AABC Commissioning Group

AIA Provider Number 50111116

Strategies for Reducing Energy in the Built Environment at Caesars Entertainment

Course Number: CXENERGY1803

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Caesars Entertainment

April 25, 2018

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Course Description

Energy management in the built environment is an important matter not only for occupant comfort and cost reduction, but also as a strategy to minimize upstream greenhouse gas emissions and impacts on global climate change. This presentation highlights an approach used by Caesars Entertainment to target energy efficiency opportunities at an enterprise level. A specific area of focus will be on retrocommissioning of major heating, ventilation and air conditioning systems.

Learning Objectives

At the end of the this course, participants will be able to:

1. How to approach energy efficiency from an enterprise perspective when multiple assets are owned and how best to prioritize opportunities.

2. Identification of low-cost/no-cost actions that can yield beneficial energy reduction results.

3. How more sophisticated retro-commissioning strategies can and should be incorporated into an energy efficiency program and specific actions that can be taken to optimize existing HVAC operations.

4. How efficiency and retro-commissioning can tie into broader corporate sustainability goals and environmental, social and governance strategies.

Agenda

1. About Caesars and Our Approach to Sustainability
2. Strategies for Retrofitting Aging Facilities
3. Deep-Dive into Retro-commissioning with Case Studies
4. Wrap-up and Q&A

About Caesars Entertainment

COMMITMENT TO GUESTS
Creating memorable guest experiences
Responsible Gaming

COMMITMENT TO EMPLOYEES
A great place to work
Diversity and inclusion
Health and wellness

COMMITMENT TO ENVIRONMENTAL STEWARDSHIP
Reducing energy consumption
Minimizing carbon emissions

COMMITMENT TO COMMUNITIES
Responsible Conduct
Positive economic contribution
Supporting local communities

$9.053B
(2015) total net revenues in U.S.

>45M
Total Rewards members

58,800
Employees worldwide (approx.)

>100M
Guest visits per year

50
Casinos in 6 countries

1,485,802
Square feet of construction according to LEED standards

>15,700
Conventions and meetings per year

38,098
Hotel rooms and suites in the U.S.

55.6M
Square feet of air conditioned space in the U.S.

10,000
Live entertainment shows per year (approx.)

55,250
Slot machines worldwide

3,690
Table games worldwide

298
Owned or managed retail stores throughout the U.S.

4
World class golf courses in the U.S.

358
Food and beverage outlets owned or managed in the U.S.

>600
Bars, restaurants and clubs in the U.S.

