SUSTAINABILITY IN CASINO DESIGN AND OPERATION[1]

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Abstract In the past, many business leaders viewed sustainability and profitability as mutually exclusive—if it's good for the environment, it's bad for business. Yet, over the past decade we've seen a growing sense of corporate responsibility and the dawning recognition that being "green" isn't being broke. In fact, quite the opposite is true. Sustainability supports business success. This is especially true in casino design and operation.

In this paper we address sustainable design strategies for casinos that help save money. With their high energy needs and frequent remodeling campaigns, casinos offer a unique opportunity for sustainable design initiatives. Various sustainable strategies—from using combined heat-and-power systems to streamlined access flooring and ductless air supply combinations—will be explored. Case studies will be analyzed to gain insight for best practice strategies to enhance building performance and ultimately reduce operational costs. Clearly, with the right planning and the right technology, "good for the bottom line and good for the environment" can be achieved through sustainable design.

KEYWORDS: *Sustainability, corporate responsibility, casino design, casino*

INTRODUCTION

In the past many business leaders viewed sustainability and profitability as mutually exclusive—if it's good for the environment, it's bad for business. Yet, over the last decade we've witnessed a growing recognition that being "green" isn't being broke. In fact, the opposite is true. Sustainability supports business success. This is especially the case in casino design and operation, where sustainability initiatives foster both cost savings and environmental preservation. The beauty of this dual purpose is that by doing what is best for the bottom line, gaming houses can become stewards for the environment.

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During the design or upgrade of any building, a number of approaches to sustainability should be considered. These range from the use of low-flow fixtures for reduced water consumption to light-colored roofing materials for less heat absorption. In this paper, we narrow our focus to sustainability initiatives that cut casino energy use, highlighting the following strategies: day lighting, energy-efficient gaming systems and electronic gaming machines, access flooring/ductless air-supply systems, lighting and HVAC retrofits, heat recovery systems, cogeneration plants, solar arrays, fuel cells, and wind-generated power. Not only do these strategies cut operating expenditures and reduce energy demands, they create appealing and comfortable interior environments that enhance patrons' gaming experience.

ENERGY DEMANDS: THE STANDARD CASINO

Why target energy demands of casinos when the gaming area is just one piece of a larger complex? First, while there is much written on approaches to sustainable design, nowhere have we found a document focused on reducing the energy needs of gaming spaces. Second, casinos do require a huge amount of energy to operate. These energy demands stem from casino use and design, two considerations that directly impact each other.

A typical casino is a windowless box, traditionally isolated from exterior air and light. This enclosed volume is often entirely dependent on the building's mechanical systems, which must attend to stringent lighting and heating-ventilation-air-conditioning (HVAC) demands. In addition to practical lighting considerations, glowing signs and other lighted markers are needed for entertainment and navigational purposes. Spot lighting directs attention to certain gaming tables or electronic gaming machines (Hirotaka Ellis et al., 2011), which simultaneously draw energy and raise the ambient temperature.

HVAC loads are particularly high on a casino floor, as the system must supply the regulated amount of ventilation to mitigate cigarette smoke, odors, and other air quality issues. HVAC systems also regulate humidity and temperature, both of which rise with the dense concentration of people, EGMs, and intense casino lighting.

Frequent reconfigurations and renovations, which require materials and energy (and money), also contribute to casino energy needs. Roughly once or twice a year, most casinos alter their gaming layouts in response to the emergence of new products or the underperformance of certain gaming arrangements. Reconfigurations generally involve adaptations to the electrical (and sometimes other) systems to accommodate EGMs, which comprise roughly 80% of the typical casino's gaming positions. In addition, security and surveillance upgrades occur on a regular basis.

Also consider that many casino floors operate twenty-four hours a day, seven days a week. This schedule couples with issues of use and design to make casino floors extremely demanding energy-wise. Fortunately with knowledge and planning, casino owners and operators can execute a variety of design and operational strategies to craft more economically and environmentally sustainable casinos.

