Marriott Measurement and Verification Program

Step 2: Detailed Measurement and Verification (M&V)

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Evaluation of Pelican Wireless Guest Room Control System

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Contents

Appendix Sections:

- **Baseline Thermostat Settings**
- **Housekeeping Policy**
- **Additional Analysis Charts**

Disclaimer

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PROJECT SUMMARY

Marriott International is dedicated to energy efficiency and has a goal to reduce energy and water consumption 20% by 2020 from a 2007 baseline. As part of Marriott's energy efficiency efforts, energy saving products and services are frequently evaluated to determine whether they should be labeled as approved energy solutions for use in Marriott's global portfolio of buildings. This report summarizes the results of the Detailed M&V study including the expected energy savings and resulting economics.

The approved Marriott guest room technology is the guest room control system that utilizes a door lock, PIR sensor, and integration into the central reservation system. The Pelican technology being reviewed integrates with the central reservation system but does not utilize the door lock and PIR sensor. Therefore the business case must be approved against a baseline stand-alone thermostat system.

It was determined that there is sufficient energy savings available with an expected return on investment (ROI) of 44% which meets Marriott's target goals. Based on the results of the Detailed M&V for this product, it is **recommended** that the Pelican Wireless solution achieves the Marriott "Approved Energy Solution" status. However to become a full Marriott Approved Energy Solution, Pelican Wireless must develop an energy saving calculator to be used in the sales process. The energy calculator accounts for site specific conditions including (but not limited to): location (local climate), typical occupancy, building construction, and internal loads (people, ventilation, and plug). The calculator is used to determine a site's specific energy savings given their site specific conditions. Once this calculator has been developed and approved, Pelican can be listed as a Marriott Approved Energy Solution.

Additional information on the results of the Detailed M&V study is provided in the following sections of this report.

ENERGY CONSERVATION MEASURE (ECM) DESCRIPTION

Description of Product/Service

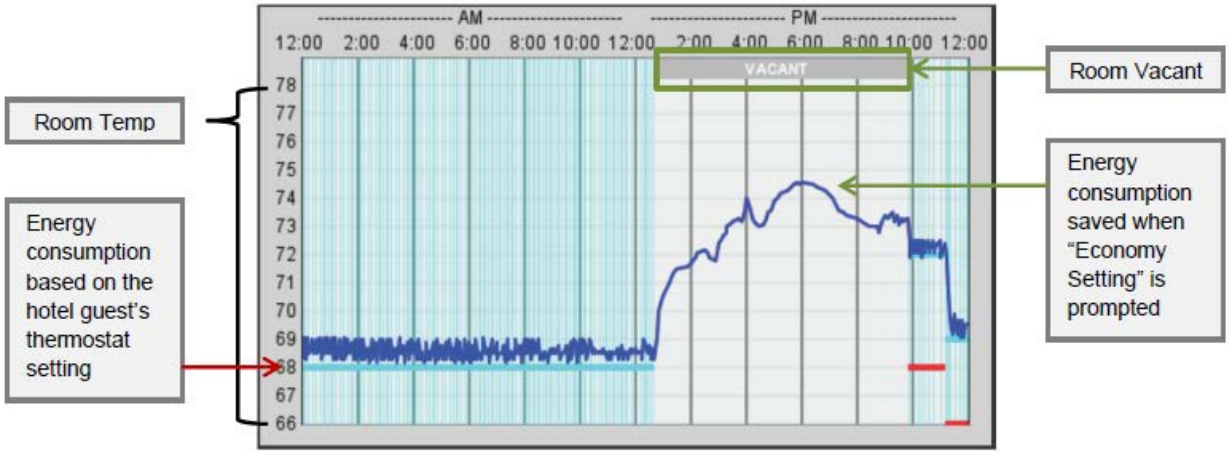
General Control

The Pelican Wireless System is a remote access, wireless HVAC (room temperature) control system for commercial applications. The Pelican hospitality product is a guest room temperature control system that connects with the central property management system (PMS). When the room is not rented, it can be put into a deep temperature set back/up mode. When the room is rented the temperature set point reverts back to a global set point and then can be controlled by the guest.

The room set point can be set from three different sources: by the guest, through the central property management system, or by a pre-programmed schedule. The guest can control the set point when the room is rented. A set point can be set through the PMS and changes when the guest checks in or out. The schedule source is an internal schedule pre-programmed into the thermostat that applies for unrented scenarios. Hotels have the ability to set and adjust set points in unrented rooms at different times of the day as well as shutting the system off. Selected set points can be more aggressive during times when

guests are less likely to be checking in. These set points and schedules can also be varied by location (orientation, floor, etc.) and by room recovery times.

Table 1 – Example of the Pelican Product in Use



The dark blue line shows the actual temperature of the room throughout the day.
The horizontal blue line shows the cool setting and the horizontal red line shows the heat setting.
The light blue vertical bars show the times when the HVAC unit was cooling the room to maintain the setting.

