



National Institute of  
BUILDING SCIENCES

GREEN  
SPORTS  
ALLIANCE

# Taking the Field: Advancing Energy and Water Efficiency in Sports Venues



A Report to U.S. Department of Energy



---

# *Taking the Field: Advancing Energy and Water Efficiency in Sports Venues*

---



National Institute of  
**BUILDING SCIENCES**  
*An Authoritative Source of Innovative Solutions  
for the Built Environment*

GREEN  
SPORTS  
ALLIANCE

Prepared for the  
U.S. Department of Energy  
Under Contract DE-EE0007516  
February 2017



---

# *Taking the Field: Advancing Energy and Water Efficiency in Sports Venues*

---

## **Table of Contents**

---

Executive Summary .....	1
Introduction to Stadiums and Arenas.....	5
The Power of Sports .....	6
Venues and the Community .....	7
Number and Size of Venues .....	7
Economic Impact of Sports .....	9
Activities to Date .....	10
Monitoring Progress, Setting Goals .....	12
Green Building Rating Systems .....	13
Lighting .....	14
Renewable Energy.....	16
Water .....	17
League Level Efforts.....	18
Sports and the Federal Government .....	20
Challenges to Overcome .....	21
Limited Data.....	21
Uniqueness of Venues.....	22
Existing Facilities .....	23
New Facilities .....	23
Ownership and Operations .....	24
Driving Forward.....	27
Partnership is the New Leadership.....	27
Operations Department.....	28
Additional Departments.....	28

Sponsors.....	29
Vendors and Concessionaires .....	29
States and Local Governments .....	29
Federal Government .....	31
Utilities .....	31
Allied Organizations.....	32
Leagues and Conferences .....	32
Management Companies .....	34
Athletes .....	34
The Fans .....	35
Designers .....	35
Benchmarking .....	36
Recognizing Leadership.....	38
Engaging the Community.....	39
Empowering Operations Staff.....	39
Financial Resources.....	40
Technology Innovations and Implementation.....	41
Lighting and Solar PV .....	41
Wind and Other Energy Generation and Storage .....	42
Refrigeration.....	42
Occupant Comfort .....	43
Field Maintenance .....	43
Plumbing and Water Use Reduction .....	46
Metering, Measurement and Verification.....	47
Paralleling Advancements in the Fan Experience.....	47
Borrowing from Other Sectors .....	47
Conclusion .....	48
Acknowledgements.....	49
Supporting Agencies .....	49
Special Thanks .....	49
Project Team .....	49
Appendix.....	50

---

# *Taking the Field: Advancing Energy and Water Efficiency in Sports Venues*

---

## **Executive Summary**

---

Stadiums and arenas are essential components in the fabric of sports and they serve a significant role in communities across America. At the same time, many communities, organizations and sectors of the economy are prioritizing the need to reduce energy and water use. By bringing together expectations for energy and water efficiency goals with the powerful influence of sports, American communities can achieve significant savings while also inspiring an enormous number of fans to take action.

By many accounts, stadiums and arenas represent an important link to the nation's values and priorities. Over 240 million fans visit these venues annually and viewers spend 31 billion hours watching sporting events on TV each year. Total square footage of these facilities easily reaches into the hundreds of millions. With at least 1,500 such sports facilities around the country—many bearing the names of iconic brands or the communities they are tied to, and sports teams and clubs employing nearly 60,000 people and generate \$22.6 billion in annual revenue—the sports sector is a significant influence on the national economy and culture.

Many of these venues and teams have undertaken actions to improve energy and water performance of venues, reduce operating costs and engage their communities. Over six years, the Seattle mariners saved approximately \$1.5 million in utility costs through investments in energy and water savings. The University of Minnesota saves \$412,000 annual through the implementation of energy conservation measures.

Essential to any energy, water, and sustainability strategy is understanding current performance and setting realistic goals for continued improvement. The National Hockey League and AEG Worldwide lead the way in benchmarking their performance and monitoring their progress. Such efforts are necessary across the sector to establish a meaningful baseline and drive progress. Green building rating programs, such as the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED), allow owners, operators and designers to think holistically about implementing sustainable design and operations practices. To date, 80 venues have utilized LEED.

Lighting and plumbing retrofits and the installation of renewable energy systems (most commonly solar photovoltaics) are growing as venues share their successes and owners and operators understand the savings opportunities.

In addition to the NHL, other leagues and conferences are working with their members to share best practices and improve sustainability at their jewel events (all-star games and championships). The federal government—particularly the Department of Energy, Environmental Protection Agency and Department of State—has engaged the sports community to assist in meeting national and international goals.

While progress is being made, challenges to widespread improvement remain. The biggest challenge is the lack of metrics and associated data to establish current performance, at both an individual venue level and across the building type. Some venues do not have the tools, resources, or training to effectively manage and measure their performance, while those that have undertaken steps to improve do not have the data to compare themselves with their peers to determine if they are leading the pack or if there is still much more to be done. Baseline data is essential to determine a starting point for the industry and for individual venues, to measure progress, inform decisions, set realistic goals, and to recognize leaders. The National Institute of Building Sciences, the Green Sports Alliance, and EPA are working to fill this gap, but data from venues is required (see <http://bit.ly/2k15V6E>).

The ownership and operations structure of sports venues is complex, from owner-occupied facilities to public-private partnership. This complexity leads to a need for multiple strategies and entry points to support performance improvements. Equally complex is the myriad entities involved in pulling off a successful sporting event. This complexity leads to multiple opportunities to develop champions, capture value, and strengthen relationships around a common mission. Working collaboratively across the design, construction, and operations process is essential to cost-effective realization of energy, water, and other performance goals. Such collaboration requires participation from the operations and other departments; sponsors; vendors and concessionaires; federal, state and local government; utilities; allied organizations; leagues and conferences; management companies; designers; athletes; and fans.

Facilitating progress within the sector requires implementing multiple strategies. Organizations that take the lead should receive recognition from their peers and others. Venues and teams must engage their fans and their communities—both to spread important values and reinforce the team's place in people's lives and the community. Operations staff must be empowered to implement energy and water savings measures and engage other departments in fulfilling their goals. Financing mechanisms must be available to incent action or improve access to capital.

The sector, with partners from government, manufacturing, vendors, academia, and others, further develop existing technology, identify new technology, and widely deploy existing technology. Technologies and practices of particular interest include lighting, renewable energy, refrigeration, occupant comfort, field maintenance (including irrigation, grow lights and hydronics), plumbing, and metering, measurement and verification tools.

Case studies and technical and outreach materials specifically focused on the needs of venue owners and operators along with technical assistance on how to best incorporate these technologies and verify their efficacy can help to advance deployments and the achievement of performance goals. A game plan has been developed, it is up to all of the players to continue its implementation.

# SPORTS VENUES BY THE NUMBERS

**240+** MILLION FANS  
VISIT ANNUALLY<sup>1</sup>

**68**  
PROFESSIONAL  
TEAMS WITH  
ENERGY-EFFICIENCY  
PROGRAMS<sup>2</sup>

**28** FORTUNE 100  
COMPANY-NAMED  
VENUES

**146** COLLEGIATE PROGRAMS  
INVESTED IN ENERGY  
EFFICIENCY<sup>3</sup>

**80**  
LEED  
CERTIFIED  
SPORTS  
VENUES<sup>4</sup>

**247,746**  
GALLONS OF WATER  
**2.3 MILLION**  
KBTUs Per NHL Game<sup>5</sup>

**\$22.7** bn  
ANNUAL  
REVENUE FOR  
SPORTS TEAMS  
AND CLUBS<sup>6</sup>



National Institute of  
BUILDING SCIENCES

GREEN  
SPORTS  
ALLIANCE

Notes:

<sup>1</sup>NIBS Analysis including MLB, NBA, NHL, NFL, MLS, NASCAR, AAA Baseball, NCAA Football and NCAA Basketball

<sup>2</sup>Natural Resources Defense Council Report, Game Changer, [http://greensportsalliance.org/resources/P\\_NRDC%20Game%20Changer.pdf](http://greensportsalliance.org/resources/P_NRDC%20Game%20Changer.pdf)

<sup>3</sup>Green Sports Alliance, Collegiate Game Changers, <http://greensportsalliance.org/resources/NRDC%20Collegiate%20Game%20Changers%20Report.pdf>

<sup>4</sup>USGBC Green Building Information Gateway, <http://www.gbgi.org/collections/18237>

<sup>5</sup>NHL 2014 Sustainability Report, <http://ice.nhl.com/green/report/>

<sup>6</sup>U.S. Census Bureau, [http://thedataweb.rm.census.gov/TheDataWeb\\_HotReport2/econsnapshot/2012/snapshot.html?NAICS=711211](http://thedataweb.rm.census.gov/TheDataWeb_HotReport2/econsnapshot/2012/snapshot.html?NAICS=711211)



---

# *Taking the Field: Advancing Energy and Water Efficiency in Sports Venues*

---

## **Introduction to Stadiums and Arenas**

---

Stadiums and arenas are essential components in the fabric of sports and they serve a significant role in communities across America. At the same time, many communities, organizations and sectors of the economy are prioritizing the need to reduce energy and water use. By bringing together expectations for energy and water efficiency goals with the powerful influence of sports, American communities can achieve significant savings while also inspiring an enormous number of fans to take action.

To effectively implement energy and water saving measures in stadiums and arenas requires an understanding of the roles and responsibilities of the numerous stakeholders involved in the planning, design, construction and operation of these venues. In 2016, a project team of representatives from the National Institute of Building Sciences and the Green Sports Alliance began working to build this understanding. The team undertook a literature review; conducted workshops and webinars; launched an industry survey; and interviewed representatives from across the sports industry. More than 125 industry representatives participated in these activities, and an additional 20,000 stakeholders received information on the project. The project team compiled that stakeholder feedback into this report.

This report identifies the potential impact that addressing sports venues can have on reducing energy and water use nationwide and sets a path forward to achieving energy and water-efficient sports venues. The report begins with an overview of the extent of sports venues in the United States then looks at what the progress sports venues have made to this point. “Activities to Date” summarizes the significant efforts to reduce energy and water use already underway across multiple venue types and within leagues and conferences. While progress is being made, challenges still remain in realizing widespread improvement. These challenges are covered in the “Challenges to Overcome” section. Finally, in the “Driving Forward” section, the report identifies a path forward, building off the lessons learned by industry leaders and best practices from other sectors.

## The Power of Sports

Across the United States, more than 240 million fans make their way through the turnstiles of stadiums and arenas each year to see their favorite sports teams. (See Table 1.) Millions more watch on television. In 2015 alone, broadcast and cable TV had more than 127,000 hours of sports programming and viewers spent over 31 billion hours watching sports.<sup>1</sup> Over 40 million people watched Game 7 of the 2016 World Series.<sup>2</sup> From Fenway Park (Boston) and Wrigley Field (Chicago), built in 1912 and 1914 respectively, to the new Golden 1 Center (Sacramento) and Mercedes-Benz Stadium (Atlanta), the venue, its story and the experiences it fosters are linked with what it means to be a fan. Whether it is the 439 attendees on average at a Bryant University (Smithfield, R.I.) or South Carolina State (Orangeburg) basketball game or the more than 110,000 fans at a University of Michigan (Ann Arbor) football game, when fans cheer on their team, they are connecting with the stadium or arena. This is particularly true for those avid sports fans that set a goal to see a game in every one of the Major League Baseball (MLB) or National Football League (NFL) stadiums. The stadium is an integral part of their sports experience and passion for the game.

League	Season	Teams	Games	Average Attendance	Total Attendance
Major League Baseball	2015-2016	30	2,425	30,168	73,159,068
NCAA Football	2015-2016	666	3,705	13,241	49,057,966
NCAA Basketball	2015-2016	1,067	14,938	2,168	32,382,283
National Basketball Association	2015-2016	30	1,230	17,849	21,954,838
National Hockey League	2015-2016	30	1,230	17,576	21,618,808
National Football League	2015-2016	32	254	69,800	17,342,667
Major League Soccer	2016	20	330	21,692	7,375,287
Pacific Coast AAA	2016	16	1103	6,381	7,063,852
International AAA	2016	14	969	6,966	6,765,909
NASCAR	2012	40	36	97,722	3,518,000
<b>TOTAL</b>			<b>26,220</b>	<b>28,356</b>	<b>240,238,678</b>

<http://www.espn.com/mlb/attendance>; [http://fs.ncaa.org/Docs/stats/football\\_records/Attendance/2015.pdf](http://fs.ncaa.org/Docs/stats/football_records/Attendance/2015.pdf);  
[http://fs.ncaa.org/Docs/stats/m\\_basketball\\_RB/Reports/attend/2016.pdf](http://fs.ncaa.org/Docs/stats/m_basketball_RB/Reports/attend/2016.pdf); [https://www.espn.com/nba/attendance/\\_/year/2016](https://www.espn.com/nba/attendance/_/year/2016);  
[https://www.espn.com/nhl/attendance/\\_/year/2016](https://www.espn.com/nhl/attendance/_/year/2016); [https://www.espn.com/nfl/attendance/\\_/year/2015](https://www.espn.com/nfl/attendance/_/year/2015);  
<http://www.mlssoccer.com/post/2016/10/24/mls-breaks-regular-season-attendance-records-third-straight-season>;  
[http://www.milb.com/milb/stats/stats.jsp?t=l\\_att&lid=112](http://www.milb.com/milb/stats/stats.jsp?t=l_att&lid=112); [http://www.milb.com/milb/stats/stats.jsp?sid=milb&t=l\\_att&lid=117](http://www.milb.com/milb/stats/stats.jsp?sid=milb&t=l_att&lid=117); NASCAR does not release attendance, 2012 estimates (See <http://www.usatoday.com/story/sports/nascar/2013/02/16/nascar-tracks-attendance/1925205/>)

**Table 1: Annual Fan Visits to Professional and Collegiate Sports Events**

<sup>1</sup> <http://www.nielsen.com/us/en/insights/reports/2016/the-year-in-sports-media-report-2015.html>

<sup>2</sup> Sandomir, Richard, “Cubs Clinched Title Before Baseball’s Largest TV Audience in Decades.” New York Times, November 3, 2016. [http://www.nytimes.com/2016/11/04/sports/baseball/world-series-game-7-tv-ratings.html?\\_r=0](http://www.nytimes.com/2016/11/04/sports/baseball/world-series-game-7-tv-ratings.html?_r=0)

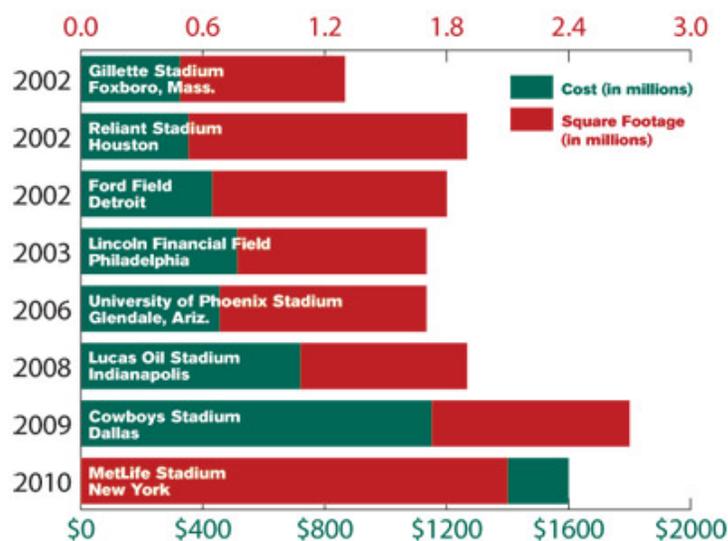
## Venues and the Community

Even non-sports fans are aware of these buildings, due to their iconic nature and the myriad community and cultural events they host. In some cases, the venue includes the city's name in its title or the team's name is emblazoned on the exterior. Take, for example, Angel Stadium of Anaheim (Calif.), Daytona (Fla.) International Speedway, Oakland (Calif.) Coliseum, and Durham (N.C.) Bulls Athletic Park. The teams themselves are strongly linked to their community, and engage in efforts to address key social issues.

As taxpayers, the citizens within a community often have a stake in the building itself, although the ownership and operations structures of stadiums and arenas can be complicated. Some state and local governments own their facility as part of their portfolio, such as the Minot (N.D.) Municipal Auditorium, the Kansas City (Mo.) Municipal Arena, and Lambeau Field (Green Bay, Wisc.). In some cases, public funding is used to partially fund the construction of a new stadium or arena, but the actual ownership and operations structure of such facilities can take many forms.

## Number and Size of Venues

While stadiums and arenas are typically characterized by seating capacity, the sheer size of these venues is significant. It is not uncommon for an NFL football stadium to top one million square feet. (See Figure 1.) Professional basketball and hockey arenas typically are more than 500,000 square feet in size. Both of these venue types rank in the top 0.1 percent by size of all U.S. commercial buildings.<sup>3</sup> While college and community venues usually are smaller, the playing surface alone accounts for significant square footage (a football field is 57,600 square feet; a hockey rink is 16,000 sq. ft.; a soccer field is at least 5,000 sq. ft.; and a basketball court is 4,700 sq. ft.<sup>4</sup>). Conservative estimates of the combined total square footage of all of the U.S. stadiums and arenas can easily be calculated in the hundreds of millions.<sup>5</sup>



Source: <http://www.athleticbusiness.com/stadium-arena/how-stadium-construction-costs-reached-the-billions.html>

**Figure 1: Cost and Square Footage of Select NFL Stadiums**

<sup>3</sup> Energy Information Administration. "A Look at the U.S. Commercial Building Stock: Results from EIA's 2012 Commercial Buildings Energy Consumption Survey (CBECS)." March 4, 2015. <http://www.eia.gov/consumption/commercial/reports/2012/buildstock/index.php>.

<sup>4</sup> Facility Specification Guide, Athletic Business. <http://www.athleticbusiness.com/facility-specifications.html>.

<sup>5</sup> Football and baseball stadiums (NFL plus college football over 50,000 seating capacity and MLB) equal approximately 130 at 1,000,000 square feet each; arenas (NBA and NHL) total 32 at approximately 500,000 square

While the exact number of stadiums and arenas in the United States is not known, some proxies provide insight. In football alone, there are easily over 300 stadiums for professional, college and high school teams. The NFL plays in 31 stadiums. For college football, the number of Division I teams and the Division II and III teams averaging 5,000 or more spectators per game totals 276 teams—many of which have a football stadium.<sup>6</sup> A few Texas high-schools have extensive stadiums, and additional stadiums used for college bowl games and other events dot the country. Add baseball and soccer venues and the number tops 500. MLB has 30 teams, while Minor League Baseball (MiLB) has 160 teams across AAA, AA, and A leagues.<sup>7</sup> College baseball venues are significantly smaller, with only 6 teams averaging more than 5,000 attendees.<sup>8</sup> Major League Soccer (MLS) teams play in 13 soccer-specific facilities.