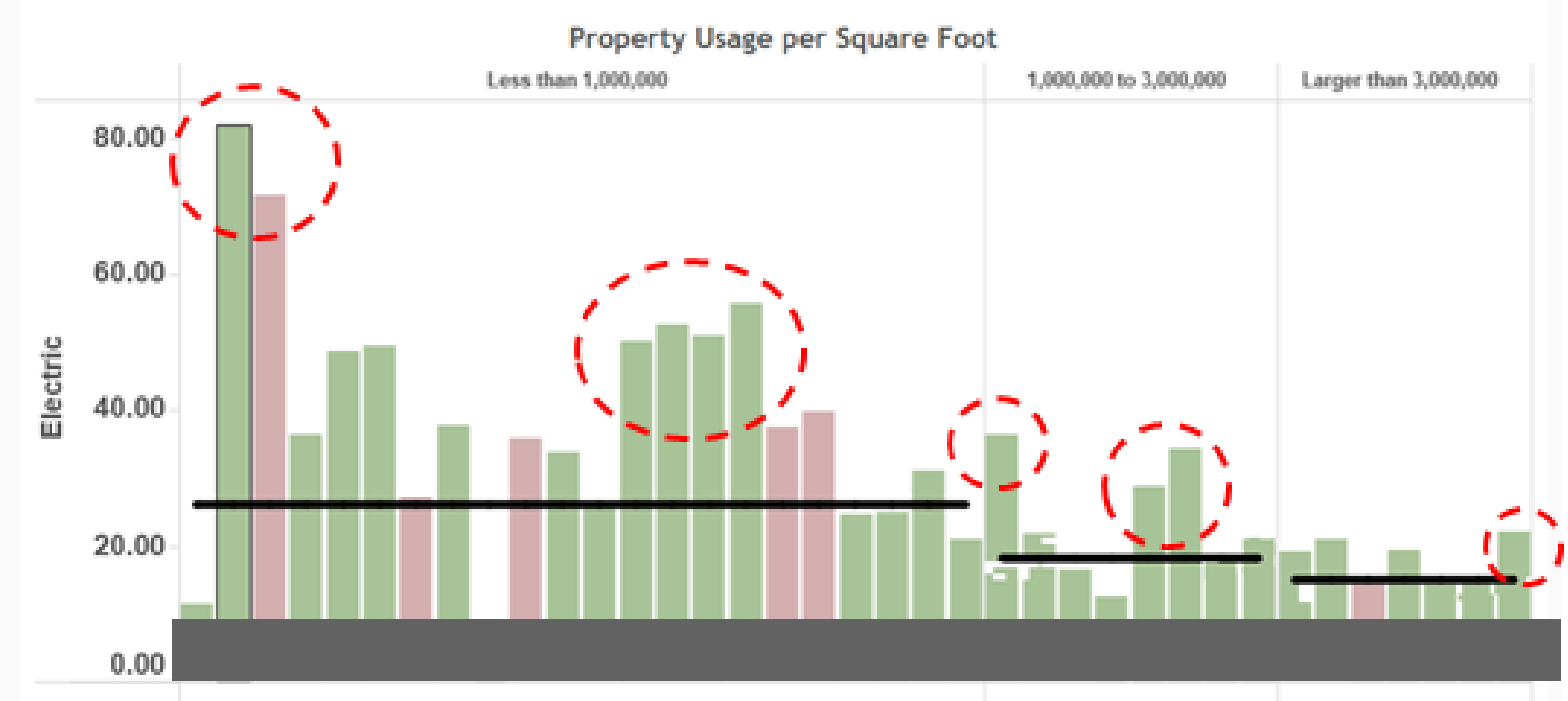
Code of Commitment

Environmental Goals

Targets (2007 Baselines)		2020	2025
Energy	Reduce energy consumption (fossil fuel based) per air-conditioned 1,000 sq. ft.	30%	40%
Greenhouse gas emissions	Reduce greenhouse gas emissions per air-conditioned 1,000 sq. ft.	30%	40%
Water	Reduce water consumption per air-conditioned 1,000 sq. ft. (2008 baseline)	20%	25%
Waste	Divert total waste from landfill	50%	60%
Green Buildings	Achieve LEED certification for all newly-built and expanded properties owned by Caesars	100%	100%
Sustainable Operations	Green Key certification for all hotel properties in North America	100%	100%

Strategies for Retrofitting Aging Facilities

Assessing Opportunities



- Evaluating energy use indexes for properties can help identify areas of opportunity
- Comparing buildings within a portfolio or an industry group is a good way to spot anomalies
- Understanding energy use and rates will allow priorities to be set

Understanding
What's Been Done

Properties

Measures

CARBON REDUCTION STRATEGY
Energy Conservation & Efficiency Roadmap

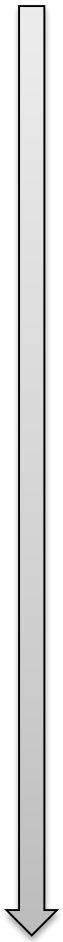
KEY: A = All | M = Most | F = Few | N = None | X = N/A

