Optimize the Bottom Line with Facility Optimization

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HVS Eco Services offers a powerful facility optimization tool that provides hotel and restaurant facility managers the key performance indicators (KPIs) they need to effectively do their job. This analysis allows facility managers to make effective, well-guided business decisions that will have an easily quantifiable impact on their energy expenditure and carbon footprint. Not only does the analysis allow operators to compare normalized energy consumption across a portfolio of hotels to identify poor performers, it also identifies the root causes of poor performance, provides actionable guidance to rectify those causes, and quantifies potential savings associated with rectifying the causes of poor performance. Without such guidance, your facility managers must employ a trial and error method, which is a highly inefficient method of improving the environmental performance across a portfolio of hotels or restaurants. Since the HVS analysis clearly quantifies the potential savings that one could realize by correcting poor performance factors, operators can clearly prioritize capital expenditures and quickly address the problems that will yield the most significant savings.

Utility billing data is the primary source of energy information one has on their portfolio of hotels. While the data in hotels' utility bills is the starting point for any environmental performance analysis, these data points don't account for the variations in each hotel's unique characteristics such as size, design, climate zone of operation, and varying occupancy levels, nor do they provide any guidance on potential causes of poor performance. While detailed energy audits or interval submetering can help identify savings opportunities, they are costly and time consuming to apply across a portfolio of hotels or restaurants. Furthermore, audits don't normalize for all the unique characteristics of your hotels, preventing a true “apples to apples” analysis. The HVS Eco Services Facility Optimization tool is a cost-effective way to turn mountains of utility data into a roadmap to realizing significant utility savings. In addition to realizing notable utility savings, this tool is a cost-effective way to earn credits toward LEED and Ecotel certifications, by conducting ongoing measurement and management of utility consumption.

The analysis combines state-of-the-art statistical analyses of utility, weather, and occupancy data, and expert knowledge of hotel energy systems, and the unique operational complexities of hospitality operations. Excerpts from a recent analysis are provided below.

Case Study Excerpts

A recent analysis of fifteen of DEMO's full-service hotels located throughout many climate zones in the United States identified potential **savings of $1,053,726 per year - a 14% reduction** in annual energy costs (**Table 1**).

The hotels used a combined 59,766,092 kilowatt-hours (kWh) of electricity per year and 145,667 million Btu (MMBtu) of natural gas per year, for a total energy spend of $7,433,284 annually.

The analysis identified several potential energy and cost savings opportunities and identified the best- and worst-performing hotels in several energy-use categories. Typical benchmarking identifies only the overall best- and worst-performing hotels, but say nothing about why a hotel performs well or poorly. The multiple-hotel benchmarking technique identifies best and worst performers in distinct areas, lending insight into why hotels perform the way they do.

Table 1: Summary of findings and estimated potential savings

	Gas savings (MMBtu/year)	Electricity savings (kWh/year)	Cost savings ($/year)

Summary

A recent HVS Eco Services Facility Optimization analysis identified potential savings of $1,053,726 per year - a 14% reduction in annual energy costs for a portfolio of fifteen full-service hotels located in various regions across the United States.

Comments

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Hotel Operations
Environmental
Architecture & Interior Design
North America
United States

Past-performance benchmarking			
Address increasing gas use in Hotel M, Hotel G, and Hotel A	2,453	—	24,527
Address increasing electricity use in Hotel F and Hotel A	—	89,025	8,903
Subtotal	**2,453**	**89,025**	**$33,430**
Multiple-hotel benchmarking			
Improve worst gas space heating sites	10,995	—	109,953
Improve worst gas water heating and cooking sites	16,103	—	161,025
Improve worst air-conditioning sites	—	3,155,312	315,531
Improve worst variable-independent electric use sites	—	4,337,865	433,787
Subtotal	**27,098**	**7,493,177**	**$1,020,296**
Grand total	**29,551**	**7,582,202**	**$1,053,726**

Notes: MMBtu = million Btu; kWh = kilowatt-hours.

Results from Multiple-Hotel Benchmarking

Multiple-hotel benchmarking identifies the best and worst performers. As previously noted, typical benchmarking identifies only the overall best- and worst-performing hotels, but say nothing about why a hotel performs well or poorly. The multiple-hotel benchmarking technique identifies best and worst performers in distinct areas, lending insight into why hotels perform the way they do.

The analysis benchmarks gas use disaggregated into space heating and domestic hot water/cooking uses. Electricity is disaggregated into space heating, air conditioning, occupancy, and independent uses. Each benchmarked parameter was normalized for outdoor temperature. The parameter coefficients were then divided by hotel area to compare energy use on a per-square-foot basis. When calculating potential savings based on model parameters, we consider the 25th percentile to be the best-performer value. The best-performer value is what hotels are striving for and is the value we use to estimate potential savings for a given hotel.