Determining the exact number of arenas nationwide is much more complicated because the facilities tend to support multiple sports, including basketball and hockey. They also tend to be smaller and support community-level activities that may or may not be the home for a specific team. The National Basketball Association (NBA) and National Hockey League (NHL) utilize 32 arenas between them. There are 1,067 Division I, II and III college basketball programs.<sup>9</sup> Some colleges use the same facilities as the NBA (e.g., Georgetown University, in Washington, D.C., uses the Verizon Center, home of the Washington Wizards) or municipal facilities. The number of municipal facilities is difficult to determine, but the total number of arenas is likely over 1,000.

While the common perception is that these buildings were designed for a single purpose—to be utilized for the 81 home games of a baseball season or eight games of a football season—an increasing number of venues, particularly arenas in urban markets, such as the Staples Center (Los Angeles) and Madison Square Garden (New York City), are looking to optimize the use of their facilities throughout the year. While MLB and NFL stadiums may not host daily events that draw large crowds, many of the facilities remain operational to some degree most of the year—either hosting small community or fan events, providing tours, or as office space for the team or facility operations.

Additionally, many teams have off-site practice facilities that they manage. While not to the scale of game-day facilities, such facilities do provide additional opportunities to test new strategies and capture additional energy and water savings. These training facilities also may host public events, including training camps.

A growing trend on university campuses and for some professional teams is to include the stadium or team practice facilities as part of a broader multi-use development that can expand the

---

feet each; MLS, minor league baseball, auto racing and college arenas and other facilities add additional square footage. Indianapolis Motor Speedway alone has 235,000 permanent seats and covers 559 acres (24.35 million square feet).

<sup>6</sup> This analysis did not include schools where the regular attendance is less than 5,000 per game, as it would tend to suggest a facility with minimal services.

<sup>7</sup> <http://www.milb.com/milb/info/teams.jsp>

<sup>8</sup> [http://fs.ncaa.org/Docs/stats/baseball\\_RB/2016/attend.pdf](http://fs.ncaa.org/Docs/stats/baseball_RB/2016/attend.pdf)

<sup>9</sup> The 5,000 attendance threshold was not applied to these programs as arenas by nature are enclosed and require some level of mechanical systems.

ability of designers and operators to incorporate measures that may have a longer payback period or support more steady utilization and energy loads. Texas Live!, a planned \$1.25 billion stadium, convention center and mixed-use district associated with the Texas Rangers, which will open in 2018 in Arlington, Texas, is one such example.

### *Economic Impact of Sports*

Sports have a significant impact on the U.S. economy. According to the U.S. Census Bureau, “Sports Teams and Clubs”<sup>10</sup> employ nearly 60,000 people nationally and generate \$22.6 billion in annual revenue across 941 establishments.<sup>11</sup> This represents significant growth since 1997. (See Appendix A.) Additional revenue and employment is included in “Promoters of Performing Arts, Sports and Similar Events with Facilities (NAICS Code 711310)” and in collegiate-level activities.<sup>12</sup>

Many sports venues also represent the corporations that drive the U.S. and global economy. AT&T Stadium (Dallas), Citi Field (New York City), and the Carrier Dome (Syracuse, N.Y.) bear the names of the largest companies in the nation. In fact, 28 of the Fortune 100 companies



have purchased naming rights to stadiums and arenas. (See Figure 2 and Appendix B.) As one researcher put it, “Marketers know that putting a name on a venue (if there is no negative association with the place) can make billions of positive impressions in the minds of potential buyers.”<sup>13</sup>

See <http://bit.ly/2kr8ySN> for an interactive map.

**Figure 2: Venues with Naming Rights by Fortune 100 Companies**

<sup>10</sup> This U.S. industry comprises professional or semiprofessional sports teams or clubs primarily engaged in participating in live sporting events, such as baseball, basketball, football, hockey, soccer, and jai alai games, before a paying audience. These establishments may or may not operate their own arena, stadium, or other facility for presenting these events. <https://www.census.gov/econ/isp/sampler.php?naicscode=711211&naicslevel=6#>

<sup>11</sup> U.S. Census Bureau, “Industry Snapshot: Sports Teams and Clubs (NAICS 711211).” [http://thedataweb.rm.census.gov/TheDataWeb\\_HotReport2/econsnapshot/2012/snapshot.hrml?NAICS=711211](http://thedataweb.rm.census.gov/TheDataWeb_HotReport2/econsnapshot/2012/snapshot.hrml?NAICS=711211)

<sup>12</sup> U.S. Census Bureau, “Industry Snapshot: Promoters of Performing Arts, Sports, and Similar Events with Facilities (NAICS 711310).”

[http://thedataweb.rm.census.gov/TheDataWeb\\_HotReport2/econsnapshot/2012/snapshot.hrml?NAICS=711310](http://thedataweb.rm.census.gov/TheDataWeb_HotReport2/econsnapshot/2012/snapshot.hrml?NAICS=711310)

<sup>13</sup> Kalb, Ira. “Putting Brand Names on Stadiums Can be Extremely Valuable.” *Business Insider*. April 10, 2013.

## Activities to Date

---

Many of these venues already are working to reduce energy and water use. Of the 126 professional sports teams in the five major professional North American leagues, 38 teams already have shifted to renewable energy for at least some of their operations and 68 have energy-efficiency programs.<sup>14</sup> At least 146 collegiate sports departments (60 athletics and 86 recreation) invested in more energy-efficient practices by upgrading their lighting and controls. 118 collegiate sports departments (50 athletics and 68 recreation) conducted energy audits of their sports facilities to identify further opportunities for energy savings. 109 sports departments (45 athletics and 64 recreation) initiated a purchasing policy to prioritize energy-efficient models for all electronics.<sup>15</sup>

While it is difficult to determine the energy and water-savings opportunities across the sector, initiatives undertaken at some facilities reveal significant results. From 2006 to 2011, the Seattle Mariners saved approximately \$1.5 million in utility costs (electricity, natural gas, water, and sewer service) by reducing natural gas use by 60%, electricity use by 30%, and water use by 25%.<sup>16</sup> In 2010, the University of Minnesota Athletics staff and the energy management department completed an energy recommissioning study of eight existing athletic facilities. The study revealed so much energy-saving potential that energy conservation measures were implemented in all eight athletic facilities, yielding more than \$412,000 in avoided utility costs annually.<sup>17</sup>

Water-efficient plumbing in the new MetLife Stadium (East Rutherford, N.J.) reduced annual water demand by 25% compared to the former Giants Stadium.<sup>18</sup> Upgrades at CenturyLink Field (Seattle, Wash.), home of the Seattle Seahawks, reduced annual utility costs by 21%. Nationals Stadium in Washington, D.C., the first Leadership in Energy and Environmental Design (LEED)-certified (Silver) MLB stadium, is expected to use 15% less energy, by cost, than a comparable conventional ballpark.<sup>19</sup>

A 2010 report found that AT&T Stadium (Arlington, Texas), home of the Dallas Cowboys, averaged \$200,000 a month in utility bills, equaling the total monthly energy needs of Santa Monica, California.<sup>20</sup> Even a 5% improvement in efficiency would provide \$120,000 in annual savings.

---

<sup>14</sup> [http://greensportsalliance.org/resources/P\\_NRDC%20Game%20Changer.pdf](http://greensportsalliance.org/resources/P_NRDC%20Game%20Changer.pdf)

<sup>15</sup> <http://greensportsalliance.org/resources/NRDC%20Collegiate%20Game%20Changers%20Report.pdf>

<sup>16</sup> [http://greensportsalliance.org/resources/P\\_NRDC%20Game%20Changer.pdf](http://greensportsalliance.org/resources/P_NRDC%20Game%20Changer.pdf)

<sup>17</sup> <http://greensportsalliance.org/resources/NRDC%20Collegiate%20Game%20Changers%20Report.pdf>

<sup>18</sup> Timberlake, Michael, "Here are the NFL's 5 Most Energy Efficient Stadiums," Alliance to Save Energy, January 11, 2014. <https://www.ase.org/blog/here-are-nfls-5-most-energy-efficient-stadiums>.

<sup>19</sup> Project Profile: A Grand Slam for Washington, DC," U.S. Green Building Council. <http://www.usgbc.org/Docs/Archive/General/Docs5108.pdf>.

<sup>20</sup> Little, Amanda, "Can Professional Sports Do More Than Politics to Save the Planet?" *Forbes*, November 15, 2010. <http://www.forbes.com/sites/amandalittle/2010/11/15/can-professional-sports-do-more-than-politics-to-save-the-planet/#e98fdc81148a>

## Facility Spotlight: New York Jets Atlantic Health Training Facility, Florham Park, New Jersey

The Atlantic Health Jets Training Center opened in Florham Park, New Jersey on September 2, 2008 as the team headquarters and training facility for the New York Jets. While the public is most often familiar with the stadium where games are played (in this case, MetLife Stadium in nearby East Rutherford, NJ), the headquarters and practice facility are the lifeblood of the organization. It fosters team culture and houses the team's day-to-day operations. Often, it can serve as a test bed for solutions contemplated for implementation at a larger scale inside the stadium.

While the facility generally is closed to the public, the team hosts periodic events to allow fans to experience the facility and meet the team. Additionally, the team has leveraged its location and proximity to large corporations in the surrounding neighborhood to establish partnerships and identify opportunities to expand their programs.

Over the nine seasons since the facility opened, facility staff has made significant strides in reducing energy consumption. The staff's first goal was to reduce chiller cycling in the main server room by installing hot gas bypass systems to run the chillers at a significantly lower capacity, matching the actual room heat load. The team began studying other ways to reduce electricity needs and, through a solar public-private venture (PPV) contract, installed more than 3,000 solar panels in the summer of 2010.

Shortly following the photovoltaic (PV) installation, facilities staff started investigating

LED lighting options, culminating in a three-phase project. All parking lot, roadway, and interior stand-alone fixtures were replaced in 2012. Roof-hanging field house lighting (pictured below) was changed from metal halide to LED fixtures in the summer of 2016. The remainder of the facility's lighting is on the docket for a capital expenditure in 2017, assuming the identification of a solution that both improves the aesthetic value of the lighting and saves a significant amount of electricity. Other indoor solutions employed include installation of lighting occupancy sensors; heating, ventilation, and air-conditioning (HVAC) programming for outside air economizing; balancing outdoor air for humidity and temperature control; and an installation of power metering equipment that allows real-time review of current amperage draw from the incoming meter.

In addition to energy savings efforts, the facility utilizes single-stream recycling with an on-site compactor, allowing removal of all aluminum, glass, paper, plastic, and cardboard from the waste stream. The on-site food vendor has a food recycling initiative and segregates its trash accordingly. A used cooking oil container on site is filled and monitored for pickup. To help the local sewerage authority with its treatment, the team installed a new and improved full kitchen food interceptor in 2016 to keep waste stream solids low.

The team remains committed to investigate opportunities to reduce energy and water use and save utility costs.



*Provided by the New York Jets*

Union Arena, a community-oriented facility in Woodstock, Vermont, is aiming to be the first ice rink in North America to become a zero-energy building (ZEB). The current strategy to achieve this goal requires two main components. The first is to improve the efficiency limits of the rink by approximately 50%. This will be done through system integration, engineering, ultra-efficient lighting and mechanical systems. The second is to use renewable energy sources to provide the other 50%. The cost of energy accounts for approximately a third of the total annual operational costs which amount to \$500,000. Built in 2003 and with 17,000 square-feet of open space, the Union Arena is open 12 months a year and is available to rent for a variety of uses, including concerts, outings, antique shows, art shows, school graduations, theatre festivals, concerts, fundraisers, and sports practices. A myriad of educational, health, and arts organizations also use the facility for events. It gets approximately 100,000 visits each year.<sup>21</sup>

Many facilities have utilized specific technologies to either produce clean energy on site or reduce energy demand. To date, these largely have focused on the installation of solar photovoltaics (PV) and LED lighting.

### Monitoring Progress, Setting Goals

---

Fundamental to any energy, water, or other sustainability strategy is understanding current performance and setting realistic goals for continued improvement. Benchmarking current performance is essential. The NHL was the first major professional league to undertake an effort to benchmark its current performance across both the league offices and the clubs. Based on this effort, the league and its clubs are better prepared to set improvement goals and facilitate sharing of best practices.

The NHL released a sustainability report in 2014 to highlight its progress and identify the continued challenges ahead.<sup>22</sup> The league focused on greenhouse gas emissions as a key metric. During the shortened 2012-2013 season, emissions were 321,460 metric tons (t) of CO<sub>2</sub> equivalent (CO<sub>2</sub>E) emissions (scopes 1 and 2) and 380,342 t of CO<sub>2</sub>E emissions, when including scope 3 emissions (from league and club air travel and waste/recycling). The league calculated energy use at 2.3 million kBtu per game. Water also is an important resource being tracked by the NHL. Primary uses of water include ice making, food services, landscaping, cooling towers, and plumbing. Annually, the clubs use over 321 million gallons of water or 247,746 gallons per game.

*In order to improve, you need to know where you are. By coming together as an industry, we all can get better at running efficient and responsible facilities.*

Jim Ibister, Vice President, Facility Administration, Minnesota Wild

In addition to the NHL Sustainability Report, other sports organizations have begun to publicly document their environmental impacts and opportunities to improve. AEG Worldwide<sup>23</sup> launched its AEG 1EARTH initiative in 2010, which identifies goals to guide company decision-making; measures and quantifies the environmental impact of its activities; and develops

---

<sup>21</sup> <http://www.thevermontstandard.com/2016/12/union-arena-wants-to-be-north-americas-first-net-zero-rink/>

<sup>22</sup> <http://ice.nhl.com/green/report/>

<sup>23</sup> AEG is a sports and entertainment presenter that owns, controls, or is affiliated with a collection of companies, including more than 100 facilities worldwide. <http://www.aegworldwide.com/about/companyoverview/companyoverview>.

strategies and tools to improve environmental performance. The core elements of AEG 1EARTH are 2020 Environmental Goals, AEG Ecometrics system, and education and communication initiatives.<sup>24</sup>

In 2016, AEG issued its fifth annual sustainability report detailing the environmental performance of its venues, festivals, and offices.<sup>25</sup> By producing these reports each year, AEG is able to monitor progress and set reasonable goals for future performance. As identified in the report, “We now collect environmental performance data for AEG’s entire portfolio of business, not just our sports and entertainment venues. In reviewing the data, we validated our historic focus on venues, which continue to comprise the vast majority of AEG’s footprint, but also gained assurance that we were being as comprehensive and transparent as possible in our reporting.”

Based on its findings and desire to set targets for 2020, AEG established a 3.2% annual reduction in greenhouse gas emissions (GHGs) goal across its operations from 2010 to 2020 and a reduction in potable water use in water-stressed sites by 2% annually from 2010 to 2020. In 2015, AEG emitted 175,279 metric tons of GHGs. While this is 21% above its goal for the year and 6% above the baseline year, organic growth and acquisitions within the company account for a significant chunk of the increase. They also have sought to increase events at existing facilities to better utilize existing assets. The operations in place since 2010 saw a 13% reduction.

AEG focused its water-use reduction goals on sites already under water stress. Despite water efficiency being a corporate best practice already, the company was able to reduce water use at 10 sites (theaters, arenas, and stadiums) by 65 million liters (approximately 17.2 million gallons) in 2015.

## Green Building Rating Systems

---

Owners and facility managers at a growing number of venues are thinking broadly about implementing sustainable design and operations practices by utilizing green building rating systems such as the U.S. Green Building Council’s LEED rating system. Since the Nationals Stadium received certification in 2008, the number of certified sports venues has expanded to 80, for a combined total of 31.1 million square feet.<sup>26</sup> (See Figure 3.)

Both new and existing venues have pursued LEED certification, either through the LEED for New Construction or the LEED Existing Buildings Operations and Maintenance (EBOM) programs respectively. The newly opened Golden 1 Center in Sacramento became the first LEED Platinum indoor sports venue.<sup>27</sup> M&T Bank Stadium, home of the Baltimore Ravens, became the first existing stadium to achieve LEED Gold in 2013 through the LEED EBOM program.<sup>28</sup>

---

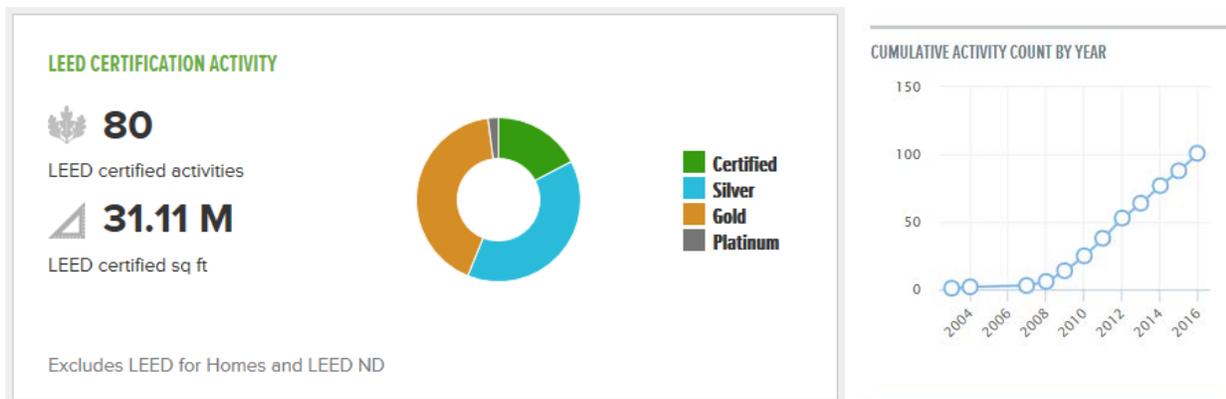
<sup>24</sup> <http://www.aegworldwide.com/about/companyoverview/aeg1earth>

<sup>25</sup> *AEG’s 2016 Sustainability Report*, <http://aegworldwide.com/media/pdf/2016-SustainabilityReport3.pdf>.

<sup>26</sup> For details on the buildings included, see the interactive collection at <http://www.gbgl.org/collections/18237>.