	Grand Casino Biloxi	Harrah's Tunica	Hotel Tunica	Roadhouse Tunica	Harrah's Council Bluffs	Hotel Council Bluffs	Harrah's Louisiana Downs	Hotel Bossier City	Harrah's New Orleans	Harrah's St. Louis	Harrah's NKC	Harrah's Cherokee	Bally's Atlantic City	Caesars Atlantic City	Harrah's Atlantic City	Showboat Atlantic City	Harrah's Chester	Hotel Southern Indiana	Hotel Hammond	Harrah's Joliet	Harrah's Metropolis	Planet Hollywood	Bally's Las Vegas	Bill's Gamblin' Hall	Caesars Palace	Flamingo Las Vegas	Harrah's Las Vegas	Imperial Palace	Paris Las Vegas	Rio	Harrah's Avalon	Harrah's Lake Tahoe	Harveys Lake Tahoe	Harrah's Reno	Harrah's Ak-Chin	Harrah's Fallsview	Caesars Golf C	Rio
1. Are energy efficient light bulbs (e.g. compact fluorescent, cold cathode and LED) used in the following areas:																																					
Guestroom Hallways?	A	A	M	N	M	X	X	A	A	A	F	A	M	A	F	A	X	A	X	A	M	A	A	N	A	A	M	A	A	A	A	A	A	A	A	X	A
Guestrooms?	N	M	M	F	M	X	X	A	M	A	M	M	M	A	F	A	X	M	X	F	M	A	M	A	M	A	M	A	M	F	A	M	M	A	A	M	X	X
Casino Area?	M	M	M	N	F	M	M	A	M	M	M	M	F	M	M	M	M	M	F	M	A	M	A	M	M	A	M	A	M	F	M	A	A	M	M	M	M	X	X
Non-casino common areas including executive offices areas, trade shops, kitchens and mechanical rooms?		N	M	N	M	F	M	N	A	M	M	A	M	A	A	A	N	A	M	A	A	M	A	N	M	A	M	A	A	A	A	M	M	M	M	F	M	N
Meeting/Ballrooms/Convention Area Hallways?	X	M	N	N	F	X	M	A	M	M	M	F	F	A	M	F	M	F	M	F	M	M	F	X	M	A	M	A	F	A	M	M	M	A	A	F	N	N
Exterior Signs?		F	N	M	N	M	M	A	A	F	A	F	N	F	A	X	M	F	A	F	F		A	F	F	A	M	F	M	A	N	F	F	M	F	A	X	X
Exterior Raceways?		X	N	N	N	A	N	X	M	N	X	F	M	X	F	N	A	N	A	F	F		X	F		A	X	F	F	M	N	F	F	M	F	A	X	M
Exterior Wash Lights?	N	N	N	N	N	N	N	N	F	N	N	N	M	F	N	A	N	N	N	F	N	N	N	N	A	M	M	N	F	A	N	F	F	X	F	M	X	X
2. Are high-efficiency linear fluorescent **T8** lamps used in back of house areas?	A	A	M	A	A	M	M	N	A	A	A	A	M	A	A	A	M	A	F	M	M	M	A	N	A	A	A	A	A	F	A	A	A	A	M	A	A	X
3. Are linear fluorescent **T8** lamps used in parking structures?	N	X	X	X	A	N	X	A	A	A	N	N	A	A	A	A	A	A	A	F	X	M	A	A	A	A	A	A	A	A	A	X	A	X	X	A	X	X
4. Are low flow showerheads **(less than 2.5 gpm)** used in guestrooms?	N	N	A	N	N	X	X	N	N	N	N	M	F	N	N	N	X	N	X	N	N	M	A	F	A	A	N	F	A	N	A	F	F	N	N	A	X	X
5. Are low flow sink aerators **(less than 2.2 gpm)** used in guestroom sinks?	N	N	X	N	N	X	X	N	N	N	N	F	F	N	N	N	X	A	X	N	N	N	A	F	M	A	N	F	A	N	A	F	F	N	N	A	X	X
6. Are low flow sink aerators **(less than 2.2 gpm)** used in public restrooms?	A	A	X	A	A	N	M	A	A	F	A	M	A	A	A	A	A	A	A	F	A	A	A	F	M	A	A	F	F	A	A	F	F	A	A	A	A	A
7. Are digital thermostats with auto-fan reset (cycling fan coil unit On/Off) or occupancy based sensors used in guestrooms?	A	A	A	A	F	X	A	A	A	N	A	A	A	A	A	A	X	A	X	N	A		A	N	F	A	A	N	A	A	A	N	N	N	N	A	X	X
8. Are variable frequency drives installed and active in the following applications:																																					
Cooling tower fans?		F	A	N	A	X	A	N	A	F	A	A	X	X	A	M	A	A	X	A	A		A	A	A	A	A	M	A	A	A	M	M	A	X	A	A	N
Air handler fans greater than 5 HP, or 8000 cfm?	M	M	M	A	A	A	M	A	A	M	M	M	M	M	M	A	A	F	A	A	A		A	A	M	A	M	A	A	A	A	M	M	M	F	M	N	X
Primary water pumps for "variable-primary" chilled water loop configurations?	A	A	A	A	A	X		N	A	A	N	A	M	X	F	N	A	A	N	A	A		N	N	A	N	N	N	A	N	A	F	F	M	X	A	X	N
Secondary water pumps for "primary-secondary" chilled water loop configurations?	X	A	A	A	M	X	A	A	A	A	A	A	M	A	A	A	X	N	N	A	A		X	X	A	N	A	X	A	A	A	F	F	M	X	X	X	N