Gas: Space Heating

Table 2 presents a prioritized list of gas space heating worst-performer hotels. For each hotel we note the likely reasons for high space heating gas use.

Table 2: Prioritized list of opportunities - gas space heating

Site	**Above-BP gas use**		**Areas for improvement**		
	MMBtu/year	**$/year**	**Temperature setpoint**	**Building envelope**	**Equipment efficiency**
Hotel A	55,832	55,832	++	+++	+++
Hotel F	54,121	54,121	—	+++	+++
Hotel I	32,086	32,086	+++	+	+
Hotel K	22,568	22,568	++	++	++
Hotel G	20,714	20,714	—	++	++
Hotel E	10,334	10,334	+	+	+
Hotel H	10,167	10,167	+	+	+
Hotel M	3,616	3,616	+	—	—
Hotel J	2,672	2,672	+++	—	—
Total	**212,110**	**$212,110**			

Notes: BP = best performer; +++ = very likely; ++ = likely; + = possible; — = unlikely; MMBtu = million Btu.

Action items to improve gas space heating efficiency include the following:

- Temperature set-point – Investigate occupied and unoccupied heating temperature set-points at the Hotel I and the Hotel J. Occupied heating temperature set-points should be no more than 70 oF and could be lower. Unoccupied areas should have much lower temperature set-points, many buildings may go as low as 60 or 55 oF.

- Building envelope – To maximize the performance of a hotel's building envelope, infiltration rates must be kept at an absolute minimum. Thermal imaging is a convenient, cost-effective way to identify areas in the hotel's envelope where air leakage is occurring. Once air leaks are found, they can be sealed using caulking, foam, or other inexpensive sealants. Revolving doors and airlocks can help to minimize infiltration rates, particularly in high-rise hotels that battle stack effect. Additionally, single-pane windows or low/no insulation will negatively impact the integrity of a hotel's building envelope.

- Equipment efficiency – For heating, poor equipment efficiency is likely due to either poor combustion efficiency of boilers or furnaces, or poor operating efficiency of the same equipment. Poor combustion efficiency is either due to excess air in the combustion mix, or corroded boiler tubes (if a boiler is in use). Thus, combustion efficiency should be tested at Hotel A and Hotel F during the next annual tune-up before the heating season. Poor operating efficiency can also be attributed to boilers which have on/off controls instead of modulation firing and this should also be considered.

Gas: Domestic Hot Water and Cooking

Table 3 presents a prioritized list of worst performers in normalized gas domestic hot water and cooking (DHW/C) use. Prioritization is based on the energy savings potential of upgrading the DHW/C gas use to the best-performer operation.

Table 3: Prioritized list of opportunities - gas, domestic hot water and cooking

Site	Above-BP gas use		Areas for improvement	
	MMBtu/year	**$/year**	**DHW**	**Cooking**
Hotel F	84,210	84,210	+++	+++
Hotel K	76,815	76,815	+++	+++
Hotel A	71,190	71,190	++	++
Hotel E	39,300	39,300	++	++
Hotel G	5,250	5,250	+	+
Hotel H	630	630	+	+
Hotel J	0	0	—	—
Hotel I	0	0	—	—
Hotel M	0	0	—	—
Total	**277,395**	**$277,395**		

Notes: BP = best performer; +++ = very likely; ++ = likely; + = possible; — = unlikely; MMBtu = million Btu.

Electricity: Air Conditioning

The main building parameters that affect air-conditioning electricity use are the building cooling changeover point (Ccp) and the cooling slope (CS) of the hotel shell and equipment.

Table 4 presents a prioritized list of air-conditioning electricity worst-performer hotels. Prioritization is based on the energy savings potential of upgrading the hotel to the best-performer Ccp and CS performance. For each hotel we note the likely reasons for high air-conditioning electricity use.