<sup>27</sup> “Sacramento Kings New Arena Is First Indoor Sports Venue to Earn LEED Platinum Designation.” September 22, 2016. <http://www.golden1center.com/news/detail/first-indoor-sports-venue-earn-leed-platinum-designation>

<sup>28</sup> <http://www.baltimoreravens.com/news/article-1/Press-Release-Ravens-And-Maryland-Stadium-Authority-Recognized/c54bae7a-9d50-4a7c-8161-e0e13c00db51>



Source: <http://www.gbig.org/collections/18237>

**Figure 3: Growth in LEED Certified Sports Venues**

In pursuing LEED certification, M&T Bank Stadium reduced electricity use from 15,952,984 kilowatt hours in 2005 to 10,881,579 in 2012, a savings of 5,071,405 kilowatt hours. The installation of waterless urinals reduced water use by 43%, resulting in three million gallons saved per year.<sup>29</sup>

While LEED has provided designers, owners and operators with a consistent framework for implementing sustainable practices and allowing ready comparison with similar venues, several challenges to a strictly LEED-driven process exist. When applying LEED, sports venues are utilizing the same criteria applied to all commercial buildings—which may not be particularly applicable to the use patterns and space types associated with these venues. Many of these challenges are discussed in greater depth in the “Challenges to Overcome” section later in this report.

*The Ravens attempt to set a standard in everything they do, both on and off the field. Working hard to stay green and sustainable at M&T Bank Stadium is another example of the Ravens doing the right thing in their community at a consistently high level.*  
NFL Commissioner Roger Goodell

## Lighting

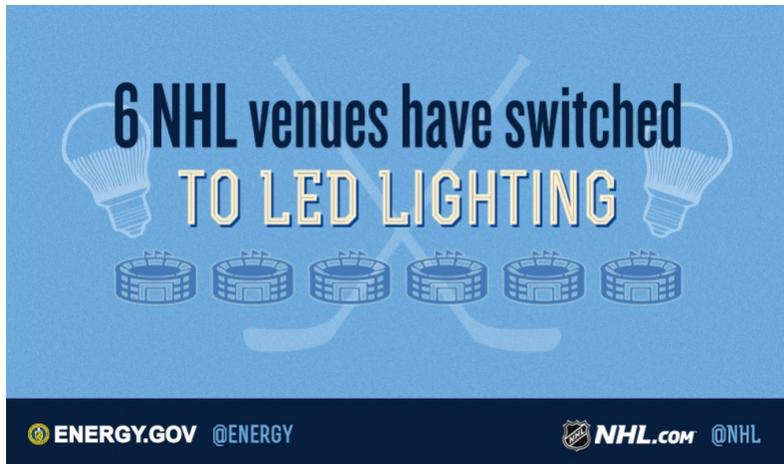
The Green Sports Alliance developed several publications that feature case studies from successful lighting retrofit projects, including *Lessons from the Field: Seattle Mariners-Path to LED*<sup>30</sup> and *Lessons from the Field: New York Yankees-Path to LED*.<sup>31</sup>

In addition to LED installations at Safeco Field by the Seattle Mariners and at Yankee Stadium, other venues have made the transition to LEDs, including NRG Stadium (football, Houston,

<sup>29</sup> Ibid.  
<sup>30</sup>

<http://greensportsalliance.org/resources/Lessons%20from%20the%20Field%20LED%20Mariner%20Case%20Study.pdf>

<sup>31</sup> <http://greensportsalliance.org/resources/Lessons%20from%20the%20Field%20LED%20Yankees%20Case%20Study.pdf>



<https://www.energy.gov/articles/nhl-scores-big-sustainability>

**Figure 4: DOE, NHL Highlight LED Use**

Texas),<sup>32</sup> Duke University at Wallace Wade Stadium (football, Durham, N.C.),<sup>33</sup> Wells Fargo Arena (basketball, Tempe, Ariz.),<sup>34</sup> Cambria County War Memorial Arena (hockey, Johnstown, Penn.),<sup>35</sup> Mercedes Benz Superdome (football, New Orleans, La.),<sup>36</sup> Bridgestone Arena (hockey, Nashville, Tenn.),<sup>37</sup> Minute Maid Park (baseball, Houston, Texas),<sup>38</sup> and Bell Centre (hockey, Montreal, Canada).<sup>39</sup>

The Moda Center, home of the NBA's Portland (Ore.) Trail

Blazers, has invested in innovative LED lighting for improved visibility. The total lighting upgrade replaced 230 mercury-based lighting fixtures with 460 mercury-free LED units and will save the franchise 939,936 kilowatt hours per year and offset 446 tons of CO<sub>2</sub> emissions annually.<sup>40</sup>

Rabobank Arena, home of the Bakersfield (Calif.) Condors of the American Hockey League (AHL), replaced the metal halide lights installed when the venue first opened in 1998 with LED sports lights in advance of the 2015-2016 season. The new lights reduced system wattage by 65%, decreasing the load from 100 kW to 35.5 kW. The switch also reduced operation of the heating, ventilation, and air-conditioning (HVAC) system.<sup>41</sup>

NASCAR's Martinsville Speedway (Ridgeway, Va.) recently added LED lighting. The project, dubbed "Light Up Martinsville," will provide better illumination, greater flexibility, and more efficiency than traditional metal halide lights. In addition to enhancing the fan experience at Martinsville, LED lighting also will enhance the quality of the broadcast for fans watching at home.<sup>42</sup>

<sup>32</sup> <http://www.energymanagertoday.com/nrg-stadium-retrofits-leds-0105529/>

<sup>33</sup> <http://www.energymanagertoday.com/stadium-saves-40-energy-leds-0113834/>

<sup>34</sup> <http://greensportsalliance.org/wells-fargo-arena-embraces-led-lighting/>

<sup>35</sup> <https://www.nhl.com/news/nhl-constellation-increase-energy-efficiency-support-environmental-sustainability-for-kraft-hockeyville-usa/c-778034>

<sup>36</sup> <https://www.greenbiz.com/article/greener-saints-team-marches-superdome>

<sup>37</sup> <http://predators.nhl.com/club/news.htm?id=778230>

<sup>38</sup> <http://www.energymanagertoday.com/minute-maid-park-in-houston-going-with-musco-leds-0121995/>

<sup>39</sup> <http://www.sportsbusinessdaily.com/Journal/Issues/2012/10/22/Franchises/Bell-Centre.aspx>

<sup>40</sup> <http://www.nba.com/blazers/trail-blazers-go-2016-17-season-loaded-fresh-fan-experiences-new-broadcast-talent/>

<sup>41</sup> *AEG's 2016 Sustainability Report*, <http://aegworldwide.com/media/pdf/2016-SustainabilityReport3.pdf>.

<sup>42</sup> <http://www.facilitiesnet.com/lighting/tip/NASCAR-Track-Debuts-Lights-with-LEDs--38156>

## Renewable Energy

In 2015, nearly a third of the NFL teams played or trained at facilities with on-site solar assets, totaling 8,000 solar PV panels, generating more than 10 million kilowatt-hours (kWh) per year.<sup>43</sup> Other sports facilities also have installed solar generation. (See Figure 5.) Lincoln Financial Field, home of the Philadelphia Eagles installed 14 wind turbines<sup>44</sup> (See Figure 6.) The Staples Center installed fuel cells. The StubHub Center (Carson, Calif.) installed an energy storage system<sup>45</sup> to reduce energy costs, which allows the facility to purchase and store energy overnight at low-demand rates of \$0.10/kWh and use it during peak demands, when the facility would have been charged \$0.60/kWh.<sup>46</sup>

MLB facilities also have installed on-site renewable energy assets. The San Francisco Giants installed more than 500 solar panels throughout their facility, which produce up to 122 kilowatts of renewable energy for Pacific Gas and Electric Company customers. Additionally, Coors Field, home of the Colorado Rockies, installed a solar PV system with 46 panels. The 9.8-kilowatt system can provide more than 14,000 kWh of energy.<sup>47</sup>



**Figure 5: Solar Installations at Professional Sports Venues**

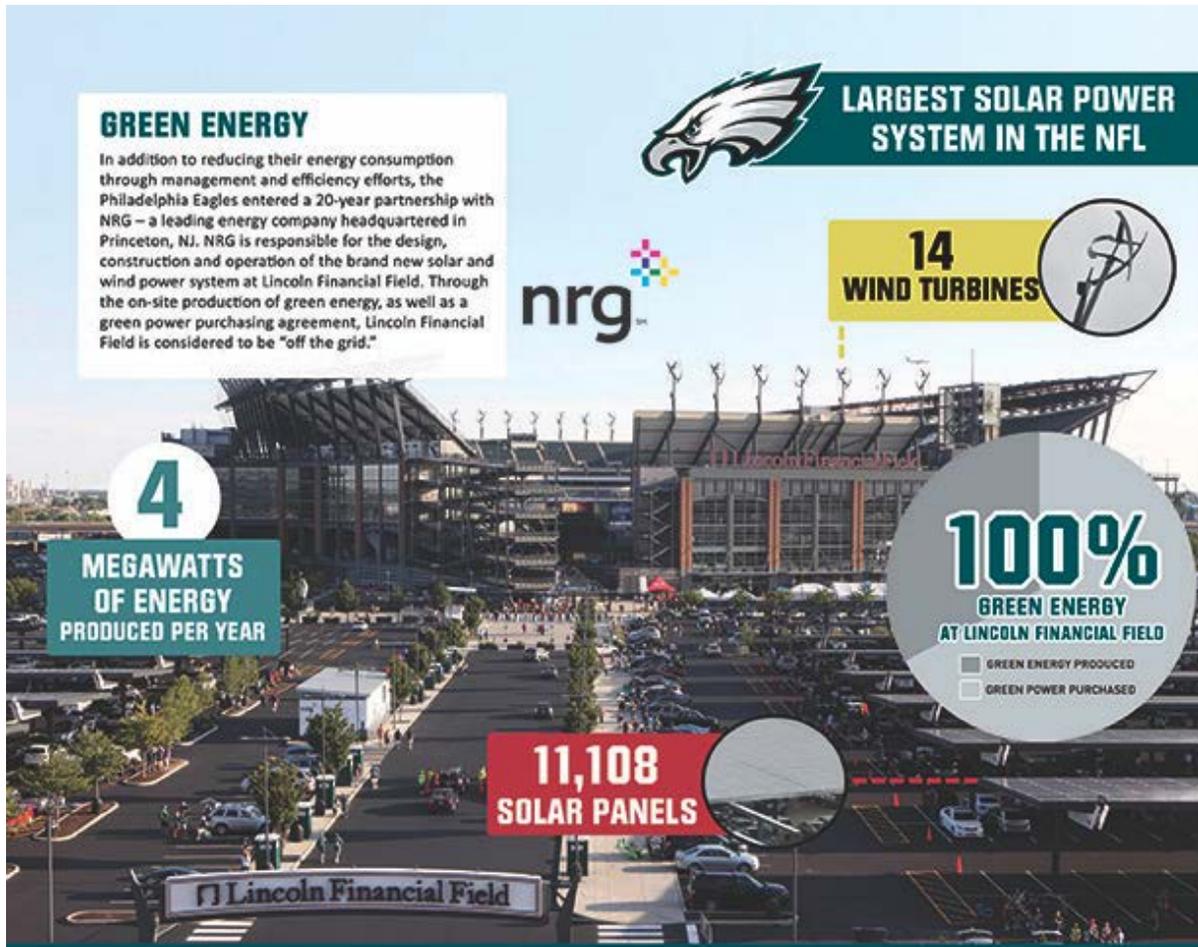
<sup>43</sup> Solar Energy Industries Association, “News: Countdown to Kickoff: The Solar-Powered Super Bowl,” February 4, 2016. <http://www.seia.org/blog/news-countdown-kickoff-solar-powered-super-bowl>.

<sup>44</sup> “Philadelphia Eagles Go Green.” <http://www.philadelphiaeagles.com/community/gogreen.html>.

<sup>45</sup> <http://www.bloomenergy.com/newsroom/press-release-11-19-15/>, <https://greensportsblog.com/2016/08/23/tesla-and-aeg-bring-energy-storage-to-las-stubhub-center/>

<sup>46</sup> Ibid.

<sup>47</sup> <http://mlb.greensports.org/greener-building/on-site-renewable-energy/>



**Figure 6: Green Energy at Lincoln Financial Field, Home of the Philadelphia Eagles**

## Water

For the NHL, water is essential. It takes between 12,000 and 15,000 gallons of water to create an NHL regulation ice sheet.<sup>48</sup> Instead of treating ice surface water chemically, the MTS Centre, home of the Winnipeg Jets, uses reverse osmosis to filter ice surface water, which produces demineralized water free of impurities that typically forms into a harder ice surface. Pure, hard ice requires less maintenance, flood water, and refrigeration energy, and also saves on wear of the ice resurfacers. Citizens Business Bank Arena (Ontario, Calif.), home of the Ontario Reign of the ECHL, an AA hockey league, became the first professional hockey arena in the United States to make ice from recycled water. Citizens Business Bank Arena has a strong history of utilizing recycled water, having used it for irrigation since 2008. Recycled water currently comprises 60% of its annual water consumption.<sup>49</sup>

<sup>48</sup> <http://ice.nhl.com/green/report/>

<sup>49</sup> <http://www.cbbankarena.com/news/detail/citizens-business-bank-arena-breaks-ground-as-first-us-professional-hockey-arena-to-make-ice-using-recycled-water>

The NHL calculated the annual water use across its clubs at 321,231,564 gallons—equivalent to 25,700 ice sheets, 247,746 gallons per game, or 16.5 gallons per attendee. That does not include, food service, plumbing, landscaping, and cooling towers, which result in significant additional water use.

Field sports that use grass turf require water for irrigation. In 2003, StubHub Center became the first stadium in California to use reclaimed water for irrigation.<sup>50</sup> The Amalie Arena (Tampa, Fla.), formerly the Tampa Bay Times Forum, uses well water for landscape irrigation.<sup>51</sup>

Staples Center and StubHub Center installed waterless urinals in 2009.<sup>52</sup> The BB&T Center (Sunrise, Fla.), home of the NHL Florida Panthers, substantially decreased restroom-sink water consumption by close to 75% from baseline consumption by retrofitting more than 400 sinks in public restrooms.<sup>53</sup> At Petco Park (San Diego, Calif.), sinks have new automated devices and 60% of urinals and toilets have automated low-flow flushers, which all told, has saved an estimated 390,000 gallons of water.<sup>54</sup> U.S. Bank Stadium in Minneapolis is expecting a savings of almost 6 million gallons in water use, a 37% decrease, based on the installation of low-flow fixtures.<sup>55</sup>

In the collegiate sphere, University of Washington's Husky Stadium used low-flow plumbing fixtures, dual-flush toilets, and native landscaping to reduce water use in the building by 40%. Husky Stadium received Salmon-Safe certification through the Pacific Rivers Council, in recognition of its pollution capture, storm water capture, and construction activity pollution reduction strategies.<sup>56</sup>

## League Level Efforts

---

The leagues and conferences provide an excellent forum for sharing best practices and encouraging competition among their members. Through development of its sustainability report and the engagement of its teams and arena operators, the NHL is exploring energy and water saving opportunities within its member teams. Top areas for focus include refrigeration, humidification systems, concessions, HVAC, lighting and technical displays, and audio systems. The arenas are exploring new technology, including LED lighting, fuel cells, and heat capture to increase their efficiency or provide cleaner energy generation.

The NHL is on the U.S. Environmental Protection Agency (EPA) list of 100% Green Power Users.<sup>57</sup> In 2011, the league offset its water footprint through a partnership with the Bonneville Environmental Foundation.<sup>58</sup> During the 2015-2016 Stanley Cup Final, the NHL offset the water

---

<sup>50</sup> AEG's 2016 Sustainability Report, <http://aegworldwide.com/media/pdf/2016-SustainabilityReport3.pdf>.

<sup>51</sup> <http://ice.nhl.com/green/report/>

<sup>52</sup> AEG's 2016 Sustainability Report, <http://aegworldwide.com/media/pdf/2016-SustainabilityReport3.pdf>.

<sup>53</sup> <http://ice.nhl.com/green/report/>

<sup>54</sup> <http://www.sandiegouniontribune.com/sdut-padres-energy-efficiency-2016jun06-story.html>

<sup>55</sup> <http://www.facilitiesnet.com/groundsmangement/tip/Birds-and-Buildings-A-New-Stadium%27s-Challenges--37355>

<sup>56</sup> <http://www.hok.com:7080/thought-leadership/sustainable-sports-venues-as-anchors-for-communities/>

<sup>57</sup> <https://www.epa.gov/greenpower/green-power-partnership-100-green-power-users>

<sup>58</sup> <https://www.nhl.com/news/nhl-counterbalances-water-and-carbon-footprint/c-281014440>

*NHL Green is not just about convincing people to join the effort. It is about amplifying and coordinating the considerable work that is already being done by our Clubs and by our Players and ensuring that this work continues to move forward. All of our people and partners — from the ice crews to the concessionaires—help us define and achieve our environmental-sustainability goals. . . We lean on them to be forward thinking, to push the envelope, to help us lessen our environmental impact League-wide.*

NHL Commissioner Gary Bettman

and carbon footprint of the event<sup>59</sup> and worked with Constellation Energy to offset carbon impacts of the 2016 Winter Classic.<sup>60</sup> The league also initiated an effort to engage community ice rinks in identifying opportunities to improve operations, thereby freeing up limited funding to support engagement of more youth in hockey.<sup>61</sup>

MLB partnered with the Natural Resources Defense Council (NRDC) to green its high-profile events, including the All-Star Game and

World Series.<sup>62</sup> The All-Star Game provides the league and the host team an opportunity to showcase and expand on greening work being done at All-Star Game-related facilities. The 2016 All-Star Game offset energy and water use through the purchase of renewable energy credits (RECs) and water restoration certificates (WRCs).<sup>63</sup>

The NBA also has used its All-Star events as an opportunity to highlight green initiatives. Since 2008, these events have incorporated green features, including the use of RECs and carbon offsets. Since 2009, the league and its teams have hosted Green Week to focus on fan engagement and service projects.<sup>64</sup> The Super Bowl has been at the forefront of the NFL's<sup>65</sup> green initiatives, starting with a recycling initiative in 1993, moving to carbon offsets in recent years.<sup>66</sup> MLS launched Greener Goals primarily to engage fans in green endeavors.<sup>67</sup>

In addition to efforts to improve car efficiency and fuel mixes, NASCAR is encouraging its race tracks to utilize alternative energy sources. Many teams and tracks now rely on solar power.<sup>68</sup> The U.S. Tennis Association (USTA)<sup>69</sup> launched the U.S. Open Green in 2008, which included carbon offsetting. Since then, the new grandstand at the Billie Jean King National Tennis Center (New York City) has earned LEED certification (certified, 2016)<sup>70</sup> and installed LEDs.<sup>71</sup>

At the international level, the Fédération Internationale de Football Association (FIFA), the international governing body for soccer, has committed to carbon neutrality by 2050.<sup>72</sup>

<sup>59</sup> Ibid.