Cooling tower "condenser" water pumps?		F	A	A	A	X	A	N	F	N	N	M	X	X	A	N	A	N	N	A	N		N	N	N	N	M	N	A	N	A	F	F	A	X	A	N	N
Hot water "hydronic heating" circulating pumps?	N	N	A	N	X	X	N	N	A	F	F	A	X	A		X	A	N	X	A	N		N	N	A	X	A	N	A	M	A	N	N		N	A	N	N
Enclosed parking garage exhaust fans?	N	X	X	X	X	X	X	A	N	X	X	A	F	N	A	N	X	N	X	X	X		N	N	A	N	X	N	A	N	N	N	N	A	X	X	X	X
Pool pumps?	N	N	N	X	X	X	X	N	X	X	X	N	N	A		N	X	N	X	X	X		N	X	N	F	A	N	F	N	N	N	N	A	N	F	X	X
9. Are "economizers or flue-gas condensers" installed on main boiler stacks to allow for heat recovery from boiler exhaust?	N	N	N	N	N	N	N	N	N	N	N	F	X	X	F	A	N	N	N	N	N		N	N	F	F		N	M	N	N				N	N	N	X
10. Are existing boilers in need of a major controls upgrade or new energy-efficient burners?	N	A	A	A	M	N	X	A	N	A	F	N	X	X	M	A	N	M	N	N	N		F	M	N	A	X	M	M	N	M			F	N	N	X	N
11. Is "flash steam heat recovery" equipment installed on steam systems over **50 psig** and operating more than 4000 hours/year?	N	N	N	X	X	X	X	X	N	N		X	X	X		A	X	X	X	X			N	X	F	X	X	N	F	N	N				N	X	X	X
12. Are plate and frame heat exchangers installed in parallel with any chillers to allow for "free cooling" when conditions permit?	N	F	M	X	N	X	N	N	N	N	F	N	N	X	F	X	N	A	N	N	N		F	A	A	A	A	N	A	A	A	M	M	A	X	X	N	X
13. Do any existing chillers have a thermosiphon cooling cycle (free cooling cycle)?	N	N	N	N	N	X	N	N	N	N		N	N	X	X	M	X	F	A	X	N	N	N	A				N	N	F	N	N	N	N	A	X	N	N	X
14. Are air handler dampers fully functioning and controls and sequences in place to permit "air-side economizing" when outside air conditions permit?	M	A	M	M	M	A	A	F	A	A	F	A	M	M	M	A	A	M	N	A	A		A	N	M	A	M	N	A	A	A	F	F	M	M	A	A	X
15. Are air handler "chilled water coils" in large units (> 18,000 cfm and/or > 4 coil rows) in need of professional cleaning to restore coil heat transfer and maximize airflows for AHUs?	N	F	F	M	N	X	F	N	N	N	A	N	M	M	F	N	X	X	N	N	N		F	N	N	M	N	N	A	X	A	M	M	M	X	N	X	X
16. Do air handler sequences of operation include "CO_2 based demand controlled ventilation" strategies?	N	F	M	N	F	A	N	N	M	F	F	M	M	N	F	A	A	A	M		A		N	N	M	N	A	N	A	A	N			A	N	A	N	X
17. Is there a heat exchanger installed in the main chiller plant to preheat domestic hot water using condenser water leaving the chillers?	N	N	N	N	N	X	N	N	N	N	N	N	N	X	N	A	N	A	N	N	N		N	N	N	N	N	N	F	N	N	N	N	A	X	A	N	X
18. Do you take advantage of "evaporation credits" by properly metering cooling towers' make-up and blowdown in order to obtain credits on your sewer bill (applicable in many states)?	N	X	X	X	N	X	N	N	A	A	N	N	X	X		A	X	N	X	N	N		X	N	N	N	N	N	F	N	N	N	N	A	X	X	N	X
19. Are you using the building automation control system to implement time-based control strategies to turn off HVAC equipment when not needed (e.g. night time, low occupancy, space not used)?	N	M	F	M	X	M	A	N	M	N	F	F	A	F	A	A	M	A	A	F			M	N	M	A	A	N	M	A	N	F	F	A		A	A	X
20. Do you have small areas that are fed from a larger air handlers that prevent you from scheduling the large air handlers on/off due to ventilation requirements in the small areas?	N	F	F	F	M	F	A	N	M	M	F	F	M	F	F	N	N	F	N	N	X		X	A	F	F	N	A	F	N	N	F	F	N	N	F	N	X
21. Are kitchen hood exhaust fans interlocked with a control system with automatic ON/OFF or variable speed controls?	N	N	X	N	F	M	X	N	F	N	N	F	M	A	M	A	A	N	M	A	N		N	N	N	N	N	N	M	A	N	F	F	F	M	A	N	N