STRATEGIES FOR CASINO SUSTAINABILITY

Day lighting

The concept of the casino as a windowless box has long held sway over casino design. Casinos' traditional lack of windows stem from a combination of sources, including jurisdictional mandates that gaming equipment not be seen from outside the building, manufacturer warnings to keep gaming machines out of direct sunlight, and the practical desire to prevent glare on gaming screens and surfaces. Another reason lies in the mentality that people will spend more time, and more money, in casinos if they are unable to track the passage of time. The thought is that casinos should be cut off from the outside world—no windows, no clocks, and no distractions to sidetrack patrons from their games of choice. Keep them focused inward, and hopefully they won't leave. Or perhaps the windowless floor plan reflects structural issues inherent in vertical casino/hotel combinations. As one commentator noted, "when you have 100,000 square feet of space topped with hotel towers and catwalks up high for surveillance crews, well, windows and skylights can be impractical."

Regardless of why daylight has traditionally been absent from casinos, in the past five years we have seen more designers and operators incorporating natural light into their gaming areas. This turn toward day lighting techniques may reflect the extensive research on natural light that suggests its positive influences on people's actions: fortified with natural light, students perform better in school, employees take fewer sick days and work more productively, and shoppers buy more. With such studies in mind, it isn't surprising to see natural light entering the casino.

In 2008 Turtle Creek Casino and Hotel near Traverse City, Michigan, owned by the Grand Traverse Band of Ottawa and Chippewa Indians, broke from the "cut-off casino" mold by including skylights that run throughout its entire complex—even the casino floor. The immediate effect of allowing daylight to penetrate the casino is up to a 50 percent reduction in lighting needs and thus a substantial savings in energy cost with an equally significant effect is increased profit. At Turtle Creek, natural light helps cut operational costs and attracts more patrons—a win–win situation.

Natural light in casinos has also debuted on the Las Vegas strip. Steven Wynn's Encore, which opened in late 2008, includes filtered daylight on its casino floor. ARIA Resort and Casino, part of the massive City Center complex that opened in 2009, include windows that provide outside views as well as skylights on its gaming floor. City Center executives, such as Vice President of Design Sven Van Assche, connect natural light with the creation of "a pleasant atmosphere." "There is an innate human comfort with daylight in an interior space," Van Assche says. "It heightens the experience, which can be said of any interior space that features daylight."

Entertainment architect Paul Steelman (2009), whose firm designed Sands Macau (completed in 2008), believes that in coming years, "natural light in the casino will be the rule, not the exception." The Sand Macau casino boasts a large expanse of east-facing glass, which allows patrons to witness the changing exterior light as the day turns to night. Natural light "offers more of a resort experience," Steelman says. "It also saves money on energy."

Energy-Efficient Gaming Systems and Electronic Gaming Machines (EGMs)

Gaming-machine technology has changed significantly over the past few decades. Classic mechanical designs have been almost completely replaced by computer-controlled machines, and companies such as International Gaming Technology (IGT), WMS Gaming, and Bally Technologies now offer an array of EGMs featuring various themes derived from pop culture—including television shows, films, and celebrities. Most casinos offer a wide variety of EGMs, with each machine dedicated to a single game and theme. If the patron wants to play a different game, he or she has to move to another machine. With the recent development of server-based gaming (Quish, 2011), soon this will no longer be the case.
Server-based gaming involves connecting EGMs to a central computer system, so the machines on the casino floor are essentially generic terminals. Different games can be downloaded to these machines, and managers use the central computer server to change games and features such as bonus payouts. This eliminates the need for technicians to manually perform the work, which saves on facility and maintenance costs while enhancing the user experience. Another benefit for casino owners is that, unlike a single game/theme EGM that becomes outmoded as fashions change, the server-based system lets managers update games in a matter of seconds without physically replacing EGMs.

Today few casino operators use pure server-based gaming systems. More common, but still not frequent, are server-supported gaming systems—essentially the step between the single game/theme EGM and server-based EGMs. ARIA, which opened in late 2009, currently houses the largest array of server-supported gaming in Las Vegas. That a new facility holds this distinction is not coincidental, as server-based and server-supported gaming systems require a dedicated IT infrastructure that may be costly and complex to insert into existing casinos. So while server-supported and server-based systems make up the next wave in gaming technology, the decision to retrofit facilities is complicated by a number of factors, including the casino's existing design, the cost of shifting to the required infrastructure, and the ROI generated by server-based or served-supported systems.