<sup>60</sup> <http://www.constellation.com/about-us/news/archive/2015/constellation--nhl-reduce-environmental-impact.html>

<sup>61</sup> <https://www.nhl.com/news/nhl-constellation-renew-partnership-for-third-year/c-282551456?tid=278748150>

<sup>62</sup> [http://web.mlbcommunity.org/index.jsp?content=programs&program=team\\_greening\\_program](http://web.mlbcommunity.org/index.jsp?content=programs&program=team_greening_program)

<sup>63</sup> <http://www.sportstechie.com/2016/04/23/green/greening-major-league-baseballs-star-game/>

<sup>64</sup> See <http://green.nba.com/>

<sup>65</sup> <http://www.nfl.com/news/story/09000d5d8205a0e7/article/nfl-green>

<sup>66</sup> <http://www.ibtimes.com/pulse/super-bowl-energy-guzzling-carbon-emitting-machine-heres-what-nfl-doing-about-it-1799874>; [http://www.in.gov/idem/recycle/files/superbowl\\_sustainability\\_report.pdf](http://www.in.gov/idem/recycle/files/superbowl_sustainability_report.pdf);

<https://www.greenbiz.com/article/green-guru-super-bowl-50-planning-net-positive-game>

<sup>67</sup> <http://www.mlssoccer.com/mls-works/greener-goals>

<sup>68</sup> <http://green.nascar.com/>

<sup>69</sup> [http://www.usopen.org/en\\_US/about/green\\_initiatives.html](http://www.usopen.org/en_US/about/green_initiatives.html)

<sup>70</sup> <http://www.usgbc.org/projects/usta-grandstand?view=overview>

<sup>71</sup> [http://www.tennisindustrymag.com/news/2015/09/us\\_open\\_awarded\\_prestigious\\_le.html](http://www.tennisindustrymag.com/news/2015/09/us_open_awarded_prestigious_le.html)

<sup>72</sup> [http://www.climateactionprogramme.org/news/football\\_association\\_fifa\\_commits\\_to\\_climate\\_neutrality](http://www.climateactionprogramme.org/news/football_association_fifa_commits_to_climate_neutrality)

## Sports and the Federal Government

A number of federal agencies have established relationships with the sports community—but not specifically on venues. The EPA was a founding member of the Green Sports Alliance and has been involved in initiatives relating to recycling and waste reduction.

Both DOE and EPA have signed Memoranda of Understanding (MOU) with NASCAR. The DOE-NASCAR MOU identifies several transformative energy technologies that will benefit NASCAR and its fans. Those technologies include electric-vehicle charging stations, solid-oxide fuel cells, advanced biofuels and emerging natural gas technologies for NASCAR teams' long-haul trucks.<sup>73</sup> The EPA-NASCAR MOU provides NASCAR with EPA technical assistance and environmental expertise, using EPA programs like Design for the Environment and the Economy, Energy and Environment (E3) framework, to help protect Americans' health and the environment.<sup>74</sup>

In 2015, EPA named the NHL a Green Power Partner of the Year in recognition of the league's commitment to purchase green power.<sup>75</sup> EPA also signed an MOU with the New Meadowlands Stadium Company, which outlined plans to incorporate environmentally-friendly materials and practices into the construction and operation of MetLife Stadium in East Rutherford, N.J. EPA has a similar agreement in place with the New York Mets for the team's stadium, Citi Field.<sup>76</sup>

### Federal Agency Engagements in Sports

**Department of Energy (DOE).** DOE, in partnership with the Green Sports Alliance and the National Institute of Building Sciences, convened a workshop in November 2016 at the M&T Bank Stadium in Baltimore, Md., which brought together sport stadium and arena owners and operators, building professionals, and other sports-industry stakeholders to examine and identify the opportunities and challenges in advancing the design, construction and operation of high-performance sport facilities. The workshop focused on developing a strategic vision and roadmap for delivering better facilities that are built and operated to incorporate energy-efficient strategies and technologies that help accelerate adoption of clean energy, protect the environment, increase resilience, save money, and inspire sports fans. This report reflects information gathered during that workshop and identifies existing resources, assesses the current state of the facilities, showcases best practices and case studies, and identifies a solutions-oriented path toward more sustainable sport stadiums and venues.

**Department of State.** Working with U.S. Embassies and Consulates worldwide, the State Department's Sports Diplomacy Division sends Sports Envoys—former or current American professional athletes and coaches—overseas to hold sports clinics, participate in community outreach activities, and engage youth in dialogues on the importance of leadership and respect for diversity. The Sports Diplomacy Division will support at least five Sports Envoy programs on the environment in 2017 and 2018, with more than 800 people expected to participate. These programs will include Green Races (5K runs) and other activities that inspire the local community and Embassy staff to recycle, plant trees, and run and bike to work, as well as encourage people to eat locally produced food throughout the year. The State Department intends to issue a new cooperative agreement, following an open competition, to advance implementation of environmentally themed sports exchanges that promote the “greening of sports.” These exchanges will build capacity and expertise in both the sports and environment spaces around the world.

<sup>73</sup> <http://energy.gov/articles/new-doe-nascar-partnership-revs-deployment-pollution-reducing-technologies>

<sup>74</sup> <https://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceac8525735900400c27/c0024ad7e5e2315585257a05005b7fca>

<sup>75</sup> <https://www.nhl.com/news/nhl-named-u-s-epa-green-power-partner-of-the-year/c-783894>

<sup>76</sup> <https://yosemite.epa.gov/opa/admpress.nsf/0/EB8BD7874DB85F38852575C8005452A8>

Building off this existing work, the White House further highlighted the government’s opportunity to influence action. Following an initial call to action on July 11, 2016,<sup>77</sup> the White House designated October 6, 2016, to be Green Sports Day.<sup>78</sup> In conjunction with the celebration of Green Sports Day, the White House announced 19 commitments made by various representatives from the sports community to grow awareness and implement actions in support of sustainability. In addition to the private-sector commitments, two federal agencies, DOE and the U.S. Department of State, committed to engage the sports community to support their missions. See text box on federal Agency Engagement in Sports.

## Challenges to Overcome

---

The sheer number of facilities, their size, and their visibility provide a compelling case to identify and implement energy and water saving measures within this sector. However, there are challenges that must be overcome to effectively realize high-performance stadiums and arenas. This section identifies some of those challenges and the next section identifies potential strategies to address them.

### Limited Data

---

While many activities are underway to identify and implement sustainability initiatives in sports, there are few metrics available to compare how these venues perform in relation to other building types. Industry stakeholders identified the lack of available data, the inability to identify “the right data and metrics,” and inconsistency in measurements as specific challenges.

While the sector has specific metrics they use regularly, such as the number of events; full and partial event utilization, and event day and operating cost calculations, they do not have consistent standards and definitions for measuring and reporting such information. They also need standards for space identification and measurements.

Despite the importance of sports and the size of the venues (highlighted earlier in this report), the leagues, conferences, corporate sponsors, and community policymakers have little knowledge about how these venues perform. Some venue operators are even behind the curve, and do not have the tools, resources, or training to effectively manage and measure their own venues’ performance. Those that have undertaken steps to understand and improve venue performance have no means to compare themselves with their peers to determine if they are leading the pack or if there is still much more to be done.

While some venue operators have incorporated sub-metering, building energy management systems and data dashboards as recent projects, their application is not widespread across the existing building stock. Many university campuses continue to operate on master meters that serve multiple buildings. One Midwest university reported that its football stadium, arena (which houses basketball, volleyball and wrestling), and a fitness center are all on one meter. Such a

---

<sup>77</sup> <https://www.whitehouse.gov/blog/2016/07/11/tackling-climate-through-sports>

<sup>78</sup> <https://www.whitehouse.gov/blog/2016/10/06/new-actions-tackle-climate-through-sports>

setup hinders the ability to understand how energy is being used, the development of successful strategies to reduce energy use, and the measurement and verification of effective strategies.

Even the Energy Information Administration’s assessment of the U.S. commercial building stock—the Commercial Buildings Energy Consumption Survey (CBECS)—provides little information on this building type. Stadiums and arenas are categorized as public assembly buildings, along with libraries, convention centers, senior centers, movie theaters, and funeral homes.<sup>79</sup>

This lack of data presents a particular challenge for designers engaged in new projects or the renovation of existing facilities. Currently, most of the energy-related information from projects is derived from LEED and energy codes, yet these were not specifically designed to address the unique nature of such facilities. Identified energy savings are determined based on energy modeling relative to ASHRAE Standard 90.1 or the International Energy Conservation Code (IECC)—neither of which specifically focus on stadium or arena-specific parameters. This leaves uncertainty in the actual performance of the facility and the ability to get feedback on the efficacy of strategies employed. Access to energy use intensity data along with intensities for process and domestic water uses would help support high-performance designs and temper the desire to value engineer out any strategies or components designed to reduce overall energy use. Effectively reducing water used in process load is particularly challenging as little information is available on how the processes are actually employed.

Having data to quantify the impact, support decision making, and inform best practices is essential.

## Uniqueness of Venues

---

As a building type, there is little doubt that stadiums and arenas do not look like or function like the typical commercial building. No other building type sees the significant swing in occupants experienced by an NFL or college football stadium. A weekday occupancy of a few dozen team and facility staff can balloon to 70,000 or more for a few hours over the weekend. An MLB park can go from minimal staffing in the off-season to over 40,000 people a night for a week straight.

Even within the estimated 1,500 stadiums and arenas, there is incredible variety in both size and structure. Baseball specific facilities range from open MiLB venues, such as Security Service Field, home of the Colorado Springs Sky Sox, with a seating capacity of 8,500, to Minute Maid Park, with its retractable roof and 40,950 seats, to the fully enclosed Tropicana Field (St. Petersburg, Fla.), with 40,473 seats. Football venues have a similar spectrum, from 70,000-seat Lucas Oil Field, home of the Indianapolis Colts, with its retractable roof, to the new enclosed U.S. Bank Stadium, home of the Minnesota Vikings and 66,665 fans, to open Lambeau Field in Green Bay, with capacity for 80,735. College football venues have similar variation, with capacities ranging from under 5,000 to over 110,000.

---

<sup>79</sup> Energy Information Administration, *Commercial Buildings Energy Consumption Survey, Building Type Definitions*. <http://www.eia.gov/consumption/commercial/building-type-definitions.php#PublicAssembly>

While the size and structure of these venues vary widely, their functions are relatively consistent—to provide fans with a memorable experience. That includes providing restroom facilities, concession stands, press boxes, and, often, luxury boxes or club spaces.

The uniqueness of stadiums and arenas can result in particular challenges (and opportunities) in implementing energy and water efficiency measures. While communities and university campuses already may have established energy-performance or sustainability goals, venue owners, project managers, and athletic departments often believe their facilities are “special,” and therefore not subject to such requirements. On the other hand, the perception of the owner and the desire to be perceived favorably by the public, realize potential cost savings, engage new and younger fans that have an increased interest in sustainability, and keep up with peers can be key drivers in actually implementing sustainability measures.

### *Existing Facilities*

---

When it comes to existing facilities, several hurdles exist in implementing retrofits aimed at reducing energy and water use. The limited time between seasons provides a short window for renovations. This often limits the scope of projects to those that can be completed with a minimal disturbance to the fans. Since the fan experience is typically a major driver of decision making, venues can be reluctant to make changes that are untested. Therefore, enhancing that fan experience is often the driving force behind retrofit and renovation efforts. Energy or water-related initiatives may be incorporated or done separately, but often are secondary to aesthetic or revenue-driven activities. When approaching energy or water-related retrofit/renovation projects, facility managers are typically the champions, but rely on examples from other teams, guidance from the league, and trusted vendors to help make the case. Owners often are reluctant to make changes that alter the facility and require extensive testing. They generally are risk-averse, want to learn from others who have implemented the technology or practice, and desire short pay back periods.

### *New Facilities*

---

When designing a new facility, it can be a challenge to get owners and others to appreciate the importance of investing in energy and water efficiency measures. The design process is often a tug-of-war between offering amenities and reducing energy and water use. The comfort and

*Our hope in creating Golden 1 Center was to help drive meaningful change in our community – which includes working to curb climate change and promote renewable energy. Businesses, including large sports franchises, have a core responsibility to help facilitate the world’s clean energy transition so that we can better protect the health and environment of future generations. The 1.2 million people who will pass through our doors each year will see firsthand how adopting the best sustainability practices can improve the fan experience.*

Sacramento Kings Owner and Chairman  
Vivek Ranadivé

experience of the fans drive the decisions. When people within an organization have bought into sustainability, they often are not the same decision makers present in the design meetings. Normally, energy measures are implemented based on first cost. To change this dynamic, the finance office needs to be brought into the discussion and sold on the potential for energy savings long-term.

Even once a stadium or arena is constructed, the design team has limited ability to effect energy and water performance. Generally, the venues do not conduct a post-occupancy evaluation, so the designers are not aware if the operations staff is

operating the facility within the design intent and whether performance goals are actually being met—to see whether the modeled energy use is playing out in real life. Such feedback loops are important for continued improvements in future designs.

## Ownership and Operations

Just as the physical structure of stadiums and arenas vary widely, so do the ownership and operations structures. Any efforts aimed at reducing energy and water use need to consider this variation and require the development of different strategies and entry points to address it. Several ownership and operations scenarios are discussed below.

The least complex structure is one where a single entity owns and operates the facility. One such example is Gillette Stadium (Foxborough, Mass.), which was paid for completely by the New England Patriots. Some state or municipal facilities are owned and operated by the state or municipality. Venue management companies also may own and operate facilities. This structure provides the single point for decision making but still requires the engagement of partners to identify and implement action.

Some state and local governments contract out the operations of the facilities they own. While the state or municipality may leave operations largely in the hands of the private-sector operator, it could incorporate facility performance requirements into the operating agreement.

Colleges and universities also employ several models for construction and operation of sports venues. NCAA Division I programs generally use one of five venue management models: management by the athletic department, management by another university department, management as an auxiliary enterprise, management by an outside enterprise (private management), or management by government.<sup>80</sup> Table 2 provides a breakdown based on a survey of Division I athletic directors. Division II and III programs likely follow similar models.

Current Management Model	Response Count	Response Percent
Operated by the Athletic Department	60	57.1%
Operated by Other University Department (e.g., finance office, facilities management department)	24	22.9%
Operated as Auxiliary Enterprise (arena is an independent university unit and is operated by its own staff)	10	9.5%
Operated by a Private Management Company	5	4.8%
Operated by a Government Entity (e.g., city, county or state)	5	4.8%
Other	1	1.0%

Source: Palmero, Mauro, L. Ming, H. Lawrence and V. Conley, “Who is in charge? An analysis of NCAA Division I Arena Management Models,” *Journal of Venue & Event Management*, volume 3, issue 2, December 2011. [https://sc.edu/study/colleges\\_schools/hrsm/research/journal\\_venue\\_and\\_event\\_management\\_archives/jvem\\_pdfs/vol3\\_no2/who\\_is\\_in\\_charge.pdf](https://sc.edu/study/colleges_schools/hrsm/research/journal_venue_and_event_management_archives/jvem_pdfs/vol3_no2/who_is_in_charge.pdf).

**Table 2: Survey of Collegiate Arena Management Models in Use**

<sup>80</sup> Palmero, Mauro, L. Ming, H. Lawrence and V. Conley, “Who is in charge? An analysis of NCAA Division I Arena Management Models,” *Journal of Venue & Event Management*, volume 3, issue 2, December 2011. [https://sc.edu/study/colleges\\_schools/hrsm/research/journal\\_venue\\_and\\_event\\_management\\_archives/jvem\\_pdfs/vol3\\_no2/who\\_is\\_in\\_charge.pdf](https://sc.edu/study/colleges_schools/hrsm/research/journal_venue_and_event_management_archives/jvem_pdfs/vol3_no2/who_is_in_charge.pdf).

Several variations exist where public financing is sought to help construct or renovate a stadium or arena. Such financing can range from a small portion of the overall cost to 100%. States and localities also may offer teams access to tax-exempt bonds or agree to cover infrastructure improvements to help defray some of the overall costs. Often, an independent stadium authority is charged with representing the interests of the state or locality. Dependent on the terms of the financing agreements, the state or municipality may own the facility and establish a lease agreement with the team. Such lease agreements lay out the responsibilities for daily management of the facility and for capital improvements. Some examples are outlined below:

- Oriole Park at Camden Yards (Baltimore, Md.) - Built in 1992, the project was financed with \$137 million in lease revenue bonds and \$60 million in lease revenue notes issued by the Maryland Stadium Authority (MSA). Revenue generated by special sports-themed lottery tickets is paying for the debt. Cash that accumulated in the lottery fund, which was established in 1988 to finance sports stadiums, covered the remaining costs. The team contributed \$9 million for the construction of skyboxes. MSA spent \$1.5 million on improvements in 1998. The 30-year lease calculates rent based on a percentage of team revenues. MSA is responsible for all ballpark management and retains responsibility for the planning and completion of all improvements. The lease requires MSA to maintain and repair the facility “in a safe and first-class manner, and in a manner that is consistent with the maintenance and repair standards of [MLB] facilities that can reasonably be said to fall within the ‘top’ twenty-five percent (25%) of all such facilities.”<sup>81</sup>
- Heinz Field (Pittsburgh, Pa.) – Built in 2001, the Pittsburgh Steelers contributed \$76.5 million for the stadium, the state provided \$75 million, and the rest came from the Allegheny Regional Asset District, which administered a 1% county sales tax. The Steelers are entitled to exclusive use and possession of the stadium and are responsible for maintenance and repair of the facility.<sup>82</sup>
- Bankers Life Fieldhouse (Indianapolis, Ind.) -, Built in 1999, financing for the facility is a public/private partnership. Public contributions totaled \$79 million, which included \$50 million from a professional sports developmental tax district around the new facility, \$4.7 million in infrastructure, \$9.3 million from Capital Improvement Board cash reserves and \$7 million from the Circle Centre Mall revenues. The Indiana Pacers contributed \$57 million, while other private sources paid for the rest. The Pacers have the exclusive right, authority, license, and privilege to use the arena and are responsible for all minor repairs, routine maintenance, an adequately trained janitorial squad, and security. The Pacers are “responsible for all costs and expenses of every kind and nature related to the use, occupancy, possession, and operation of the [arena].”<sup>83</sup>

Table 3 provides a summary of the cost and public financing for NFL, MLB, NHL, and NBA venues. Information on the individual stadiums and arenas can be found in Appendix C.