- Surveying property operators to see what energy conservation measures have been implemented is a good way to understand potential areas of opportunity
- Scaling low-risk, high-value opportunities allows for "quick-wins"

General High-Level Strategies

1. Operating Procedures
2. Lighting
3. Water Conservation
4. Basic Controls
5. **Retro-Commissioning – Deep Dive**
6. Demand Response
7. Building Shell Improvements
8. On-site generation



COMPLEXITY

Operational Improvements - Property Audits

Sample Approach:

- Evaluate the shutdown procedures for areas that are not open for business;
- Identify potential savings opportunities;
- Communicate findings to property leadership for appropriate evaluation, distribution and action

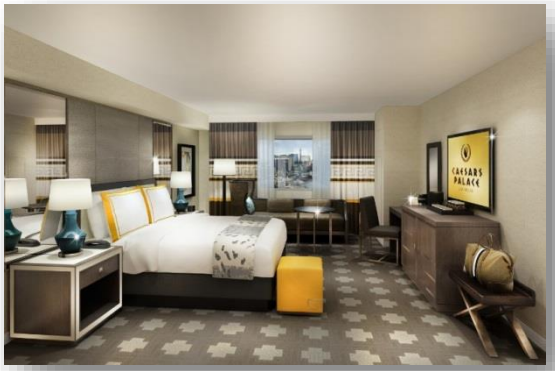
Audits conducted randomly between 1:00 am and 4:00 am

	Audit #1	Audit #2
Property 1	$24,638	$14,821
Property 2	$21,405	$12,197
Property 3	$22,085	$13,555
Property 4	$42,746	$16,256
Property 5	$14,351	$13,050
Property 6	$49,691	$36,495
Property 7	$19,003	$13,527
Property 8	$28,836	$18,303
Property 9	$32,916	$51,133
Total	**$255,671**	**$189,337**

Energy Efficient Lighting

LED MR16s

- Installed more than 100,000 LED MR-16 lamps
- Average energy savings per lamp was more than 80%
- Annual energy-cost savings of $1.2MM



LED T8

- Primary lighting in back-of-house, garages, cove lighting, etc.
- Approximately 500,000 lamps replaced to date
- 40-50% energy savings

Common Area PAR and R Lamps

- Replacing all CFL technology with LED
- Longer life lamps reduces R&M and labor expense

Guestrooms

- Adopted LEDs as a standard in new guestrooms

Note: Ballast and dimming compatibility are two important considerations.

Water Conservation

- Replaced standard washers at laundry facility with tunnel washers (60M gpy savings)
- Installed over 16,000 low-flow showerheads (2.5 gpm to 1.75 gpm)
- Adopted low-flow restroom fixtures as a standard:
  - ✓ Faucets - 0.50 gal per minute
  - ✓ Toilets - 1.60 gal per flush
  - ✓ Urinals - 0.13 gal per flush
- Educate customers (in-room programs/water on request)
- Xeriscaping and vegetation replacement with desert landscaping
- Water treatment and cooling tower sub-metering
  - Evaluate water use trends and quickly identify leaks or other malfunctions
  - Monitor cooling tower conductivity and blow-down to prevent water waste.

Basic Controls, Timers and Photocells

Stand-alone Analog T-stat

Digital T-stat with Integrated Occupancy

Networked Thermostat

- Installed more than 15,000 digital guest room thermostats
- Invested more than $3.4M in thermostat retrofits
- Annual energy-cost savings of $1.4M
- Expected annual energy savings exceeding 17.2 GWh

Retro-
Commissioning

DEEP DIVE

Types of Building Commissioning

1. **New Building Commissioning (Cx)**

   Method of risk reduction for new construction and major renovation projects to ensure that building systems meet design intent and operate optimally.

