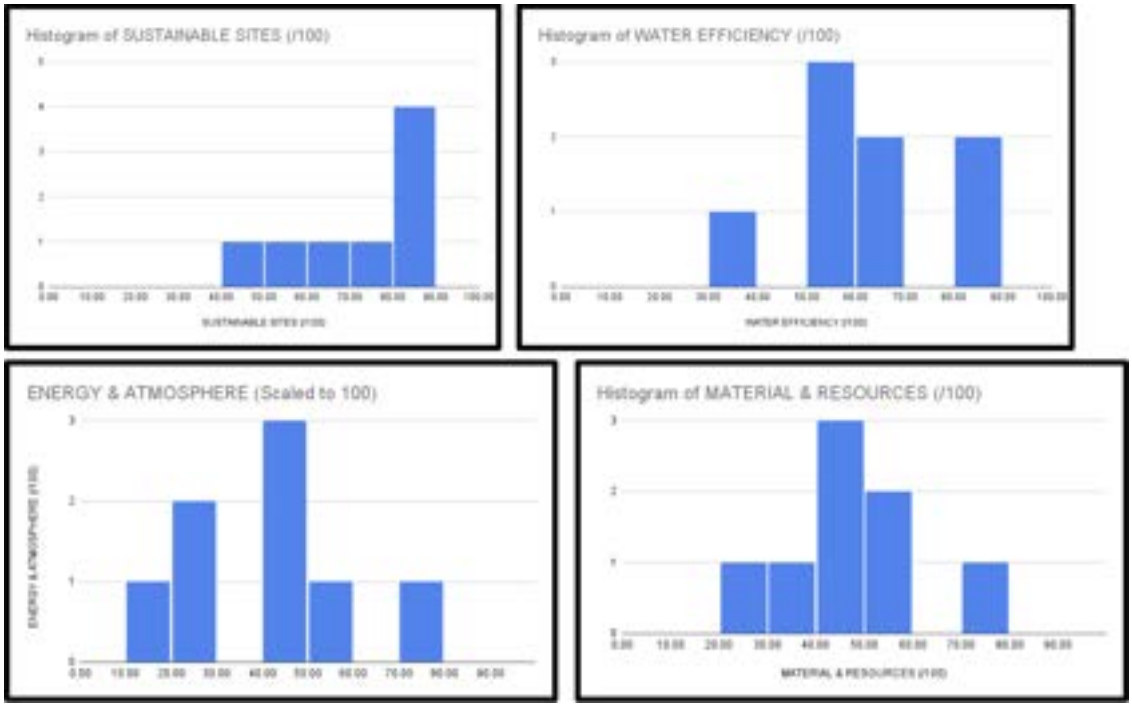

***Figure 3**. LEED Histograms of the 4 major categories on a LEED Scorecard; Sustainable Sites, Water Efficiency, Energy & Atmosphere, and Material & Resources. Data was collected from scorecards of 8 NBA Arenas and scaled to 100.*

The first major category in the LEED Certification process is “Sustainable Sites,” which focuses on how a building interacts with and impacts its surrounding environment. This category includes several key subcategories, such as stormwater management, mitigating the heat island effect, and site development strategies. These subcategories are critical in promoting sustainable sites and reducing the environmental footprint of large buildings like arenas.

The histogram illustrating how the LEED Certified NBA arenas performed in this category is shown in Figure 3, top left. I find that half of the arenas achieved scores between 80 and 90, indicating a strong performance in sustainable site management (Fig. 3). This is an impressive result, as it suggests that many arenas are excelling in areas such as reducing stormwater runoff, improving local ecosystems, and minimizing the heat island effect caused by large concrete and brick buildings. Notably, this was one of the categories where so many arenas performed exceptionally well, with only one arena scoring below 50. This trend highlights the importance that many arenas place on sustainable site practices and their ability to implement effective strategies to reduce environmental impacts in this area.

The second major category on LEED Scorecards is "Water Efficiency." This category assesses how well a building conserves water and minimizes its overall water consumption. Key subcategories within Water Efficiency include water use reduction, water-efficient landscaping, and innovative wastewater technologies, all of which are crucial for decreasing the environmental strain on local water resources. As previously mentioned, many arenas have implemented effective strategies to address water usage, such as reducing irrigation needs through landscaping techniques and recycling water for non-potable uses.

I found that five arenas achieved Water Efficiency scores between 50 and 70 (Fig. 3, top right). This indicates solid performance in this category, though not as high as the "Sustainable Sites" category. While a score between 50 and 70 is still good, it suggests that there may be more room for improvement in water efficiency measures across these arenas. Some arenas may need to further explore innovative water-saving technologies or adopt more aggressive strategies for reducing water consumption. However, the results still show a commitment to water conservation and sustainable practices, which are critical to achieving overall environmental sustainability in arena operations.

Next, the third major category on the LEED Scorecard is "Energy & Atmosphere," which carries the most weight in the certification process, making it a critical area for arenas to perform well in to achieve higher levels of LEED certification. This category focuses on a building's energy consumption and environmental impact, with subcategories including on-site renewable energy generation, green power, and optimized energy performance. These factors are essential for reducing greenhouse gas emissions and improving energy efficiency, both of which are key to creating more sustainable facilities.