Another measure that will affect future energy demands of EGMs involves the development of an American National Standards Institute (ANSI) standard for sustainable EGMs. This document, still under revision by the Sustainable Gaming Standards Committee (SGSC), addresses all aspects of the EGM supply chain, from manufacture and distribution through operation and maintenance. The goal is to set an energy-efficient and environmentally sensitive benchmark for those who create, sell, buy, and operate EGMs. Hansel (2010), chairman of the SGSC, believes that adherence to their developing ANSI standard will make EGMs 50 percent more energy-efficient within the next five years. With over a million EGMs in the United States alone, this would amount to a hug energy and cost savings, (Hansel, 2011).

Streamlined Access Flooring/Ductless Air-Supply System

With traditional gaming floors, wiring and communication can be cumbersome, especially because gaming layouts and EGM configurations change frequently. One standard for casino-floor construction consists of a concrete slab with a trenched grid to accommodate power and data wiring. With access flooring, the entire grid floor system is built on top of the slab, not embedded within it. This allows greater flexibility, quick gaming layout changes, and facility and maintenance cost savings.

In addition to gaming flexibility, access flooring can also act as a ductless air-supply system. Air flows through the access flooring and enters the gaming space at floor level through vents in the EGM bases or the floor. This highly innovative system is superior in several ways. First, the ceiling is clear of diffusers, which allows for an aesthetically cleaner space. More importantly, this streamlined system eliminates the need for ductwork and its upfront cost. In addition, because this system uses convection (the conditioned supply air enters at floor level and naturally rises to warm the space), the size of the mechanical equipment can be reduced. Return air ducts or plenums in the ceiling efficiently remove the stale air (along with cigarette smoke and lingering odors) from the space, substantially improving indoor air quality. Utilizing reduced mechanical equipment and convection in place of air-circulating fans, this under-floor air system reported saves up to 30 percent of HVAC energy costs.

Lighting Retrofits

Casino lighting systems, which consume up to 30 percent of the total electrical costs of operating a gaming facility, can generally be described as functional (for the table games) or decorative (for enhanced customer experience). Recent years have brought significant improvements in the retrofit of each, including the application of LEDs (light emitting diodes) and fiber optics. An additional approach in lighting retrofits involves occupancy sensors and electronic dimming systems, where applicable, to significantly reduce lighting use. A net energy benefit accrues on the amount of cooling required on the casino floor as a result of reduced lighting loads.

Lighting retrofits can produce a cost savings of up to 30 percent due to decreases in electrical consumption, labor costs, and bulb replacement. The return on investment (ROI) on lighting retrofits is typically short, often less than two years. In the case of an older Las Vegas gaming facility, the El Cortez Hotel and Casino, an extensive lighting upgrade provided an even larger and quicker payoff. “In addition to improving light levels and standardizing the lighting throughout [El Cortez], the upgraded system reduced energy consumption and costs by as much as 40 percent relative to the less-efficient . . . system previously in place.” The project costs were recovered within 19 months, (Dyslin, 2008).

Operators must carefully consider retrofits in the casino environment to ensure adequate lighting levels, the quality of light and overall effectiveness. Yet, with the right assessment teams and lighting professionals, a retrofit of an existing lighting system can play a big role in decreasing energy costs and consumption.

HVAC Retrofits

Many casino air-handling systems are designed to operate at maximum or code-required occupancy levels, meaning that the rate of outdoor air brought in and exchanged for indoor air is based on the maximum number of people a space holds at its busiest times. On days with an average number of patrons—which is most of the time—the HVAC system may still operate with the highest ventilation rates. With this in mind, HVAC retrofits on the casino floor generally involve reducing outdoor air rates during low occupancy periods. Often referred to as "Demand Controlled Ventilation," these HVAC strategies reduce outdoor air ventilation in proportion to indoor carbon dioxide levels, which are monitored by carbon dioxide sensors.