2. **Re-Commissioning (ReCx)**

   Process through which buildings are commissioned again as a check to ensure that systems are functioning as originally planned and constructed.

3. **Retro-Commissioning (RCx)**

   Commissioning applied to an existing facility, whether previously commissioned or not, to help the facility and its systems meet the Owner's current and anticipated future requirements.

4. **Monitoring Based Commissioning (MBCx)**

   Relies on measurements of energy use to diagnose problems, account for savings and help ensure that savings persist over time.

Why Retro-Commissioning?

- Operating requirements have changed
  - Spaces have been added, deleted or modified
  - Changes in internal loads
- Equipment has changed over time due to repair and replacement
- Systems and sensors are out of tune
- Controls and strategies are dated
- ***Building conditions have changed, owner requirements have changed, technology has changed***

Retro-Commissioning can help the facility and its systems meet the owner's current facility requirements - not necessarily the original design requirements – to improve operating efficiency and indoor comfort.

Some Benefits of RCx

Improved Occupant Comfort

- ✓ Indoor air quality
- ✓ Improved thermal comfort

Improved Building Operation

- ✓ Reduced maintenance calls
- ✓ Solutions to systematic problems
- ✓ Create benchmarks for efficient operations

Reduced Operating Costs & Decreased Energy Consumption

- ✓ Elimination of excessive equipment run times
- ✓ Replacement of malfunctioning equipment or sensors
- ✓ Optimization of controls sequences
- ✓ Extended equipment life

Typical Measures

- **HVAC Controls:** HVAC scheduling, temperature reset, chiller sequencing, etc.
- **Outside Air:** Demand control ventilation, economizing, rebalancing, etc.
- **Variable Frequency Drives (VFDs):** Variable flow for pumps, fans, etc.
- **System Repairs:** Control valves, damper actuators, sensors, compressed air leaks, insulation, etc.
- **Lighting Controls:** Occupancy sensors, daylighting, etc.
- **Miscellaneous:** Re-commissioning flat plate heat exchangers, optimizing chilled water distribution operation, etc.

Case
Study

Paris Las Vegas

Paris Hotel and Casino
RCx Case Study

Paris Hotel and Casino in Las Vegas

- 4.1 million square feet located
- 2,920 suites and hotel rooms
- 8,750 ton central chilled water plant
- Annual energy usage and cost
  - 61.5 million kWh of electricity
  - 185 million cubic-feet of natural gas
  - Cost of over $5.7 million

Originally opened in September 1999, the property has been modified and reconfigured over the years. This 2015 project targeted components of the heating, ventilation and air conditioning (HVAC) and control systems to improve energy efficiency and facility operations.

Paris Hotel and Casino
RCx Case Study

Measures Implemented

Central Chilled Water Plant:

- ✓ Conversion from constant primary-variable speed secondary chilled water distribution system to all-variable speed operation.
- ✓ Upgrade of existing proprietary controls system to open-protocol BACnet controls.
- ✓ Install a 1,200 HP variable speed drive on one chiller and sequence staging to allow its new efficient operation to be maximized.
- ✓ New dedicated controller to enable optimization sequences to:
  - Vary the primary chilled water flow through the chillers to match the building load.
  - Vary the condenser water flow through the chillers to reduce pump energy as loads drop.
  - Operate additional cooling towers to lower the condenser water temperature and reduce chiller power.