Table 4: Prioritized list of opportunities - electric air conditioning

Site	Above-BP electricity use		Areas for improvement		
	kWh/year	**$/year**	**Temperature setpoint**	**Insulation / infiltration**	**Equipment efficiency**
Hotel B	1,790,247	179,025	++	+++	+++
Hotel A	785,577	78,558	+++	++	++

Hotel N	579,489	57,949	+ +	+ +	+ +
Hotel J	431,488	43,149	+ + +	—	—
Hotel K	347,528	34,753	+ +	+	+
Hotel I	329,053	32,905	+ + +	—	—
Hotel L	268,650	26,865	+	+ + +	+ + +
Hotel F	200,130	20,013	+ +	+	+
Hotel E	195,345	19,535	+	+ +	+ +
Hotel C	50,135	5,013	—	+ +	+ +
Hotel G	45,079	4,508	+	+	+
Hotel H	40,502	4,050	—	+ + +	+ + +
Hotel M	15,791	1,579	+	+	+
Hotel D	0	0	—	—	—
Total	**5,079,012**	**$507,901**			

Notes: BP = best performer; +++ = very likely; ++ = likely; + = possible; — = unlikely; kWh = kilowatt-hours.

Action items to improve electric air conditioning efficiency include the following:

- Temperature set-point – Investigate occupied and unoccupied cooling temperature set-points at Hotel A, Hotel J, and Hotel I. Occupied cooling temperature set-points should be no less than 72 oF and could be higher. Unoccupied areas should have much higher temperature set-points, many buildings may go as high as 80 oF.

- Insulation/Infiltration – Similar to improving gas space heating efficiency, reducing infiltration rates is crucial to realizing an improvement in electric air conditioning efficiency. Air leaks around windows and doors, and tiny cracks in the building can contribute to increasing infiltration rates. We recommend that a thermal imaging analysis be conducted at Hotel B, Hotel L, and Hotel H to identify and repair any points of infiltration. As previously noted, revolving doors and airlocks can help to minimize infiltration rates, particularly in high-rise hotels that battle stack effect. Additionally, single-pane windows or low/no insulation will negatively impact the electric air conditioning efficiency. Even if hotels do have double-pane windows, window films should be installed because they reduce cooling loads, improve shatter resistance, block up to 99 percent of ultraviolet radiation, and reduce glare. Temperatures near the windows are reduced as well, which increases occupant comfort. Typical films have a total thickness of 0.001 to 0.004 inches. They are made with a variety of adhesives and can be applied on-site to single- or double-glazed windows, usually to the inner surface, facing the room. Some of the early window film products suffered from problems with film fading, color shift, installation difficulties, and poor adhesive performance. Those difficulties have largely been solved with the newest products and application techniques. Payback periods of less than three years have been reported.

- Equipment efficiency – For cooling, poor equipment efficiency is likely due to either the age of the conditioning equipment, economizer functionality and/or fan and pump controls, or the type of equipment itself. Air-conditioners and chillers can have a variety of efficiency ratings such as EER, SEER, COP and IPLV. That said, most efficiency ratings have improved over time and newer equipment is likely to be much more efficient. For some equipment, economizing (or using outdoor air for cooling when the situation warrants) can reduce or eliminate the need for mechanical cooling. Cooling is likely distributed to the facility with either pumps or fans. Pumps and fans can be controlled inefficiently with cycling, throttling valves or inlet/outlet vanes. Variable frequency drives (VFDs) are a more efficient method of control. Finally, the type of equipment may itself be more or less efficient. For example, a centralized water-cooled chiller system may be much more energy efficient than "PTAC" units in each hotel room.

<u>Electricity: Independent</u>

Table 5 presents a prioritized list of worst performers for variable-independent electricity use. Prioritization is based on the energy savings potential of upgrading the variable-independent energy use to the efficiency of a best-performer operation.

Table 5: Prioritized list of opportunities - variable-independent electric use

Site	Above-BP electricity use		Reasons for poor performance	
	kWh/year	$/year	Equipment efficiency	Poor controls/part-loaded equipment
Hotel A	1,559,385	155,939	+ + +	+ + +
Hotel C	1,473,240	147,324	+ + +	+ + +
Hotel D	1,305,240	130,524	+ + +	+ + +
Hotel B	1,246,864	124,686	+ +	+ +
Hotel E	1,121,550	112,155	+ +	+ +
Hotel F	806,085	80,609	+ +	+ +
Hotel I	409,860	40,986	+	+
Hotel G	272,265	27,227	+	+
Hotel J	251,550	25,155	+	+
Hotel K	54,203	5,420	+	+
Hotel N	0	0	—	—
Hotel L	0	0	—	—
Hotel H	0	0	—	—
Hotel M	0	0	—	—
Total	**8,500,242**	**$850,024**		

Notes: BP = best performer; +++ = very likely; ++ = likely; + = possible; — = unlikely; kWh = kilowatt-hours.

Action items to improve variable-independent electricity use include the following:

- Equipment efficiency – Lighting, vending machines, and miscellaneous office equipment are the primary consumers of variable-independent electricity in a hotel. Lighting is the most intensive consumer of electricity by a significant margin. A variety of lighting techniques can be used to provide efficient lighting throughout hotel.