I find that the Energy & Atmosphere category poses more challenges for many arenas. While energy efficiency and renewable energy adoption are essential, several arenas struggled to reach high scores in "Energy & Atmosphere." Six arenas received scores between 10 and 50, and three of those scored between 10 and 30 (Fig. 3, bottom left). These lower scores indicate that, despite efforts, many arenas may still rely more on non-renewable energy sources or have not yet optimized their energy performance to the fullest extent.

The performance in the Energy & Atmosphere category is in contrast to the higher performance seen in categories like "Sustainable Sites" and "Water Efficiency," where the majority of arenas scored significantly better. The comparatively lower scores in "Energy & Atmosphere" highlight the challenges of reducing energy consumption in large venues, where so much energy is required to operate the venue. Nonetheless, the results display the importance of continued investment in renewable energy technologies and energy-saving initiatives to drive future improvements in this critical area.

Finally, the fourth major category on the LEED Scorecard is "Materials and Resources," which evaluates how effectively arenas manage materials, waste, and recycling efforts. Key subcategories include the storage and collection of recyclables, recycled content, and the incorporation of rapidly renewable materials. This category is particularly significant for arenas, as the production of solid waste is one of the largest environmental impacts these venues generate, as discussed previously. A strong performance in this area would indicate that the arena is actively working to reduce waste, prioritize sustainable material use, and promote a circular economy within its operations.

Notably, I find that most arenas demonstrated solid efforts in Materials and Resources, with three arenas scoring above 50 and another three scoring between 40 and 50 (Fig. 3, bottom right). These results suggest that many arenas are making an effort to reduce their environmental footprint by focusing on sustainable materials and waste management practices. Initiatives such as separating recyclables, using materials with recycled content, and sourcing renewable resources likely contributed to these good scores.

By focusing on recycling programs, composting, and the use of sustainable construction materials, these arenas are addressing the immediate environmental concerns of waste production and also contributing to long-term sustainability solutions in the sports industry. This trend indicates that reducing material consumption and improving waste management is becoming increasingly integrated into the operations of NBA arenas.

To sum up, I found that the NBA arenas that lead in sustainability, as indicated by their LEED certification, are performing well overall, demonstrating a commitment to environmentally responsible practices. However, there is room for improvement, particularly in areas like energy efficiency and material management. By continuing to invest in innovative technologies, renewable energy sources, and enhanced waste reduction strategies, these arenas can further reduce their environmental impact and set an even higher standard for sustainability in sports.

Conclusion

Finally, it is important to also discuss how these arenas may be affected by climate change and global warming. For instance, the geographical location of arenas is critical in dictating the amount of power and energy that they use. There are arenas located in high-risk areas, so it is imperative that they are proactively taking steps to minimize their footprint. For instance, Phoenix is heatwave-prone. For example, the average temperature in Phoenix in May is 91°F to 99°F, and this will only increase over time, so the arena will likely face greater cooling demands and greater electricity consumption (WeatherSpark). Additionally, arenas in other drought and heat-prone areas such as California and Texas would face the same issue. Minimizing water and electricity usage is incredibly important, both now and through the course of the lifespan of these arenas, which were built to last multiple decades of use, as future decades will see increasing impacts from climate change.

Now, there are some push backs and criticisms of LEED and its certification system, that I acknowledged and formed an opinion on during my research. For example, the LEED rating system has faced some criticism for allowing buildings to attain certification based on predictions from computer models rather than actual sustainable practices. However, multiple arenas in the NBA went through a recertification process long after they were constructed and had been certified before, in order to display the improvements they made, meaning they didn't have to show computer models because the building existed.

Another common pushback is that the LEED rating system is "gimmicky" because it allows buildings to take the easiest and cheapest path to green glory without actually doing much for the environment. However, what I found is that none of the arenas in the NBA are LEED "Certified" at the baseline level, but instead hold Silver, Gold, or Platinum status, additionally with most achieving significantly higher points than the minimum required for their category. If they wanted to get easy points, those arenas would not have been able to achieve higher rankings like the ones they have now.

Through analysis of sustainability initiatives and LEED certification data, it's clear that NBA venues are emerging as leaders in environmental sustainability within professional sports. Additionally, arenas like Chase Center and Golden 1 Center exemplify this leadership, going well beyond basic environmental requirements through substantial investments in innovative technologies and practices. For instance, Chase Center's implementation of an on-site biodigester and Golden 1 Center's achievement of LEED Platinum certification—the first indoor professional sports venue in the world to do so—demonstrate unprecedented commitments to sustainability (Hanway). The fact that a third of NBA arenas now hold LEED certification above the basic level, with all new arenas of the past decade earning certification, reflects a broader shift toward prioritizing environmental stewardship across the league. This commitment is also displayed by structural changes within arena management. Chase Center's hiring of the NBA's first full-time sustainability manager represents a significant evolution in how venues approach environmental responsibility. This trend may become more common in the NBA and sports in general, as teams begin to focus on the sustainability of their venues as well. As the NBA continues to prioritize environmental sustainability, these initiatives set a powerful example for other industries, demonstrating that significant environmental responsibility can coexist with world-class sports entertainment.

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