Paris Hotel and Casino
RCx Case Study

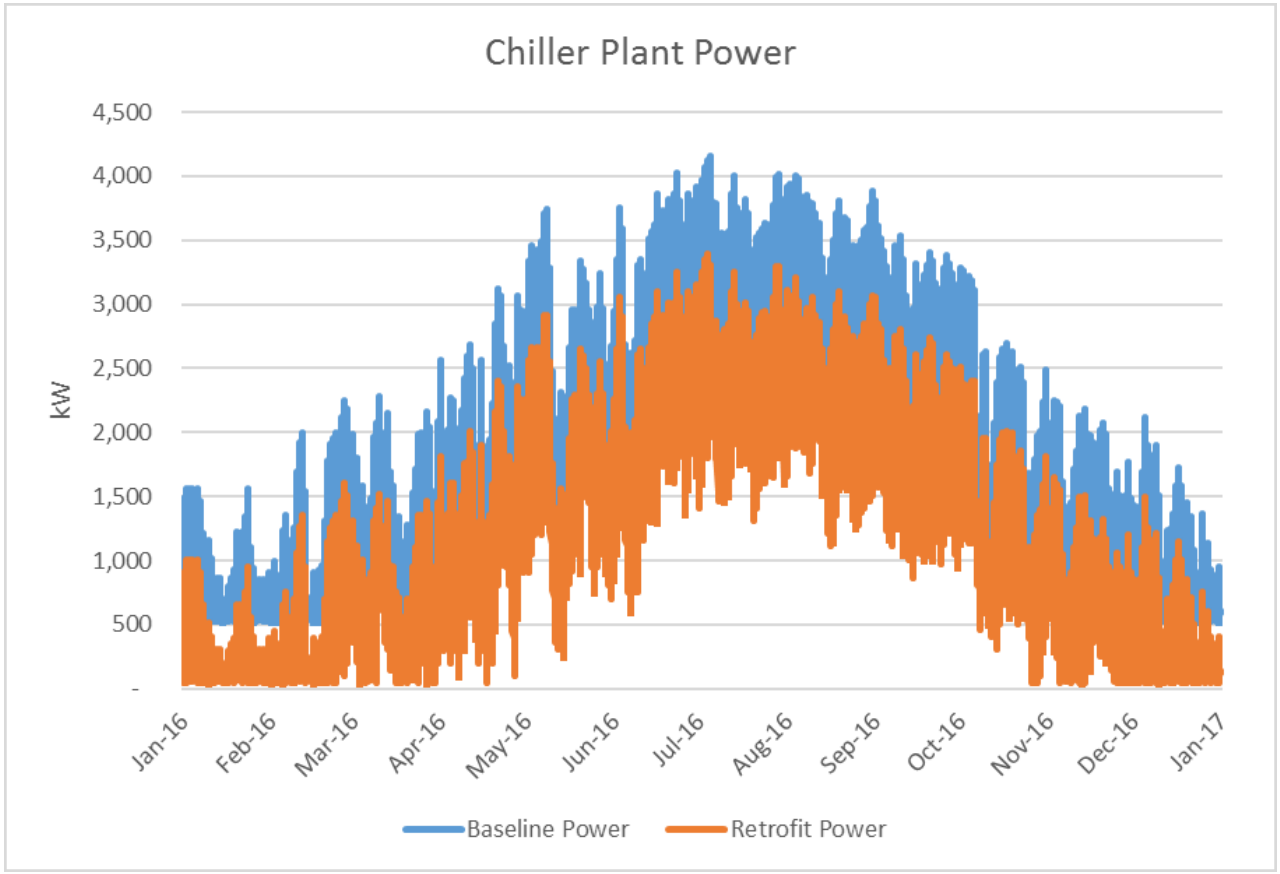
Measures Implemented

Air-side Systems:

- ✓ Upgrade and integrate older building global controllers into new BACnet platform for entire property.
- ✓ Air Handlers:
  - Install VFDs on single zone air handlers and modulate flow (saving fan energy) to match loads in building.
  - Modify AHU sequences during hot conditions to recirculate more building air and bring in less hot outdoor air and reduce chiller plant load.
  - Modify AHU sequences during cold conditions to bring in more outdoor air for “free cooling”, reducing chiller plant load.
  - Modify AHU sequences to deliver colder air which allows fans to run slower.
  - Install Belimo smart energy valves on four large AHU’s .