Because of the complexity of these ownership structures, sometimes it is unclear as to who must approve (and/or fund) a project. One MiLB park manager described a situation where the county

---

<sup>81</sup> <http://law.marquette.edu/assets/sports-law/pdf/ls-mlb-baltimore.pdf>

<sup>82</sup> <http://law.marquette.edu/assets/sports-law/NFL.16.pdf> and <http://law.marquette.edu/assets/sports-law/pdf/ls-nfl-pittsburgh.pdf>

<sup>83</sup> <https://law.marquette.edu/assets/sports-law/pdf/lease-summary-indiana-pacers.pdf>

League		Facility Cost (\$mil)	Renovation Cost (\$mil)	Average Age	Time Since Renovation	Public Finance %	Renovation Public Finance %
NFL Total	Sum	\$14,025.36	\$995				
	Average	\$467.51	\$249	25.35 years	11.86 years	66%	37%
MLB Total	Sum	\$8,718.70	\$117.00				
	Average	\$311.38	\$117.00	24.89 years	19 years	61%	26%
NHL/NBA Total	Sum	\$8,955.00	\$1,121.00				
	Average	\$213.21	\$560.50	20.17 years	12 years	58%	10%
Total	Sum	\$31,699.06	\$2,233.00				
	Average	\$316.99	\$319.00	23.07 years	12.6 years	61%	28%

Source: Derived from National Sports Law Institute, "Facility Updates," *Sports Facility Reports*, vol. 17, 2016. <http://law.marquette.edu/national-sports-law-institute/sports-facility-reports-volume-17-2016-0>.

**Table 3: Professional Stadium and Arena Cost, Age and Financing**

parks and recreation department owned the facility itself but ongoing operations fell to the team. Frequent turnover within the parks department made it difficult to establish momentum around facility initiatives. This structure resulted in the classic case of split incentives: even when the team was willing to invest in facility improvements to cut operations costs, gaining approval from the parks department was challenging.

As is common in commercial and residential buildings, the split-incentive challenge can mean that cost-effective energy and water saving measures are left undone. In the case of sports venues, however, the owner is typically a governmental or quasi-governmental entity. Assuring these entities are aligned with broader sustainability goals at the state or local level can help facilitate collaborative approaches to facility improvements.

While many facilities and operations offices champion energy and water efficiency initiatives, their ability to affect widespread change is constrained. Energy and water management is just one aspect of responsibility for facility operations staff. The department's responsibilities can include waste management; grounds keeping and field conditions; maintenance and general up keep; utilities management (including Wi-Fi); and audio and video infrastructure. Unless energy and water performance is made a priority, financial and staff resources for these areas is limited.

The facility owner is a key decision maker. Owners that have bought in to the importance of energy and water efficiency can drive improvements and empower the facility management team to identify opportunities. However, even with a dedicated owner, return on investment (ROI) often drives the discussion. ROIs are generally calculated using life-cycle cost analysis. A three to five-year ROI may be seen as practical, but if funding is limited, promotional or front-of-house activities would take precedence.

## Driving Forward

---

There is clearly an opportunity to affect widespread energy and water savings in sports venues. Momentum is building to engage owners and operators in a shared vision. Yet, significant speed bumps still need to be overcome—particularly when it comes to having the data necessary to understand where the sector currently stands and where it can and should go. Like many building sectors, stadium and arena stakeholders must examine and evolve embedded policies, practices, and procedures to achieve identified goals.

Identifying and implementing energy and water savings opportunities can occur at various scales based on current industry organizational structures. In addition to a national (or even North American) effort across multiple venue-types, the leagues or conferences can work together to identify issues and develop solutions within their sport or typical venue type. Holding regional collaboratives, workshops, conferences, and networking events that engage representatives from the different venues, along with vendors, designers, and other stakeholders, could further expand the identification and sharing of best practices and build a healthy sense of competition.

Based on extensive dialogue with stakeholders representing all aspects of the industry, the team is being drafted and the game plan is in development. The sections that follow outline the components of a potential strategy to cross the goal line.

## Partnership is the New Leadership

---

Just as success on the field is determined by the ability of team members to work together, the ability to realize energy and water performance goals requires engagement and buy-in from across the organization. While sports-related sustainability takes many forms—from waste reduction and recycling to green cleaning—the design, construction, and operation of venues to achieve performance goals is likely the most complex. It requires engagement of architects, engineers, owners, operators, vendors, and spectators. The diversity of team members can be

*Sports buildings I particularly like. There's an irony with these athletes [that] are such high performers. You look at the Rangers organization over the years, they worry about your nutrition, they worry about sleep, you worry about your hydration, your training methods. Everything is about being more efficient and then they're playing in a building that uses yesterday's technology. Nobody does that and doesn't end up getting hurt in the long run; you really have to update every aspect of it. So the sports facilities really have a nice kind of metaphor there.*

Mike Richter, Former NY Rangers Goalie

seen as a challenge, but it presents multiple opportunities to develop champions and capture value.

Working collaboratively across the entire design, construction, and operations process is essential to the cost-effective realization of energy, water, and other performance goals. Each participant throughout the venue's life cycle has valuable expertise to share. Future activities to impact facility performance must engage these various partners in establishing common goals for everyone to rally behind and contribute to their realization.

In many cases, the team shares a collective culture, values, goals, and pride that builds from the sports-focused environment. These collective beliefs can effectively be leveraged through a performance-oriented goal to support significant savings. Engaging and empowering facilities, security, communications and sponsorship personnel, and concessionaires can lead to long-term

success. One venue found the pursuit of LEED EBOM certification as a unifying activity that brought multiple departments together and even resulted in changes in employee’s behavior outside of work.

### *Operations Department*

---

The operations department is an obvious starting point for any effort to advance energy and water performance. Operations personnel have daily, hands on experience with the facility and understand the ins-and-outs of what makes it work. They are both implementer and champion, but must be empowered by ownership and provided adequate resources to effectively research and implement improvements. The Empowering Operations Staff section discusses challenges and opportunities for operations staff.

Because many solutions go beyond technology replacement and require changes in behavior, the operations staff must engage and educate other facility occupants to realize the anticipated savings. Getting buy-in from staff and partners outside the operations department is essential.

*Without a doubt, the opportunity to manage facilities is one of the coolest aspects of being an athletics director. But as with so many elements of the job, there’s more to the responsibility than is apparent at first glance.*

“So You Want to be an AD,” NCAA

### *Additional Departments*

---

Setting up a culture of sustainability and savings across the organization will help realize goals. Convening people from across the organization to get buy-in and to empower them as champions is a valuable endeavor. Security teams can be an important ally in implementation, and can serve as a monitor for executing procedures set by operations.

In the past, the typical mentality around building operations was to leave everything on in case someone needed to use a particular space. That approach is now shifting to one where a user must make a request to activate a particular space. Non-facilities personnel often are unaware of the cost implications of various requests made to light, heat, or cool certain areas. Providing this information can inform decision making around allowing such activities or so it can be charged back to departments, concessionaires, vendors, or sponsors making the request.

Providing visibility to a facility’s energy and water-efficiency initiatives also is challenging—owners often have the ultimate say in the messages being conveyed, so they need to be equipped with information that supports the benefits of such messaging. Additionally, front-of-the-house activities are often disconnected from the back-of-the-house and few such messages are getting out. When the story is being told, it is due to a leader or sponsor pushing for it. In many cases, owners only focus on the sport or key community-focused initiatives (poverty, inclusion, etc.). Identifying sponsors or supporters that can amplify the message would help. If sustainability is seen as a staff-wide priority, opportunities to engage sponsorship teams and security teams grow.

Communications/media staff serves an important role in identifying messaging around improvements that work to enhance the team image, solidify the role in the community, engage sponsors in supporting and further highlighting the activities, and translating the venue’s actions into steps that can be taken at the individual level. They play an important role in engaging the community as discussed below.

Corporate/sponsor relations staff play an important role in both amplifying the ability of the team to implement efficiency measures and to garner widespread exposure. Engaging sponsors in sustainability initiatives can raise the profile for owners and present opportunities to share the project and supporting messages with fans and the community.

### *Sponsors*

---

Garnering interest from front office departments and owners often requires a leader or sponsor who is interested in having a story told around sustainability. Many sponsors have internal sustainability or corporate social responsibility (CSR) goals. They are looking for opportunities to highlight their successes and affiliate with organizations that share similar goals. In some cases, sponsors may be willing to lend their internal expertise to assist teams in setting and achieving sustainability-related goals.

Identifying common goals among the venue and sponsors will allow much broader and far-reaching initiatives that leverage the brand power of the team and the sponsor and support a stronger message to the fans.

### *Vendors and Concessionaires*

---

Service providers (vendors, concessionaires) should be brought into the sustainability culture and engaged in identifying and implementing energy-saving measures, including proper shut down and consolidation of appliances. Often, concessionaires can share successful practices learned from other venues or identify opportunities that can only be learned through on-the-ground experience. Many service providers want to be valued partners and can contribute expertise in meeting performance goals. Some would even consider funding facility upgrades if it makes their operations more efficient and builds a deeper relationship.

Frequent communication, engagement, and training of concessionaire personnel can facilitate buy-in and reinforce the priorities of the venue owner and operator.

### *States and Local Governments*

---

As identified previously, state and local government can play myriad roles in the ownership, financing, and operations of all types of sports venues. Leveraging that role and relationship with the primary occupant and others that use the venues in the early planning stages can help assure that high-performance goals are a priority. As new facilities are proposed, and siting and financing are negotiated, the state or local government can attach requirements in line with broader community goals. Regulations, operations agreements, or leases in the future could

*California has more green buildings than any other state in the nation, and Sacramento's new arena is an example of the elegant design and construction we need to meet our ambitious climate goals.*  
California Governor Jerry Brown

incorporate requirements to benchmark and report and meet performance targets in line with the government's overall energy and water-efficiency targets. As these venues meet or exceed performance targets they could help amplify the state or local government's broader sustainability efforts and serve as showcases of success to the community.

## Minnesota B3 Guidelines and U.S. Bank Stadium

U.S. Bank Stadium is a fixed-roof stadium located in the Downtown East section of Minneapolis, Minnesota, located on the former site of the Hubert H. Humphrey Metrodome. U.S. Bank Stadium serves as the home of the Minnesota Vikings of the National Football League (NFL) and the Minnesota Golden Gophers Baseball Team (NCAA).

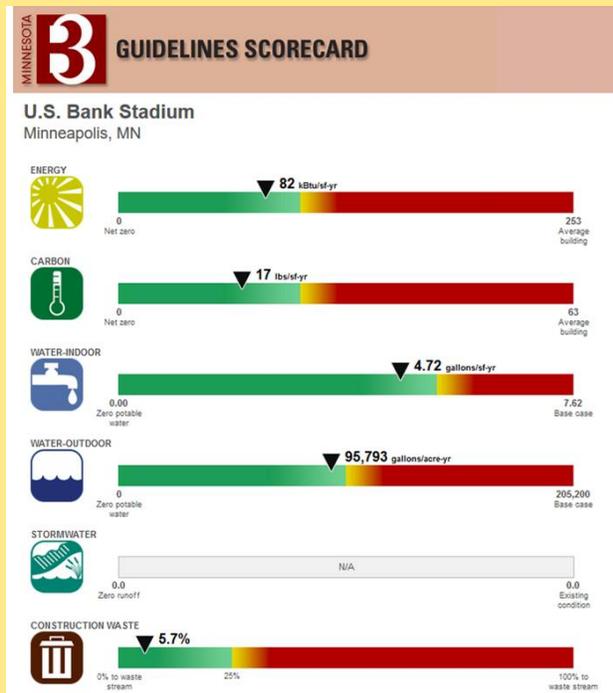
Since 2004, all new state buildings funded by bond money are required to meet the State of Minnesota Sustainable Building Guidelines, commonly referred to as the B3 Guidelines. These were developed to be compatible with LEED and other national guidelines, but with a more specific focus on regional values, priorities, and requirements. The guidelines attempt to quantify the human, community, environmental, and life-cycle economic costs and benefits for each project.

The B3 Guidelines can be applied to the design of new buildings or renovations to meet sustainability goals for site, water, energy, indoor environment, materials, and waste. By using the B3 Guidelines, projects would automatically be applying the SB 2030 Energy Standard. After design, during the building occupancy period, the stadium also uses the B3 Benchmarking tool to track and compare actual energy use and the B3 Post-Occupancy Evaluation (POE) to survey occupants on the indoor environmental quality of the building.

The B3 Sustainable Building 2030 (SB 2030) Energy Standard is a progressive energy conservation program designed to significantly reduce energy use and carbon emissions in Minnesota commercial, institutional, and industrial buildings. Based on the national Architecture 2030 program, SB 2030 has been tailored to the needs of Minnesota buildings. The SB 2030 Energy Standard for all projects built after 2010 is 60% below that of an average building.

The first step for the design team was to establish an energy use intensity baseline for NFL stadiums, as stadium energy usage data in general was not very prevalent. After a benchmarking and energy modeling exercise, the design team arrived at 140.4 kBtu/sqft. Multiple energy conservation measures for envelope, lighting, and MEP/HVAC systems were considered by the design and construction teams and incorporated into the design of the stadium resulting in a reduced EUI of 91.7 kBtu/sqft, a reduction of 35%. In addition, these measures are projected to result in energy cost savings of \$1.26 million per year compared to a baseline building. Per the B3 Guidelines, these strategies were verified via construction documentation review, on-site verification of the strategies selected, and construction submittals.

*Provided by ME Engineers*



**Figure 7: B3 Scorecard for U.S. Bank Stadium**

States and municipalities are not currently the drivers of sustainable venues (even in publicly owned venues, operations are typically contracted out), but this approach can change as state and local governments begin looking across their portfolios to identify energy and water savings and incorporate these venues into broader community initiatives. For example, state and local governments can use the sports venues they own and operate to showcase new technologies and help drive greater adoption of those technologies in their communities. They can also partner with their local teams and use the teams and sports venues as a way to engage fans about local programs, initiatives, or community wide goals.

One example of successfully applying state-level performance requirements to a stadium is the recently opened U.S. Bank Stadium in Minneapolis, Minnesota. Because the project was financed using state general obligation bonds, the stadium was subject to the requirements of the state's Sustainable Building Guidelines, known as the B3 Guidelines, which influenced the requirements for the design and long-term performance of the facility.<sup>84</sup> The text box explains how B3 requirements applied to the project and how the design team addressed them.

### *Federal Government*

---

The State Department, DOE and EPA have already engaged elements of the sports community to advance their missions. Additional federal engagement at the venue level can further facilitate achievement of their mission while also garnering exposure to a broad segment of the population.

Stadiums and arenas present an excellent opportunity to engage multiple agencies in developing a comprehensive strategy to meet multiple federal-level goals. The U.S. Department of Homeland Security can focus on measures to improve resilience at the venue and community level, and support the safety of participants at these high-profile facilities. The U.S. Department of Transportation (DOT) can support the implementation of public transit solutions to address the influx of people on game days and work with DOE to facilitate electric vehicle charging infrastructure or showcase other energy saving technologies. In addition to the development of an ENERGY STAR score and certification, EPA's interest in storm water management and smart growth can be part of the discussion.

### *Utilities*

---

Like teams themselves, utilities have a unique connection with their communities. In addition to serving the team's energy needs, the utility serves the local fan base. Leveraging this unique positioning to enhance both brands and enhance efficiency could provide a strong message to the community. Utilities also can provide technical assistance and financing to identify and implement efficiency measures while the team and venue can help get the word out about utility energy efficiency programs.

---

<sup>84</sup> Minnesota B3 Case Study Database, U.S. Bank Stadium. <http://casestudies.b3mn.org/ProjectDetail?id=5616>

### *Allied Organizations*

While venues that undertake initiatives at the individual level are highly dependent on the cooperation of owners, operations staff, other staff, concessionaires, sponsors, and the state and local government, they still can get input and hear lessons learned from peers within other organizations. These organizations provide opportunities to develop and share best practices, recognize leaders, and support broad, sector-wide activities. Organizations like the Green Sports Alliance provide leaders in the sports industry and those with an interest in improving a forum for sharing best practices. Other organizations are also available as resources (see the text box).

### *Leagues and Conferences*

Like the affiliated organizations, the leagues and conferences provide an opportunity to work at the macro scale. League or conference members tend to be more uniform relative to venue size and operational parameters, presenting even greater opportunities for development and sharing of best practices. They can support specific and relevant benchmarking programs that can facilitate action by their members. As identified in this report, the leagues have all implemented green programs, which can continue to grow as knowledge and interest expand. As the interest in energy and water efficiency grows among league or conference members, the leagues and conferences may elect to establish mutual goals for energy and water use reductions, financing tools, and other resources to help achieve a common mission and enhance the league's or conference's image.

*Our member universities and athletics departments are national leaders in minimizing their impact on the environment. . . we look forward to convening an esteemed group of experts to design new initiatives and share best practices to enhance our collective efforts.*  
Pac-12 Commissioner Larry Scott

The Pac-12 conference will host a summit of sustainability officers from member schools in June 2017 to design new initiatives and share best practices. The conference's television network will also continue to share information with its audience on sustainability initiatives from across the conference.<sup>85</sup>

### **Collaborating for Change: The Green Sports Alliance**

The Green Sports Alliance is the central hub of a burgeoning movement to make sports more sustainable. Since launching



nationally in March 2011 with 6 professional teams and 5 venues as founding members, the Green Sports Alliance has grown to nearly 400 professional and collegiate teams and venues from 20 different sports leagues and 14 countries.

With the support of the Alliance and its partners, sports members are embracing renewable energy, energy and water efficiency, safer chemicals, and other environmentally responsible practices, while encouraging fans to do the same.

The Alliance helps its members reach their environmental goals through direct support and focused research, facilitated networking with recognized leaders in the industry, compilation and sharing of best practices in venue operations and team communications, workshops, a monthly webinar series, and much more.

*Provided by Green Sports Alliance*

<sup>85</sup> <http://pac-12.com/article/2016/10/06/pac-12-host-first-conference-wide-college-sports-sustainability-summit>

## Working Collectively through Allied Organizations

In addition to the Green Sports Alliance, several organizations serve key roles in bringing together stakeholders to address important issues related to sports, venues or facility owners. These organizations provide opportunities for identification of common issues, sharing of best practices, creation of peer networks, and recognition of leaders. Several of these organizations and their specific areas of focus are discussed here.

**APPA:** APPA: Leadership in Educational Facilities (previously known as the Association of Physical Plant Administrators) promotes leadership in educational facilities for professionals seeking to build their careers, transform their institutions, and elevate the value and recognition of facilities in education. Programs include the Facilities Management Evaluation Program, the Facility Performance Indicators Survey and Report, and a joint project with the National Association of College and University Business Offices on Key Facilities Metrics. APPA is the association of choice for more than 15,000 educational facilities professionals from 1,300 educational institutions throughout North America. See <http://www.appa.org>.