Outdoor air rates significantly impact energy demands and costs as the air brought in from outside must be cooled, heated, and/or dehumidified before it can be introduced into the occupied space. Thus, a retrofitted HVAC system that adjusts ventilation rates in response to indoor air quality conditions is more energy efficient and cost efficient, saving up to 20 percent of operating costs. Additional HVAC retrofits generally focus on reducing motor horsepower requirements by using high efficiency motors, variable speed drives, and similar applications where the casino environmental demands can be achieved by utilizing more efficient mechanical equipment.

Retrofits of HVAC systems to incorporate "smart" building energy management technologies—such as carbon dioxide sensors—are a proven technique to both reduce air-handling-related energy needs and costs without compromising indoor air quality or customer comfort.

Heat Recovery Systems

Energy recovery systems in the casino environment typically take the form of air-side system heat wheels. Gaming spaces require a significant amount of outdoor air to achieve the typical building code mandate, which often approaches a capacity of 100-percent outdoor air during demand periods. Air-side system "heat wheels" are located in the return air portion of the typical rooftop HVAC unit, arranged so the heat energy contained in the return (inside) air is transferred to the incoming (outside) air before it is exhausted, thus reducing the amount of energy required to heat or cool "new" incoming air.

Air-side system heat wheels provide additional benefits. They lower construction costs, as mechanical equipment can be reduced in size because of the reduced need to condition incoming air. Smaller mechanical equipment also lessens the weight on structural members, which in turn lessens the amount (and thus the cost) of materials that comprise the structural system. Furthermore, heat wheels provide an effective means to dilute and exhaust air pollutants such as cigarette smoke. All of these features lead to reductions in energy demands and costs.

Combined Heat and Power (CHP or Cogeneration)

Combined heat and power cogeneration systems, also known as CHP or cogeneration, can provide large casino facilities with a reliable, efficient energy source. CHP produces electric power, typically by using a natural gas-fired reciprocating engine or turbine. As a byproduct CHP produces heat energy, which may be recovered and used to decrease various thermal loads, such as hot water and space heating. Depending on the size of the CHP system and the facility it serves, CHP can provide between 50 to 70 percent of a facility's energy needs.

Larger casinos that have a relatively continuous (i.e. flat) thermal load profile are often good candidates for CHP systems. Despite the initial cost investment, CHP offers casino owners and operators a number of benefits. First, CHP is a reliable energy source that can continue to operate during a power outage. This is important because the closure of the casino floor due to insufficient light or thermal control can cost a casino over one million dollars a day of lost revenue. Second, CHP produces power close to the casino facility. This eliminates energy losses caused by the processes of transmission and distribution. (A typical central power plant transmission–distribution arrangement can lose over 60 percent of the energy produced during transmission and distribution from the originating fuel source.) This efficiency translates into cost savings for facilities using power from CHP. Because CHP plants are typically located near the place the energy will be used, more of the CHP-produced power arrives at the place of use (i.e., less is lost during transmission and distribution). This means less energy and/or fuel needs to be purchased from outside vendors. Third, CHP power is cleaner than traditional energy sources in that it reduces fuel use, creating less air pollution.

Facilities such as City Center in Las Vegas, Borgata in Atlantic City, and Revel (scheduled to open in May 2012) in Atlantic City use CHP to produce electricity, then capture the waste heat for process steam, hot water heating, space heating, and other thermal needs. In 2004 Caesar's (formerly Harrah's) Rio All Suite Hotel and Casino installed a CHP system, the first in Las Vegas. According to the US Environmental Protection Agency, Rio's CHP system generates 40 percent of the electricity, 60 percent of the hot water, and 65 percent of the heating requirements of the resort.

Solar

Solar energy comes from sunlight shining on a semi-conductor device (namely a collection of photocells), which produces electrons that are collected to a wire grid and subsequently produce direct current (DC). In most cases DC is converted to alternating current (AC) by using a device known as an inverter. Solar thermal (fluid) systems may be used for pre-heating domestic hot water, swimming pool water, and similar applications. Solar energy systems are designed to operate with traditional power distribution systems.