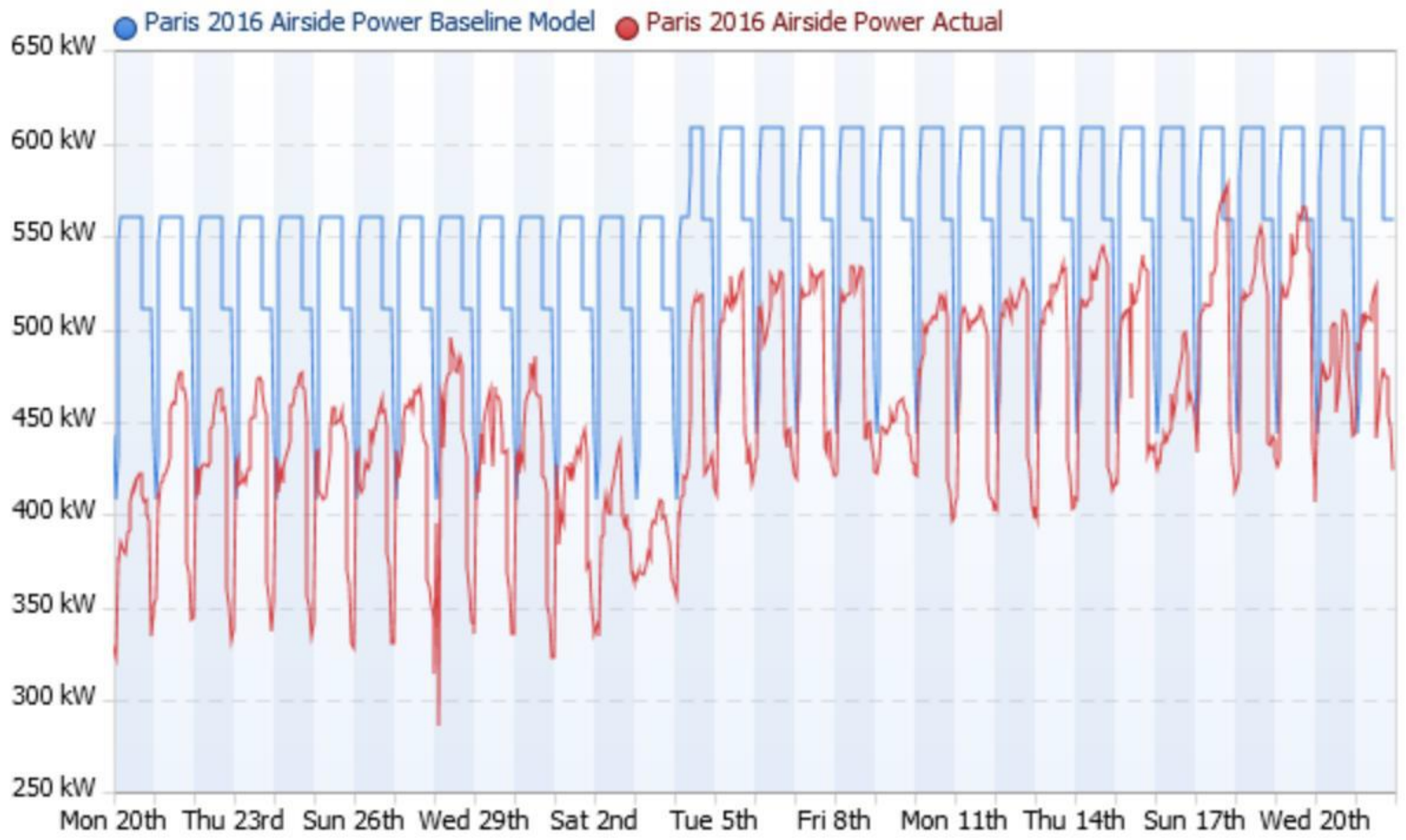
Paris Hotel and Casino
RCx Case Study

Chilled Water Plant Analysis – Post Retrofit



Paris Hotel and Casino
RCx Case Study

AHU Fan Power: Baseline vs Retrofit June-July 2016



Paris Hotel and Casino
RCx Case Study

Financial Information and Results

- Total project cost: $1.565 million
- Utility rebates: $233,421
- Annual savings:
  - 5.57million kWh
  - 108,740 therms
  - $483,700
- Simple payback on investment: 2.75 years
- Annual emissions reductions of 2,825 MTCO2e (metric tons of carbon dioxide equivalent)

Environmental Goals

Targets (2007 Baselines)		2017*	2020	2025
Energy	Reduce energy consumption (fossil fuel based) per air-conditioned 1,000 sq. ft.	22%	30%	40%
Greenhouse gas emissions	Reduce greenhouse gas emissions per air-conditioned 1,000 sq. ft.	35%	30%	40%
Water	Reduce water consumption per air-conditioned 1,000 sq. ft. (2008 baseline)	19%	20%	25%
Waste	Divert total waste from landfill	44%	50%	60%
Green Buildings	Achieve LEED certification for all newly-built and expanded properties owned by Caesars	100%	100%	100%
Sustainable Operations	Green Key certification for all hotel properties in North America	100%	100%	100%

2017 data is estimated and going through final verification which may result in slight changes.

Questions and Open Discussion

This concludes The American Institute of Architects
Continuing Education Systems Course

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