**Association for the Advancement of Sustainability in Higher Education (AASHE):** AASHE is a membership organization that empowers higher education faculty, administrators, staff, and students to be effective change agents and drivers of sustainability innovation. It enables its nearly 1,000 members to translate information into action by offering essential resources and professional development to a diverse, engaged community of sustainability leaders. It provides resources on the sustainability performance of campus buildings and administers the Sustainability Tracking, Assessment and Rating System (STARS), a transparent, self-reporting framework for colleges and universities to measure their sustainability performance. See <http://www.aashe.org>.

**International Association of Venue Managers (IAVM):** Representing public assembly venues from around the globe, IAVM's active members include managers and senior executives from auditoriums, arenas, convention centers, exhibit halls, stadiums, performing arts centers, university complexes, and amphitheatres. IAVM defines sustainability as: The ability of public assembly facilities to fulfill client and industry needs whilst exercising environmental responsibility through

use of green standards, application of technologies, processes, practices and related business implications—balancing the fulfillment of human needs, now and for generations to come, while enhancing the health of ecosystems and the ability of other species to survive in their natural environments. Its Sustainability Committee works to promote sustainable venues. See <http://www.iavm.org>.

**Mayors Professional Sports Alliance:** The Mayors Professional Sports Alliance, chaired by U.S. Conference of Mayors President and Oklahoma City Mayor Mick Cornett, is composed of mayors from cities with sports teams in the NFL, NBA, NHL, MLB and MLS. Its mission is to share among the mayors information, resources, and support on issues related to professional sports and to work effectively with leagues, players and owners. To date, the Alliance has not focused heavily on venue performance, but has collected case studies on the impact of sports within member cities and provides a database of team and arena/stadium lease and franchise agreements intended to assist mayors negotiate future lease agreements. The Alliance currently includes mayors from 47 cities. See <http://mayorcitiesports.org/>.

**Stadium Managers Association (SMA):** SMA is dedicated exclusively to stadium operations and promotes professional, efficient, and state-of-the-art management of stadiums around the world. Its members are administrators and operations personnel from teams; colleges and universities; facility managers and public sports authorities; and suppliers to the industry. It is a member-driven organization where stadium managers and vendors collaborate on issues and solutions that enhance the safety, profitability, and service of their facilities. SMA conducts operations surveys to assess the current state of the industry across all aspects of stadium management. Annual seminars and discussion groups help the organization support safe and efficient stadium and ballpark operations. See <http://www.stadiummanagers.org>.

## Management Companies

Many venues are operated by a global, national, or regional management company that brings economies of scale and consistency to facility operations. Through management standards and education and training of venue personnel, these entities are able to implement positive measures in multiple venues. The aggregation of improvements across these multiple venues can result in significant energy and water savings.

AEG Worldwide has been looking across its portfolio to assess its impact and establish meaningful goals. This leadership and the leadership of similar organizations can provide a significant pull for others in the industry to drive change. Conversely, if these organizations are not onboard, progress may be limited.

## Athletes

Current and former athletes can help extend the message and solidify their place as role models for young fans. For example, Ray Lewis and Mike Richter have undertaken initiatives specifically tied to sustainability. Their efforts are highlighted in the Athletes Take Action sidebar. Encouraging other athletes to step forward would increase visibility and show how individuals can be involved.

Getting team personnel and athletes into the community are important ways to expand team loyalty and highlight what teams are doing to promote sustainability. For example, if the venue is undergoing a lighting retrofit to LEDs, the team and a corporate sponsor can provide an

## Athletes Taking Action

**Ray Lewis, Power52** - Former Baltimore Ravens linebacker Ray Lewis is leading a new non-profit organization to expand access to renewable energy in low-income communities. The non-profit, Power52, aims to build clean energy projects in low-income areas of Baltimore and produce energy that can be used by people living in them. The projects will help provide job training in the renewable energy sector for people in the communities. It also aims to give college or trade school scholarships for low-income people. "Power52 will not only give people opportunities, but it will also educate people so that they can understand the importance of energy independence while cutting their utility bill," Ray Lewis said in a statement. See <http://www.power52.org>.



**Mike Richter, Environmental Capital Partners/Athletes for a Healthy Planet/Healthy Planet Partners/Brightcore Energy** – Following a successful career cut short by injury as the goalie for the New York Rangers, Mike Richter went back to school where his interest in environmental issues blossomed. He became fixated on the idea of using the capital market to create innovative ways to fix environmental problems. This interest would eventually lead him to start his own company, Healthy Planet Partners (HPP), a for-profit business that finances updates to existing buildings. HPP retrofits commercial buildings with clean energy that is efficient, reliable, and renewable. It functions both as a green bank and as a chief energy officer to lower operational costs and reduce environmental impact. Richter also was a part of the team that founded Environmental Capital Partners, a \$100 million equity firm that funds investments in resource efficiency. In addition, he launched Athletes for a Healthy Planet to help athletes continue to understand their connections to the environment. He is joined in that venture by fellow hockey players Mark Messier and Angela Ruggiero and other high-profile athletes, including John McEnroe and Billie Jean King. Richter now serves as President of Brightcore, a company that provides LED-based solutions.

LED bulb to fans with an explanation of the facility retrofit and what fans can do at home. They also could sponsor and promote a whole house lighting retrofit for a low-income household. A similar event can be conducted that accompanies plumbing retrofits to low-flow fixtures. Facility changes to HVAC or refrigeration systems can be accompanied by a giveaway of ENERGY STAR certified appliances. A plan to distribute seedlings can accompany the installation of a green roof or changing landscaping to more drought tolerant plants.

### *The Fans*

---

Ultimately, the success of sports relies on the engagement and enthusiasm of the fans. This enthusiasm can be channeled to affect positive change in the community. Empowered fans can drive the team to embrace energy and water efficiency goals. Season ticket holders, luxury suite owners, alumni, and other prominent fans that share their interest with team management can bring attention to the issues.

*At Stanford, sustainability has become a core value in all aspects of university operations, and Stanford Athletics is no exception. The Department of Athletics, Physical Education, and Recreation is committed to reducing its environmental footprint and raising awareness among the millions of students, athletes, visitors, and participants in its programs each year.*

Moira Hafer, Sustainability Specialist,  
Stanford University

Additionally, fans offer an opportunity for the team to see sustainability messages amplified throughout the community. Imploring fans into action within their own home and workplaces requires effective messaging by sponsors, the team, the league, and the local media. Developing these effective messages will require feedback from fans.

Finally, undertaking energy and water efficiency, and sustainability activities and initiatives provide an opportunity for teams and venues to engage a new set

of fans that are already taking action in their own lives and would be more inclined to cheer for and attend games based on the actions of their local teams.

### *Designers*

---

Energy and water-efficiency measures incorporated during the design of the facility can result in savings across the useful life of the facility, assuming they are operated and maintained. They are usually the most cost-effective way to implement efficiency measures as retrofits often require specialized solutions. However, even if cutting-edge efficiency measures are not implemented during initial construction, careful planning during the initial design phase to allow for future installations can reduce future costs and headaches.

The design process is often a tug-of-war between amenities and the reduction of energy and water use. Decisions are being driven by fan comfort and experience. Where staff within the team have bought into sustainability, they are often not the same people in the design meetings. Energy measures are still implemented based on first cost. The finance office needs to be brought into the discussion and sold on energy savings.

Even once constructed, the design team has limited ability to effect energy and water performance. Generally, no post-occupancy evaluation is conducted, so the designers are not aware of how the operations staff is operating the facility relative to the design intent and whether performance goals are actually being met—whether the modeled energy use is playing

out in real life. Such feedback loops are important for continued improvements in future designs and identifying cost-effective retrofit opportunities. Establishing an ongoing relationship with owners and operations staff is important for both the performance of individual venues and the overall sports industry.

## Benchmarking

As discussed previously, the establishment of baseline data on the performance of stadiums and arenas is essential to determine a starting point for the industry and for individual venues, to measure progress, to inform decisions, to set realistic goals, and to recognize leaders. To date, such data is largely missing. An effort is underway to change that.

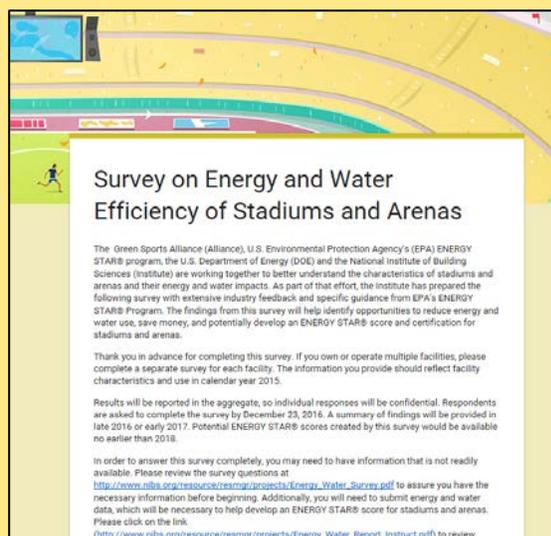
While many building types can determine their performance relative to their peers and receive recognition as a top performer through the EPA ENERGY STAR program, stadiums and arenas have not had the opportunity. Because the CBECS data on these building types is limited, another means for determining the state of the building stock is required. The Green Sports Alliance and the National Institute of Building Sciences, working with EPA, developed an industry survey to collect data from facility owners to support development of ENERGY STAR

### Building a Baseline through the Energy and Water Efficiency Survey

Professional teams and athletes spend considerable time and effort scouting opponents, reviewing statistics and studying tape of past games. These actions support development of a game plan and serve to push the team to implement actions that increase their chance for a win. Ideally, venue designers, operators, and managers should have similar tools to understand how their individual venue is performing, where improvements are possible and what it will take to be amongst the leaders.

Despite the importance of energy and water performance data in the design and operation and management of sports venues, no databases exist that can provide such information. As discussed in the text, the Energy Information Administration's Commercial Buildings Energy Consumption Survey (CBECS) includes these venues within public assembly buildings which represents a broad array of building types that cannot be disaggregated.

The project team launched the *Survey on Energy and Water Efficiency of Stadiums and Arenas* to collect the information necessary to identify industry benchmarks and the venue characteristics that influence energy and water use. If a statistically significant number of venues agree to share their data, the EPA ENERGY STAR program may be able to score and certify the energy performance of venues compared to their peers. Results from this survey will be reported only in the aggregate; individual responses will remain confidential. Take the survey now at <http://bit.ly/2k15V6E>.



## About the EPA ENERGY STAR Program

Most people recognize the little blue ENERGY STAR label as designating the most energy-efficient consumer appliances and electronics, but the EPA-managed program also works with thousands of building owners—including stadiums and arenas—to improve whole-building energy performance.

Businesses and organizations that participate begin by benchmarking their facilities in EPA's Portfolio Manager® (<http://www.energystar.gov/benchmark>), a free online tool for measuring and tracking energy and water use. Building owners have access to more than 150 different metrics that provide insights into how the property is performing. Those that consistently benchmark energy use save an average of 2.4% per year. These findings, from EPA's Data Trends series, are based on data from more than 100,000 buildings that benchmarked in Portfolio Manager.



Certain property types also receive a 1 to 100 ENERGY STAR score, which compares a property's energy performance to similar properties nationwide. The score is automatically adjusted using standardized methods to take into account differences in building attributes, operating characteristics, and weather. Sports venues currently do not have an ENERGY STAR score, but the EPA is trying to change that by approaching the sports venue industry for help. It is working with the Green Sports Alliance, the National Institute of Building Sciences, and others to recruit stadiums and arenas to anonymously share their energy and water use through a national survey (see footnote 86). If enough data is collected, EPA will roll out new ENERGY STAR scores for sports venues in 2018.

Over 400,000 buildings across all 50 states, representing over 40 billion square feet (40% of the commercial market) have benchmarked in Portfolio Manager, making it the industry standard for determining energy efficiency in buildings. Those that score 75 or higher on the 100-point scale perform in the top 25% in the nation and can earn ENERGY STAR certification from the EPA. ENERGY STAR certified buildings use 35% less energy than typical buildings, on average. That's why green building rating systems like Leadership in Energy and Environmental Design (LEED) and Green Globes include ENERGY STAR.

ENERGY STAR is more than a score. Organizations that participate in this voluntary program get access to low- and no-cost energy-efficiency measures, guidelines for energy management, ways to engage employees and building occupants, national campaigns, and more. Through ENERGY STAR, EPA makes it easy to differentiate an organization's achievements with objective, government-backed benchmarks. Facilities use it to make their financial and sustainability leadership stand out from the rest. See <https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings> for more information.

*Provided by EPA ENERGY STAR*

tools. The survey is designed to identify variations across venues and the impact they have on energy use. As of publication of this report, the survey remains open and additional responses are required.<sup>86</sup> To be successful, such an effort requires broad participation from owners and operators.

A benchmark (like ENERGY STAR) based on monthly measurements is important to allow comparison amongst peers, but a more dynamic, real-time system is important for building management and the identification of best practices. In the near-term, an ENERGY STAR type effort is important to get most owners and operators engaged and thinking about energy and water use. Today's industry leaders and the whole industry in the future would likely incorporate real-time data analysis. While many facilities are not currently equipped to capture such information, it is likely to become a common practice (a discussion follows on the tools to make this a reality). In addition to supporting facility operations, a meaningful and trusted baseline is needed to support the design process.

Multiple types of benchmarks could be valuable, particularly given the types of events and the frequency of use these venues see. Benchmarking that focuses on the characteristics of a particular event held at the facility would provide a different type of information in contrast to annual energy use. For example, the energy and water use, waste generation, and other metrics associated with the ramp up, conduct and ramp-down of an NFL football game would allow simple comparison across venues, drive competition within leagues, and potentially overcome any concerns relative to the uniqueness of venues. This type of benchmark may best be determined at the league level. For any benchmarking effort, the parameters covered will need to be defined.

*We believe that through completing the indoor arena/stadium survey, we became more aware of our energy and water usage, and it is through this process of benchmarking that we become better equipped to conserve natural resources and make decisions that are economically sound, socially just, and environmentally sustainable.*

Wes Walling, Director of Building Operations, Creighton University

Organizations like DOE, the National Institute of Building Sciences, the Green Sports Alliance, and the leagues can help serve as neutral and trusted aggregators and facilitate the development of consistent measurement and reporting standards.

## Recognizing Leadership

---

Leadership can take many forms. As the industry begins to coalesce around monitoring performance and improvement, it is important to have multiple means for recognizing progress. This encourages participants to enter the process no matter what stage they are in and provides a recognizable path for future recognition. Figure 8 outlines potential categories for recognition and the path towards progressively higher levels of achievement. Such recognition can be offered by groups like the Green Sports Alliance, SMA, IAVM, AASHE and APPA; the leagues and conferences; regional groups; or federal agencies like DOE or EPA.

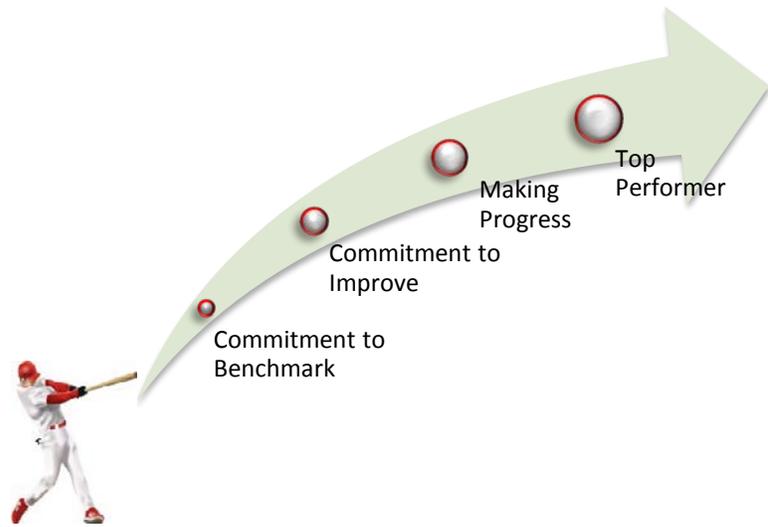
The leagues and conferences can provide additional recognition and incentives by incorporating sustainability practices into specifications for jewel events. If a venue is interested in hosting an

---

<sup>86</sup> See <https://goo.gl/forms/Z7mX9L8pxBSC85ri1> to complete the survey.

all-star game or a championship, they must meet a minimum level of sustainability requirements and then include other attributes that will be considered as part of the evaluation process.

Finally, steps should be taken to recognize teams and venues that have taken additional steps to educate their fans on the energy and water efficiency efforts undertaken at the facility and how similar efforts can be implemented in their homes and businesses.



**Figure 8: Opportunities for Recognition**

In addition to motivating individual efforts toward a common goal, recognition helps everyone develop a collection of best practices and motivation for leaders to share their successes with their peers.

### Engaging the Community

Actions within sports venues can result in considerable energy and water savings. However, this is just one opportunity where sports can have an impact. Teams benefit through the creation of communities of interest where fans share a common love of the team and pay attention to their actions. Utilizing this common love to spread important values and practices reinforces the team's place in people's lives and the community and helps engage even more fans.

*Our Mission – to GO GREEN! To create and sustain championship performance on the field and in the community through programs that promote the quality of life in our region, green the environment and to improve our impact on the planet.*

Philadelphia Eagles

In addition to highlighting the activities teams undertake directly through announcements on event days and in local media outlets, teams can use their recognition and stature along with sponsor support to produce radio and television public service announcements (PSA). Leagues and conferences can support production of PSAs as well. The PSAs can be featured during the time allocated to teams or leagues under their broadcasting agreements and as part of a broader campaign. Specific messages may resonate with sponsors, who may be willing to support an ad campaign.

### Empowering Operations Staff

Often, facility managers and technicians are the driving force behind sustainability initiatives. However, their success depends on their ability to engage others within the organization, make a compelling case for investment, and carve out time for implementation. In many cases, advancing energy and water performance is not necessarily about the implementation of technology, but informing management and educating staff and partners. Effective management

means understanding the facility and analyzing day-to-day activities and establishing policies and procedures that address these variations. The availability of real-time or near real-time data is essential to understanding the facility, effectively managing energy and water use, and identifying energy and water-savings opportunities. A building energy management system or building automation system, accompanied by data dashboards, is a valuable tool for facility managers.