Solar collectors are becoming a more popular alternative energy source for casinos. Solar energy does not produce greenhouse gas emissions, lowers power costs, and reduces resource consumption. However, significant space must be allocated for large solar panel arrays. Effective solar collection systems depend on the careful consideration of site and geography. In addition, some people are concerned by the aesthetic appearance of solar panels, although newer

technologies offer additional options for solar collector forms. Likewise, technological advances have allowed material costs of solar collectors to decrease in recent years, but the installation cost of these systems is still expensive relative to more traditional energy sources. Fortunately, high installation costs ($5.00/watt+/-) are often partially offset by utility company rebates/incentives and federal tax credits to help casinos ensure a more reasonable ROI.

In March 2010, Harrah's Rincon Casino and Resort in conjunction with the Rincon Band of Luiseno Indians completed a large solar plant that covers 90 percent of Harrah's Rincon's HVAC needs, equivalent to the energy required to power 2,200 homes. This huge solar field, located in Valley Center, CA, is comprised of almost 4,000 solar panels over a 5.5-acre site. It is anticipated to offset almost 25 percent of the resort's overall energy needs. (Lew, 2010)

Fuel Cells

Fuel cells, an advanced form of combined heat and power technology, convert the chemical energy of a hydrogen-based fuel directly into electricity without combustion. Waste heat from the conversion process can be captured to offset thermal loads such as hot water and space heating. Fuel cell technology emits fewer carbon dioxide emissions than that of traditional fossil fuels.

Given the high cost of fuel cell equipment and rapidly evolving technology, fuel cells in the gaming environment are not generally used. Nevertheless, in 2002 the Mohegan Tribe initiated a project to raise awareness about fuel cells and demonstrate that they are a viable alternative source of energy. After five years of using fuel cells to provide power for the Mohegan Sun Casino and Resort in Uncasville, CT, the Mohegan Tribe concluded that their fuel cell project demonstrated that fuel cell technology can produce clean, safe and highly reliable power, while also offering significant cost savings. Due to the reduced environmental effects and the overall cost savings—the equivalent of $3.5 million dollars in commercial-rate utility fees over five years—the Mohegan Tribal Council plans to continue exploring the possibilities of fuel cell technology.

Wind

Wind power is one of the most promising alternative green technologies emerging today. Wind power is created when wind spins the blades of a wind turbine, which in turn spin a shaft. The shaft connects to a generator that converts this mechanical power into electricity.

A clean fuel source, the benefits of wind power are many, including its lack of pollutants and its reliance on a renewal resource—wind. Of course, wind depends on geography and climate, and is not always available in certain locations. For wind power to be a viable option for gaming (or any) facilities, steady winds are required. For example, small turbines need consistent winds over 20MPH to be cost effective. Additional challenges of wind turbines for a gaming site include considerations of noise, vibration, visual impact, community impact, initial costs, and maintenance costs.

Nevertheless, wind power is the fastest growing energy source in the world, and casino owners are picking up on this trend. Currently the Cheyenne and Arapaho Tribes are developing a 22-turbine wind farm in Oklahoma. Twenty of the 102-ft-tall wind turbines (which should be completed in

the spring of 2012) will provide energy for the tribes' Lucky Star Casino in Concho, which comprises a large part of the tribes' $200,000 monthly energy bill. The hope is that the wind power generated from the farm will more than cover these monthly bills, and leftover energy will be sold as an additional source of revenue.

CONCLUSION

Of the sustainable practices discussed here, many of them come with initial costs. In the case of lighting and HVAC retrofits, ROI is typically short term, less than two years. In other cases, upfront costs and slower ROIs appear to make certain technologies impractical. This is particularly true regarding alternative energy sources such as CHP-, solar-, fuel-cell–, and wind-derived power. Fortunately, an array of local through federal grants, rebates, and other incentive programs help ensure a quicker and more reasonable ROI for interested casino owners. In the United States, the US Department of Energy has funded a website called DSIRE, which is "a comprehensive source of information on state, local, utility, and federal incentives and policies that promote renewable energy and energy efficiency."

Today casino owners and operators can chose from a growing number of sustainable initiatives that will help them save money. From the adoption of day lighting techniques through the use of alternative energy sources, sustainable practices can no longer be overlooked as detrimental to a casino's financial success. Casinos can be both profitable and ecologically responsible. With the right planning and the right technology, "good for the bottom line" and "good for the environment" can be achieved through sustainable design.

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