  - **Daylighting**. Natural daylight has been shown to improve a hotel's indoor environment while reducing energy use and peak demand. Whenever possible, any lighting renovation should start by using daylighting as much as possible and reducing electric lighting accordingly. Good daylighting design will not introduce excessive heat gain, heat loss, glare, or uneven illumination. Daylighting controls in lobbies can improve lighting quality while reducing energy costs. Hotels have also used clerestories and tubular skylights to provide daylighting in hallways, lobbies, and guestrooms.

  - **Compact fluorescent lamps (CFLs)**. In guestrooms, CFLs are becoming the standard for table, floor, and reading lamps, and in recessed and vanity lighting in the bathroom. CFLs reduce energy use by two-thirds and yield savings of up to $20 per lamp per year. Many hotel public areas, including corridors and hallways, can use CFLs in wall sconces and in recessed downlights. During renovations or when buying new table or floor lamps, consider fixtures designed to accept only CFLs so that maintenance staff cannot accidentally relamp them with incandescents.

  - **Light-emitting diodes (LEDs)**. In hotel restaurants and lounges, LEDs are frequently used to create specialized lighting effects. LEDs can also provide an accent to exterior arch elements and facades and can serve as nightlights in guestrooms. Using LED exit signs is also a proven energy- and labor-saving measure that can pay for itself in one year.

  - **Outdoor lighting**. For parking lots and outdoor applications, any incandescent or mercury vapor lighting should be replaced with something more efficient. High-pressure sodium and metal halide are the most common choices, but fluorescent lighting is often a more efficient option. In parking garages, which often use inefficient high-intensity discharge fixtures, high-efficacy fluorescent fixtures can provide more even illumination with fewer fixtures. Fluorescent lamps should be enclosed when used outdoors in cold climates.

Induction lamps are another possibility—they boast a very long life and are a good choice in hard-to-access areas. LEDs are also becoming a viable option, although they are currently expensive and will not be cost-effective for many applications. It's also important to avoid over-lighting outdoor areas. Most hotel parking lots offer far more lighting than levels required by local code. Using lower-wattage bulbs can actually increase the safety of your lot: an over-lit lot can be dangerous to drivers if their eyes cannot adjust quickly enough in the transition from highly lit to dark areas. Additionally, an over-illuminated exterior can negatively impact nocturnal species, and reduce guests' enjoyment of the night sky.

  - **Lighting controls**. Controls, typically occupancy sensors and scheduling systems, can also reduce lighting energy use. Occupancy sensors save energy and also help to reduce maintenance costs by lengthening the relamping interval. Turning fluorescent lights off for 12 hours each day can extend their expected calendar life by 75 percent, to nearly seven years. In large restrooms, ceiling-mounted ultrasonic occupancy sensors detect occupants around partitions and corners. For hallways, a recommended strategy is to use a combination of scheduled lighting and dimming plus occupancy-sensor controls after hours. Dimming lights in unoccupied hallways and stairwells, then turning them up to full brightness when someone enters is a sensible approach. Occupancy sensors are also appropriate for meeting rooms and back-of-house areas.

- Poor controls/part-loaded equipment – High temperature-independent use could also be attributed to appliances and equipment are simply left running when not in use. Part-loaded equipment means that fans, pumps, chillers or other equipment that is typically temperature dependent has poor part-load efficiency. For example, if a hotel is cooled with a chilled water loop, flow may be controlled with a bypass, which is inefficient. In such a situation, no matter the temperature and cooling requirements, the pumps draw the same amount of power, and are thus have poor part-load efficiency or control.

- Computers and office equipment – For hotel office spaces, a computer monitor can use two-thirds of the total energy of a desktop system, so it is important to power down monitors whenever they are not in use. The Energy Star Power Management program provides free software that can automatically place active monitors and computers into a low-power sleep mode through a local area network. Whole-computer power management can save $15 to $45 annually per desktop computer.

As illustrated in the case study excerpts presented herein, our analysis provides facility managers with a clear, prioritized action plan to quickly and efficiently improve the environmental performance of their portfolio. Utilizing this powerful tool allows operators to not only reduce utility expenditure and carbon footprint, but also document progress to stakeholders such as guests, employees, equity partners, lenders, and the municipalities in which the hotels operate.

Without the benefit of this analysis, facility managers have no true sense of which properties offer the greatest savings potential, and no clear way of measuring improvement or regression over time. The HVS Eco Services Facility Optimization analysis, which should be performed on an annual, or biannual basis, is designed for hotel or restaurant portfolios of three or more, located anywhere in the world.