However, energy and water is just one responsibility for operations personnel, so their capacity is very limited. It is important to assure that operations personnel have the tools and resources to effectively identify and implement energy and water savings measures. This includes developing a peer network where examples from other teams and guidance from the league and trusted vendors can be shared. Recognizing the unique nature of sports venues, education and certification opportunities for personnel in these areas may be warranted. At a minimum, for any new technology implemented, staff must be trained on its effective utilization.

Management scenarios and accompanying strategies for dark days, sports events, concerts, and other venue uses should be established to manage both HVAC and lighting needs. A high-level audit type checklist may be useful.

Increased visibility of energy and water savings opportunities may help make the case for a full-time energy manager. Few venues currently have such a position. In lieu of a dedicated staff member at each venue, it may be advantageous to have a shared energy manager resource within a metropolitan area across venues or at the league level. Utilities or others could potentially help cover the costs of such a resource.

## Financial Resources

---

In addition to having limited facility staff time to implement conservation measures, some venues—particularly those owned or operated by minor league teams, communities, or colleges and universities—have limited access to capital. Several common financing mechanisms utilized in other building types can be used in stadiums and arenas, but have not yet been widely implemented. Developing targeted programs, resource materials, and case studies can help expand their utilization.

In many communities, utilities support energy-efficiency investments through both technical and financial assistance. With most customers, the utility has little opportunity to be recognized for their work in this area. However, in addition to energy and water savings within the venue, there may be opportunities to create additional value through sponsorships and community programs and help get the word out about existing utility programs for consumers and businesses. The NHL has partnered with Constellation Energy at the league level to support green initiatives, including carbon offsets for the Stanley Cup Playoffs and assistance in efficiency activities at community rinks.

Property Assessed Clean Energy (PACE) programs and utility on-bill financing allow property owners to borrow money and repay through their property tax bill or utility bills. Financing is usually obtained through the assistance of a state or local government program. Because many

venues are owned by public entities, they may not be subject to property taxes, so PACE financing may not be appropriate.<sup>87</sup>

Energy Saving Performance Contracts (ESPCs) allow building owners to engage an Energy Service Company (ESCO) to identify, finance, and implement energy savings measures. The ESCO is in turn repaid over a set term from the resultant energy savings. The building owner then retains any additional savings beyond the established obligation period. This provides energy improvements without any net increase in cost to the building owner. ESPCs have found great success within the municipality, university, school, and hospital (MUSH) sectors. Given their size and potential energy savings opportunities, stadiums and arenas may be ideal candidates. However, venue owners and operators must be sure not to be too conservative in accepting measures identified by the ESCO, thus limiting opportunities to implement broader, more-comprehensive measures in the future.<sup>88</sup>

The Commercial Building Tax Deduction (§179D) allows building owners to deduct up to \$1.80 per square foot for expenses incurred for energy-efficiency improvements related to lighting, HVAC, and the building envelope designed to achieve a certain performance level. For government-owned properties, the deduction may be allocated to the designer responsible for the improvements. While the deduction is currently only applicable for improvements before December 31, 2016, it has been regularly extended by Congress since enacted in 2005. If the deduction is extended and brought to the attention of venue owners, operators, and designers, it may provide a sufficient incentive for investment in efficiency improvements.<sup>89</sup>

## **Technology Innovations and Implementation**

---

Owners, operators, and designers identified numerous opportunities to further develop existing technology, identify new technology, and deploy existing technologies more widely. Where technologies are in widespread use in other industries, it would be advantageous to develop case studies and technical and outreach materials specifically focused on addressing some of the challenges identified in this report. Technical assistance on how best to incorporate these technologies into sports venues and to verify their efficacy may be beneficial to advance deployments.

### *Lighting and Solar PV*

---

As indicated previously, LED lighting retrofits for both playing surface and non-playing surface lighting is already beginning to gain traction and installation of solar PV is expanding. While deployment is growing, the sheer volume of the opportunity represents significant energy savings. Entities like DOE have extensive programs focused on deploying and improving these technologies to benefit all building types.<sup>90</sup> Where practical, DOE, manufacturers, and others should provide materials in a format specifically directed to this sector. Case studies featuring sports venues are particularly useful in facilitating broader application.

---

<sup>87</sup> For more information on PACE see <http://pacenation.us/>.

<sup>88</sup> For more information on ESCOs and ESPCs see <http://www.naesco.org/what-is-an-esco>.

<sup>89</sup> For more information on the Commercial Building Tax Deduction see <https://energy.gov/eere/buildings/179d-commercial-buildings-energy-efficiency-tax-deduction>.

<sup>90</sup> <https://interiorlightingcampaign.org/about>, <https://energy.gov/eere/ssl/solid-state-lighting>

## *Wind and Other Energy Generation and Storage*

---

To date, there have been a limited number of installations of wind turbines and other energy generation and storage technologies on stadiums and arenas. Lincoln Financial Field, home of the Philadelphia Eagles installed 14 wind turbines.<sup>91</sup> Staples Center installed fuel cells and the StubHub Center installed an energy storage system.<sup>92</sup> Such systems may provide benefits for other venues as well. In-depth examination and case studies of the systems themselves, the accompanying economic decision making and the co-benefits would be helpful in advancing research, development, and deployment of these technologies. In fuel cells and energy storage, co-benefits to examine include enhanced resilience and the ability to shift electric loads off peak rate periods.

## *Refrigeration*

---

A big component of the fan experience is the various food and beverage options available. Keeping soda and beer cold during games and keeping hot dogs and pretzels fresh requires refrigeration. From individual coolers and beverage dispensers at concession stands and in luxury boxes to centralized walk-in coolers and commercial ice machines, venues require a significant amount of refrigeration.

Where venues have exclusive beverage providers, there may be opportunities to work collectively to reduce costs and improve performance. Many vendors have internal technical and design staff that can support the design and deployment of new systems, including staff training. Vendor contracts often include provisions for the vendors to supply branded display cases. Assuring those cases are in line with facility energy performance goals could provide savings at little to no cost to the venue. Teams or leagues could come together with vendors, manufacturers, and technical experts to write a common specification that will drive the market and support bulk purchasing.

Concessionaires have a significant role to play in managing energy associated with refrigeration. As indicated above, getting their buy-in is essential for any effort aimed at improving performance, but particularly where their decisions impact energy and water use directly. Engaging concessionaire leadership in discussions with vendors and providing periodic education and training can be valuable in garnering buy-in and realizing continued results.

In addition to the equipment itself, refrigeration management may be a significant energy saving opportunity. One venue reported working with a concessionaire to set up protocols for when concession stand coolers should be emptied and turned off between home games. Collecting and disseminating best practices for refrigeration management could support significant energy and water savings.

In addition to refrigeration associated with food and beverage, the NHL has expressed interest in identifying opportunities to advance ice-making. This includes identifying the next generation of refrigerants that provide effective and efficient ice making with limited global warming potential

---

<sup>91</sup> “Philadelphia Eagles Go Green.” <http://www.philadelphiaeagles.com/community/gogreen.html>.

<sup>92</sup> <http://www.bloomenergy.com/newsroom/press-release-11-19-15/>, <https://greensportsblog.com/2016/08/23/tesla-and-aeg-bring-energy-storage-to-las-stubhub-center/>

factors. Attempts to address this issue should engage agencies such as DOE and EPA, along with refrigerant and equipment manufacturers. Professional societies, including ASHRAE, also have a role to play.

### *Occupant Comfort*

---

Occupant thermal comfort is determined by multiple factors including temperature, humidity, and air movement. To date, sports venues have focused largely on utilization of traditional methods of cooling spaces. However, venues and designers are beginning to look at new approaches. The Golden 1 Center is believed to be the first major sports arena that makes use of displacement ventilation (and even features a feedback mechanism within the Center's app).<sup>93</sup> BBVA Compass Stadium has installed low-velocity fans to make the Houston heat bearable and limit the amount of conditioned spaces required.<sup>94</sup>

As these new technologies are implemented, monitoring both fan experience and energy use and sharing the results broadly across venue owners and designers will be important in expanding their use. Identifying solutions for both new and existing facilities will be essential. Technical expertise from DOE, the national labs and professional societies, including ASHRAE, can further advance knowledge in this area and identify additional energy saving opportunities.

### *Field Maintenance*

---

Many sports, including football, baseball, and soccer, require a turf field. While some venues have made the switch to artificial turf, some venues (including M&T Bank Stadium) have reverted back to natural turf to support player safety. Maintaining the field in top condition requires the proper combination of light, temperature, and irrigation. These factors are common to many agricultural operations, so a collaborative effort with agricultural organizations may be valuable.

Many venues with natural turf have begun employing grow lights to help stimulate grass growth in areas of the field that are shaded by the stadium structure or experience extensive player contact. Currently, there are no performance requirements for these high intensity lights and they are generally unregulated. Further, because they are not intended to provide lighting for humans, standards based on their efficacy must be developed. Standards for LED-based horticultural lighting are underway and could be used for sports grow lights.<sup>95</sup> Bringing groundskeepers and facility managers together from venues that use these lights could support development of a common specification and advancement of the technology while supporting realization of energy performance goals.

---

<sup>93</sup> <http://www.stadia-magazine.com/news.php?NewsID=70733>, <http://www.golden1center.com/news/detail/control-the-climate-at-golden-1-center>

<sup>94</sup> <http://www.bigassfans.com/case-studies/bbva-compass-stadium/>

<sup>95</sup> Jiao, Jianzhong, "Stakeholders make progress on LED lighting horticulture standards," LEDs Magazine, June 2, 2015. <http://www.ledsmagazine.com/articles/print/volume-12/issue-6/features/standards/stakeholders-make-progress-on-led-lighting-horticulture-standards.html>.

## Facility Spotlight: Golden 1 Arena, Sacramento, California

When the Sacramento Kings began planning for Golden 1 Center, California was experiencing the fourth straight year of record-breaking high temperatures and drought – including the worst drought to hit the state in 1,200 years.

It was within this context that Vivek Ranadive took over the franchise with a profound vision to make Golden 1 Center not just a smart public investment that generates a real economic impact for Sacramento, but the new global standard bearer for how technology can reimagine the fan experience and meet unparalleled energy and environmental sustainability goals that benefit the community.

Working alongside globally recognized sports designers AECOM, the Kings looked to challenge business as usual and develop a holistic approach to venue design and construction that maximized the sustainable potential of the facility, with the goal of obtaining the highest level of LEED status possible.

As part of the project's Environmental Impact Study (EIS), the team also assessed the sustainability benefits of the proposed downtown location. For example, the EIS concluded that moving the arena from a more suburban location to the heart of the city makes it accessible by Amtrak, bike, bus, light rail, and foot traffic and reduces the average miles traveled per attendee by 20%, cuts overall air emissions by 24% and reduces travel-related greenhouse gas emissions by 36% per attendee.

When Sacramento's City Council ultimately voted to authorize a public-private partnership with the Kings in 2014, sustainability was a part of the conversation. The City contributed \$255 million to a once-in-a-generation project that will have a positive impact on the local economy, reduce emissions and provide a new home for entertainment and culture.

Energy efficiency and resiliency were core goals from the outset of the design. Combining on-site



and off-site solar, the building is the first 100% solar-powered sports venue.

Along with the creation of a passively optimized façade that balances solar shading with access to high-quality daylight, the building leveraged a number of innovative, active energy-efficiency measures that include:

- Heat recovery within main air handling units
- LED lighting throughout the venue
- Innovative dehumidification strategies that leverage the chilled water return water as the source of passive reheat
- Thermal displacement ventilation within the arena bowl
- Advanced zonal control
- High-efficiency HVAC equipment
- Free cooling and the use of diurnal range

As a result, this high-performance building exceeds the California T-24:2013 Energy Code by more than 30%.

With over 300 days of sunshine in Sacramento, solar innovation was key to meeting the team's high sustainability goals and ultimately making Sacramento's Golden 1 Center the world's first indoor arena to derive 100% of its electricity from solar energy. Acknowledging the urban location of the project, Golden 1 Center leverages an urban-smart solar strategy to achieve this that involves combining more than 700kW of PV solar on the roof of the venue with a remote 10.9 MW solar field.

## Facility Spotlight: Golden 1 Arena, Sacramento, California



The arena's five story tall bi-folding glass hangar doors—which make the arena the world's first indoor-outdoor sports venue—will take advantage of Sacramento's unique "delta breeze" to passively cool the arena. The doors also are part of another first for North American sports—the venue incorporated a displacement ventilation system that cools the lower bowl with passive climate control, decreasing the energy spent on high-demand overhead fans. The FanFirst Connected Comfort solution, which combines the displacement ventilation and fan crowdsourcing through the team's mobile app, is another first and creates the most comfortable arena venue in the world.

The thermal displacement ventilation (TDV) solution within the arena bowl provides air to the lower bowl through the seat risers. This solution takes advantage of the natural stratification that is inherent within tall, high-occupancy spaces, and is the first time it has been utilized at a professional sports venue in North America.

In addition to having energy-efficiency benefits that result from the elevated supply temperature of 62° Fahrenheit and the ability to expand the periods during which the venue can leverage free cooling and reduce the reliance on mechanical cooling, the solution also enhances the comfort and air quality experienced by the fan by providing the fresh air directly to the occupied zone. Driven by thermal stratification and natural buoyancy, heat and contaminants in the air rise to a high level outside of the occupied zone.

Opening the arena to the world did not come without challenges. Kings ownership had to be able to guarantee the NBA that the floor would maintain a constant temperature and humidity for peak athlete performance, even with the hangar doors open. To solve this, the design team undertook significant building simulation and virtual prototyping using computational fluid dynamic (CFD) simulation during the design, followed by a robust monitoring and commissioning process post-construction to validate performance.

Acknowledging Sacramento's leadership as the state capital during California's ongoing drought conditions, Golden 1 Center has made a commitment to significantly reduce water consumption within the arena. Within Golden 1 Center, the plumbing fixtures were selected to balance water conservation with the durability required within a high-traffic public venue. Through the use of ultra-low flow fixtures, the anticipated annual water consumption has been reduced by more than 40%.

Outside the building, drought tolerant plants and high-efficiency irrigation reduce the amount of water used outside the venue by more than 50%, which when combined with the indoor strategies allow the building to save more than 1 million gallons a year. The building also incorporates a future grey water storage tank within the foundations that can be used at a later date as part of a grey-water solution within the arena venue.

By engaging the construction team during the design process, the Kings were able to ensure that the sustainable design strategies were successfully transitioned from the design drawings to the physical construction.

*Provided by Golden 1 Arena and the Sacramento Kings*



**Figure 9: Grow Lights and Irrigation at BBVA Compass Stadium, Houston, Texas**

Natural turf also requires irrigation. As indicated above, some venues like StubHub Center have transitioned to using reclaimed water for irrigation. This reduces the energy required to treat water and limits stress on water supplies and treatment facilities. Efficient application of water would further reduce water needs. A collaborative effort among

groundkeepers, irrigation equipment manufacturers, and turf management researchers could support advancements in irrigation equipment and systems. Lessons learned and technology improvements would be widely applicable, from professional and collegiate venues to local community parks. Such an effort could provide additional benefit within commercial and residential irrigation applications.

Unlike most other applications of turf, sports fields must be in playing shape throughout the season—even in winter. This means continuing turf growth when temperatures are low—when turf would normally go dormant. In order to trick the turf into continued growth, ground temperatures must be maintained within a specific window. Hydronic systems are installed beneath the surface to keep temperatures steady. Opportunities may exist for improved efficiency within these systems.

As teams consider transitioning to natural turf, it may be fruitful to have a holistic research initiative to understand current energy and water use and opportunities to be more efficient. Such efforts should engage expertise in lighting, irrigation, hydronics, and agriculture.

### *Plumbing and Water Use Reduction*

---

Many venues have found significant water savings through the installation of low-flow plumbing fixtures and waterless urinals. Advancing installation of these technologies will require development and sharing of case studies. In order to test the impact of a shift to waterless urinals, one venue reported starting with the retrofit of just a few restrooms, and then completing a more extensive retrofit once facilities and maintenance staff were comfortable.

This may be an area where utilization of water-savings performance contracts could be attractive. Venue owners would be able to deploy water-saving measures with little to no upfront capital.

## *Metering, Measurement and Verification*

---

Data is essential to determining the current state of performance and the success of interventions intended to increase performance levels. However, as indicated throughout this report, such information for sports venues is incredibly limited. Technology development and deployment in this space is essential to realizing improvements.

As is occurring across the building industry, the development of inexpensive, easily deployable sub-meters and sensors will be an important advancement. Vendors and other interested entities will need to work with venue owners and operators specifically to develop the appropriate use case and support deployment.

Designers of sports venues are particularly interested in better understanding how energy and water are actually being used within venues—particularly in specific systems, services and amenities, and processes. Enhanced information in these areas will support important feedback loops to enhance future projects. Development of common measurement and verification (M&V) protocols for these facilities could support consistency and widespread deployment.

Many within the sector have indicated the need for a per-event metric, in addition to the annual metric provided by programs like ENERGY STAR. In addition to developing standards on how to measure and express such a metric, the sector requires the availability of incremental data supplied by a smart meter or network of sub-meters through a building energy management system.

## **Paralleling Advancements in the Fan Experience**

---

As venues look to enhance the fan experience through increasingly immersive and connected environments, energy and water efficiency opportunities should be infused into the designs and product development and not become an afterthought. Integrating fan comfort into the Golden 1 Center's app is one example of using the latest technology to impact facility energy use. Additional opportunities include focus on Wi-Fi systems and display technology. Facility designers, manufacturers and vendors, researchers, operators, and other stakeholders can work collaboratively to develop a common set of specifications and best-practice installation and operation criteria.

## **Borrowing from Other Sectors**

---

Sports venues often possess a variety of spaces common in other facility types—just in a unique configuration. Relevant sectors include retail, food service, office, and hospitality. Curating lessons learned within these other sectors into sports venue-specific applications could further expand energy and water-savings opportunities. While not specifically related to venue facility management, additional activities in sustainability, resilience, health, and technology advancement can be applicable within these venues and provide a highly visible test case. Venues could deploy electric vehicle charging, public transportation, resilience, and health and nutrition programs.

## Conclusion

---

Unlike most building types, stadiums and arenas have unique relationships with their occupants and the communities where they are located. Millions of Americans follow sports and pass through these venues to cheer on their favorite team. Despite this attention, little is actually known about how stadiums and arenas in the aggregate use energy and water. Several venues have begun implementing energy and water savings measures, from lighting replacements to renewable energy deployment with significant results. Illuminating energy and water use across the sector and establishing the networks, tools, and technologies to help reduce resource use and capture operational savings can lead to measurable results. In addition to the direct energy, water and cost savings within these venues, sports venues represent a significant opportunity to inspire and engage fans to implement energy and water saving strategies in their daily lives, amplify actions at the state and local level, and ultimately help create healthier, more resilient, vibrant and sustainable communities.

Realizing the potential energy and water savings, while enhancing the fan experience and meeting other challenges, will require the collective efforts of venue owners and operators, leagues and conferences, designers, corporate sponsors, vendors and concessionaires, fans, athletes, government, and allied organizations. Compared to efforts in other building types, energy and water savings initiatives within stadiums and arenas are in the first quarter with lots of game still to play. A game plan has been developed, it is up to all of the players to continue its implementation.

## Acknowledgements

---

The authors wish to thank and acknowledge several organizations and individuals for their contributions to this research and report.

## Supporting Agencies

---

This research and report would not have been possible without the input and engagement of the following agencies and individuals:

U.S. Department of Energy

Jason Hartke

Adam Guzzo

Sultan Latif

U.S. Environmental Protection Agency

Clark Reed

## Special Thanks

---

Representatives from the following organizations provided valuable input and contributed to development of this report:

Aberdeen IronBirds

APPA

Association for the Advancement of  
Sustainability in Higher Education

Baltimore Orioles

Baltimore Ravens

BBVA Compass Stadium

Bowie BaySox

BuroHappold

Creighton University

Essex Consulting

Henderson Engineering

HOK

Houston Rockets/Toyota Center

International Association of Venue  
Managers

Major League Baseball

M&T Bank Stadium

Maryland Stadium Authority

ME Engineers

Mercedes-Benz Stadium

Minnesota Wild

National Hockey League

New York Jets

New York Mets

Northwestern University

Populous

Sacramento Kings/Golden 1 Center

Stadium Managers Association

Stanford University

St. Louis Cardinals

University of British Columbia

U.S. Conference of Mayors

U.S. Green Building Council

U.S. Tennis Association

## Project Team

---

National Institute of Building Sciences

Ryan Colker

Green Sports Alliance

Dania Gutierrez

## Appendix

### Appendix A: Key Industry Statistics, Sports Teams and Clubs

	1997	2002	2007	2012	07-12 % Chg
Number of establishments	483	674	814	941	15.6%
Receipts/Revenue (\$ Millions)	7,809	13,025	18,794	22,672	20.6%
Annual payroll (\$ Millions)	4,922	8,546	11,852	14,564	22.9%
Total employment	33,330	40,746	50,730	58,826	16.0%
Receipts/Revenue per establishment (\$1,000)	16,167	19,325	23,088	24,093	4.4%
Receipts/Revenue per employee (\$1,000)	234	320	370	385	4.0%
Receipts/Revenue per \$ of payroll (\$)	1.59	1.52	1.59	1.56	-1.8%
Payroll per employee (\$)	147,686	209,750	233,622	247,576	6.0%
Employees per establishment	69.01	60.45	62.32	62.51	.3%
Receipts/Revenue per capita (\$)	29	45	62	72	15.8%
Population per establishment	564,486	426,744	370,063	333,596	-9.9%

U.S. Census Bureau, "Industry Snapshot: Sports Teams and Clubs (NAICS 711211)."

[http://thedataweb.rm.census.gov/TheDataWeb\\_HotReport2/econsnapshot/2012/snapshot.html?NAICS=711211](http://thedataweb.rm.census.gov/TheDataWeb_HotReport2/econsnapshot/2012/snapshot.html?NAICS=711211)

### Appendix B: Fortune 100 Companies Holding Venue Naming Rights

Rank	Company	Stadium	Team	Location
9	Ford Motor Company	Ford Arena	N/A	Beaumont, TX
		Ford Center	Evansville Purple Aces (NCAA) Evansville Thunderbolts (SPHL)	Evansville, IN
		Ford Field	Detroit Lions (NFL)	Detroit, MI
10	AT&T	AT&T Center	San Antonio Spurs (NBA) San Antonio Rampage (AHL) San Antonio Stars (WNBA)	San Antonio, TX
		AT&T Field	Chattanooga Lookouts (MiLB)	Chattanooga, TN
		AT&T Park	San Francisco Giants (MLB)	San Francisco, CA
		AT&T Stadium	Dallas Cowboys (NFL)	Arlington, TX
13	Verizon	Verizon Arena	N/A	North Little Rock, AR
		Verizon Center	Washington Capitals (NHL) Washington Mystics (WNBA) Washington Wizards (NBA) Georgetown University (NCAA)	Washington, DC

		Verizon Wireless Center	Minnesota State Mavericks (NCAA)	Mankato, MN
23	J.P. Morgan Chase	Chase Field	Arizona Diamondbacks (MLB)	Phoenix, AZ
26	Bank of America	Bank of America Stadium	Carolina Panthers (NFL)	Charlotte, NC
27	Wells Fargo	Wells Fargo Arena	Iowa Energy (NBA-D) Iowa Barnstormers (IFL) Iowa Wild (AHL)	Des Moines, IA
		Wells Fargo Arena	Arizona State University (NCAA)	Tempe, AZ
		Wells Fargo Center	Philadelphia 76ers (NBA) Philadelphia Flyers (NHL) Philadelphia Soul (AFL)	Philadelphia, PA
29	CitiGroup	Citi Field	New York Mets (MLB)	Queens, NY
34	Procter & Gamble	Gillette Stadium	New England Patriots (NFL) New England Revolution (MLS)	Foxborough, MA
35	State Farm Insurance	State Farm Arena	Rio Grande Valley Vipers (NBA-D)	Hidalgo, TX
		State Farm Center	University of Illinois (NCAA)	Champaign, IL
37	Comcast	Xfinity Arena	Everett Silvertips (WHL)	Everett, WA
		Xfinity Center	University of Maryland (NCAA)	College Park, MD
38	Target	Target Center	Minnesota Timberwolves (NBA) Minnesota Lynx (WNBA)	Minneapolis, MN
		Target Field	Minnesota Twins (MLB)	Minneapolis, MN
40	MetLife	MetLife Stadium	New York Giants (NFL) New York Jets (NFL)	East Rutherford, NJ
44	PepsiCo	Pepsi Center	Colorado Avalanche (NHL) Colorado Mammoth (NLL) Denver Nuggets (NBA)	Denver, CO
		Tropicana Field	Tampa Bay Rays (MLB)	St. Petersburg, FL
45	United Technologies	Carrier Dome	Syracuse University (NCAA)	Syracuse, NY
		Pratt & Whitney Stadium at Rentschler Field	University of Connecticut (NCAA)	Hartford, CT
50	Prudential	Prudential Center	New Jersey Devils (NHL)	Newark, NJ

	Financial		Seton Hall (NCAA) NJIT (NCAA) New York Riveters (NWHL)	
56	Dow Chemical	Dow Diamond	Great Lakes Loons (MiLB)	Midland, MI
58	FedEx	FedEx Field	Washington Redskins (NFL)	Landover, MD
		FedEX Forum	Memphis Grizzlies (NBA) University of Memphis (NCAA)	Memphis, TN
59	Caterpillar	Dozer Park	Peoria Chiefs (MiLB)	Peoria, IL
62	Coca-Cola	Coca-Cola Field	Buffalo Bisons (MiLB)	Buffalo, NY
		Coca-Cola Park	Lehigh Valley IronPigs (MiLB)	Allentown, PA
66	Tyson Foods	Tyson Event Center	Sioux City Musketeers (USHL) Sioux City Bandits (CIF) Sioux City Hornets (MBL)	Sioux City, IA
67	American Airlines	American Airlines Arena	Miami Heat (NBA)	Miami, Florida
		American Airlines Center	Dallas Mavericks (NBA) Dallas Stars (NHL)	Dallas, Texas
69	Nationwide	Nationwide Arena	Columbus Blue Jackets (NHL)	Columbus, OH
73	Liberty Mutual Insurance Company	SafeCo Field	Seattle Mariners (MLB)	Seattle, WA
76	Massachusetts Mutual Insurance Company	MassMutual Center	Springfield Thunderbirds (AHL) American International College (NCAA)	Springfield, MA
77	Oracle	Oracle Arena	Golden State Warriors (NBA)	Oakland, CA
80	United Continental	United Center	Chicago Blackhawks (NHL) Chicago Bulls (NBA)	Chicago, IL
81	Allstate	Allstate Arena	Chicago Wolves (AHL) DePaul Blue Demons (NCAA) Chicago Sky (WNBA)	Rosemont, IL
87	Publix Supermarkets	Publix Field at Joker Marchant Stadium	Lakeland Flying Tigers (MiLB) Gulf Coast Tigers (MiLB)	Lakeland, FL

### Appendix C: Professional Stadium and Arena Cost, Age and Financing<sup>96</sup>

National Football League								
Venue	Team	Facility Cost (\$mil)	Renovation Cost (\$mil)	Year Built	Year Renovated	Public Finance %	Renovation Public Finance %	Notes
University of Phoenix Stadium	Arizona Cardinals	\$455		2006		76%		
Georgia Dome	Atlanta Falcons	\$214		1992		100%		
M&T Bank Stadium	Baltimore Ravens	\$229		1998		87%		
Ralph Wilson Stadium	Buffalo Bills	\$22		1973		100%		
Bank of America	Carolina Panthers	\$247.70		1996		0%		
Soldier Field	Chicago Bears	\$13		1924	2003	62%		
Paul Brown Stadium	Cincinnati Bengals	\$453		2000		89%		
FirstEnergy Stadium	Cleveland Browns	\$315		1999		76.50%		
AT&T Stadium	Dallas Cowboys	\$1,150		2009		30%		
Sports Authority Field at Mile High	Denver Broncos	\$364.20		2001		73%		
Ford Field	Detroit Lions	\$430		2002		36%		
Lambeau Field	Green Bay Packers	\$0.96		1957	2001	100%	57%	
NRG Stadium	Houston Texans	\$352		2002		73%		
Lucas Oil Stadium	Indianapolis Colts	\$750		2008		50%		
EverBank Field	Jacksonville Jaguars		\$130	1946	1995	90%		
Arrowhead Stadium	Kansas City Chiefs	\$53	\$375	1972	2010	100%	66%	
City of Champions Stadium	Los Angeles Rams	\$2,500		2019		100%		
New Miami Stadium	Miami Dolphins	\$125	\$450	1987	2016	10%	0%	
U.S. Bank Stadium	Minnesota Vikings	\$1,076		2016		51%		
Gillette Stadium	New England Patriots	\$325		2002		0%		

<sup>96</sup> Derived from National Sports Law Institute, "Facility Updates," *Sports Facility Reports*, vol. 17, 2016. <http://law.marquette.edu/national-sports-law-institute/sports-facility-reports-volume-17-2016-0>.

Mercedes-Benz Superdome	New Orleans Saints	\$134	\$40	1975	2015	100%	25%	
MetLife Stadium	New York Giants/New York Jets	\$1,600		2010		0%		
Oakland Alameda Coliseum	Oakland Raiders	\$25.50		1966	1996	100%		Also Oakland Athletics (MLB)
Lincoln Financial Field	Philadelphia Eagles	\$512		2003		39%		
Heinz Field	Pittsburgh Steelers	\$281		2001		69%		
Qualcomm Stadium	San Diego Chargers	\$27		1967		100%		
Levi's Stadium	San Francisco 49ers	\$1,300		2014		12%		
CenturyLink Field	Seattle Seahawks	\$360		2002		83%		
Raymond James Field	Tampa Bay Buccaneers	\$168.50		1998		100%		
Nissan Stadium	Tennessee Titans	\$292		1999		100%		
FedEx Field	Washington Redskins	\$250.50		1997		28%		
NFL Total	Sum	\$14,025	\$995	Average Age	Time Since Renovation			
	Average	\$468	\$249	25.35 yrs	11.86 yrs	66%	37%	
<b>Major League Baseball</b>								
Venue	Team	Facility Cost (\$mil)	Renovation Cost (\$mil)	Year Built	Year Renovated	Public Finance %	Renovation Public Finance %	Notes
Chase Field	Arizona Diamondbacks	\$354		1998		75%		
Turner Field	Atlanta Braves	\$235		1996		100%		
Oriole Park at Camden Yards	Baltimore Orioles	\$107		1992		96%		
Fenway Park	Boston Red Sox	\$0.450		1912		0%		
Wrigley Field	Chicago Cubs	\$0.250		1914		0%		

U.S. Cellular Field	Chicago White Sox	\$167		1991		100%		
Great American Ball Park	Cincinnati Reds	\$291		2003		96%		
Progressive Field	Cleveland Indians	\$175		1994		82%		
Coors Field	Colorado Rockies	\$215		1995		75%		
Comerica Park	Detroit Tigers	\$361		2000		38%		
Minute Maid Park	Houston Astros	\$252		2000		68%		
Kauffman Stadium	Kansas City Royals	\$250		2009		100%		
Angel Stadium of Anaheim	Los Angeles Angels	\$24	\$117	1966	1998		26%	
Dodger Stadium	Los Angeles Dodgers	\$18		1962		0%		
Marlins Park	Miami Marlins	\$515		2012		76%		
Miller Park	Milwaukee Brewers	\$414		2001		71%		
Target Field	Minnesota Twins	\$545		2010		72%		
Citi Field	New York Mets	\$688		2009		19%		
Yankee Stadium	New York Yankees	\$1,100		2009		32%		
Citizens Bank Park	Philadelphia Phillies	\$346		2004		50%		
PNC Park	Pittsburgh Pirates	\$237		2001		85%		
PETCO Park	San Diego Padres	\$285		2004		66%		
AT&T Park	San Francisco Giants	\$325		2000		0%		
Safeco Field	Seattle Mariners	\$517		1999		76%		
Busch Stadium	St. Louis Cardinals	\$357		2006		12%		
Tropicana Field	Tampa Bay Rays	\$138		1990		100%		
Globe Life Park in Arlington	Texas Rangers	\$191		1994		71%		
Nationals Park	Washington Nationals	\$611		2008		100%		
MLB Total	Sum	\$8,719	117	Average Age	Time Since Renovation			
	Average	\$311	117	24.89 yrs	19 yrs	61%	26%	

National Hockey League/National Basketball Association								
Venue	Team	Facility Cost (\$mil)	Renovation Cost (\$mil)	Year Built	Year Renovated	Public Finance %	Renovation Public Finance %	Notes
Philips Arena	Atlanta Hawks (NBA)	\$213.50		1999		91%		
TD Garden	Boston Celtics (NBA)/Boston Bruins (NHL)	\$160		1995		0%		
Barclays Center	Brooklyn Nets (NBA)/New York Islanders (NHL)	\$1,000		2012		40%		
Time Warner Cable Arena	Charlotte Hornets (NBA)	\$265		2005		100%		
United Center	Chicago Bulls (NBA)/Chicago Blackhawks (NHL)	\$175		1994		0%		
Quicken Loans Arena	Cleveland Cavaliers (NBA)	\$152		1994		48%		
American Airlines Center	Dallas Mavericks (NBA)/Dallas Stars (NHL)	\$420		2001		30%		
Pepsi Center	Denver Nuggets (NBA)/Colorado Avalanche (NHL)	\$165		1999		3%		
The Palace of Auburn Hills	Detroit Pistons (NBA)	\$70		1988		0%		
Oracle Arena	Golden State Warriors (NBA)	\$25.5	\$121	1966	1997	100%	20%	
Toyota Center	Houston Rockets (NBA)	\$235		2003		100%		
Bankers Life Fieldhouse	Indiana Pacers (NBA)	\$183		1999		43%		
Staples Center	Los Angeles Clippers (NBA)/Los Angeles Lakers	\$375		1999		19%		

	(NBA)/Los Angeles Kings (NHL)							
FedEx Forum	Memphis Grizzlies (NBA)	\$250		2004		100%		
American Airlines Arena	Miami Heat (NBA)	\$213		1999		59%		
BMO Harris Bradley Center	Milwaukee Bucks (NBA)	\$90		1988		0%		
Target Center	Minnesota Timberwolves (NBA)	\$104		1990		100%		
Smoothie King Center	New Orleans Pelicans (NBA)	\$114		1999		100%		
Madison Square Garden	New York Knicks (NBA)/New York Rangers (NHL)	\$123	\$1,000	1968	2013	100%	0%	
Chesapeake Energy Arena	Oklahoma City Thunder (NBA)	\$89		2002		100%		
Amway Center	Orlando Magic (NBA)	\$480		2010		87.50%		
Wells Fargo Center	Philadelphia 76ers (NBA)/Philadelphia Flyers (NHL)	\$210		1996		11%		
Talking Stick Resort Arena	Phoenix Suns (NBA)	\$90		1992		39%		
Moda Center	Portland Trail Blazers (NBA)	\$267		1995		82%		
Golden1 Center	Sacramento Kings (NBA)	\$507		2016		46%		
AT&T Center	San Antonio Spurs (NBA)	\$186		2002		84%		
Vivint Smart Home Arena	Utah Jazz (NBA)	\$94		1991		22%		
Verizon Center	Washington Wizards (NBA)/Washington Capitals (NHL)	\$260		1997		23%		
Honda Center	Anaheim Ducks	\$123		1993		100%		

	(NHL)							
Gila River Arena	Arizona Coyotes (NHL)	\$180		2003		82%		
KeyBank Center	Buffalo Sabres (NHL)	\$127.50		1996		44%		
PNC Arena	Carolina Hurricanes (NHL)	\$158		1999		84%		
Nationwide Arena	Columbus Blue Jackets (NHL)	\$175		2000		0%		
Joe Louis Arena	Detroit Red Wings (NHL)	\$57		1979		100%		
BB&T Center	Florida Panthers (NHL)	\$212		1998		87%		
Xcel Energy Center	Minnesota Wild (NHL)	\$130		2000		74%		
Bridgestone Arena	Nashville Predators (NHL)	\$144		1996		100%		
Prudential Center	New Jersey Devils (NHL)	\$375		2007		66%		
CONSOL Energy Center	Pittsburgh Penguins (NHL)	\$321		2010		0%		
SAP Center at San Jose	San Jose Sharks (NHL)	\$162.50		1993		82%		
Scottrade Center	St. Louis Blues (NHL)	\$135		1994		46%		
Amalie Arena	Tampa Bay Lightning (NHL)	\$139		1996		62%		
NHL/NBA Total	Sum	\$8,955	1121	Average Age	Time Since Renovation			
	Average	\$213	560.5	20.17 yrs	12 yrs	58%	10%	





National Institute of  
BUILDING SCIENCES

1090 Vermont Avenue, NW  
Suite 700  
Washington, D.C. 20005  
(202) 289-7800  
[www.nibs.org](http://www.nibs.org)

GREEN  
SPORTS  
ALLIANCE

421 SW 6th Ave, Suite 450  
Portland, Oregon 97204  
(877) 203-9566  
[greensportsalliance.org](http://greensportsalliance.org)