As can be seen in the graph, the guest who occupied the room had the thermostat set to 68°F during their stay and checked out of the hotel at 12:42PM. The Pelican system turned the HVAC unit off during the vacant time. Then at 9:51PM a guest checked into the room. The Pelican system immediately set the thermostat to maintain a Cool of 72°F and Heat of 68°F.

The thermostat is a dual set point (heat and cool) thermostat. The thermostat will automatically adjust the opposing set point to maintain a minimum 3-5°F deadband between the cooling and heating set points to reduce cycling between heating and cooling.

This product does not change thermostat operation when the room is rented (but unoccupied) like other guest room control systems. While this product does not capture the energy related savings of an unoccupied but rented room scenario, it is less expensive to implement than other typical guest room control systems since door contact sensors and occupancy sensors are not needed.

Technology/Components

All components of their product are manufactured, designed, and assembled by Pelican. The product consists of the following components:

- One gateway (per property, can handle up to 2000 components)
- One Property Management System interface (works with Marriott's FS PMS)
- Room hardware includes a thermostat (wired or wireless)
    - Wired requires 24 volts and 3 wires
    - Wireless utilizes a battery powered remote thermostat
    - Can also connect to line voltage of the HVAC unit to power a low voltage thermostat

The control system can be connected to balcony door (or window) sensors to turn the room unit off when the door is opened.

The table below breaks down the pricing used in these projects; these are average prices and can be adjusted for quantity. The prices below do not include installation fees; however the system can typically be installed using in-house labor.

There is an annual subscription fee that is required for the system to interface with the hotel's PMS. The subscription is free for the first year and is based on a per thermostat price for subsequent years. The subscription includes the following services:

- A real-time connection between the hotel's PMS and the thermostats. Guest control and pre-program scheduling come with the basic service, however a subscription is required to schedule via the PMS.
- Covers the server fee to access two years of historical trend data for every thermostat.
- Continuous monitoring of trend data (assist in optimizing system set points)
- Alert notifications (via email/text message) on individual room performance
- Weekly Performance Comparison Reports
- Unlimited admins and users
- Open ADR 2.0 functionality (in locations that want to opt into a Utility program)
- Software updates for all on-site products and for customer's server,
- Product support and assistance with global changes to thermostats setback settings.

Ongoing Optimization Services

As part of the installation, the Pelican team works with the facility team to optimize pre-programmed schedules and address individual room performance issues. Initially the team will start with a handful of pilot rooms programmed with general vacancy set points (74°F cooling and 68°F heating). They collect data (efficiency level of guest room HVAC units, recovery rate based on time of day, check-in times, and check-out times) and graph this data to work with the hotel's management to determine the optimal way to manage their economy settings based on their specific climate needs. Over time these set points are widened through a "watch then adjust" process until optimized. This process is applied to the remainder of rooms and typically takes over six months. The Pelican team also works with the facility team to identify "problem" rooms. This service is offered for the lifetime of the product.

Reporting Capabilities

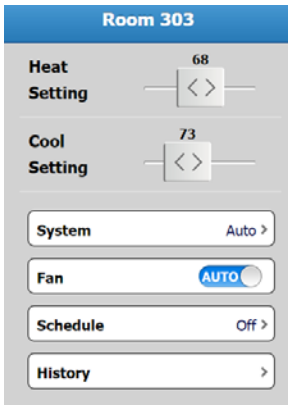
Pelican also incorporates real-time data reporting of all guest rooms through a web browser that allows data to be viewed from any computer or mobile device. The following is a summary of information provided:

- Unit Performance Information - Two years of data is available through the management system/dashboard or web browser. (see Table 3 below for an illustration)
    - Central rented/unrented status
    - Actual temperature and the selected temperature set point
    - Unit status (auto, on/off, heat, cool)
    - Set point source (station = user, remote = central reservation system, schedule = pre-programmed schedule)
    - Window or balcony door status
- Energy and Cost Saved – this information is available, alongside the Unit Performance Information, for individual rooms. Energy and cost savings can also be rolled up by floor, area, and up to the property level. The approach to calculating these energy savings is explained in the "Energy Savings Methodology" section below.
- Performance Comparison Reports - these reports are sent to the identified facility manager every week (see Table 4 below for an illustration)
    - Report summarizes how one room compares to other rooms
        - A performance rating for each room HVAC unit is calculated using unit run time and the number of degrees of temperature change during that cycle
        - Based on those calculated performance ratings, the rooms are ranked from 1 to 10 (with a ranking of "1" indicating the worst performers and "10" being the best performers)
        - The estimated energy savings listed is for the report period (date at the top of the report)
- Performance notifications - alerts can be sent via text, email, or on the management system
    - If the room temperature is moving away from the set point
    - If the room remains 3°F from the set point for more than an hour

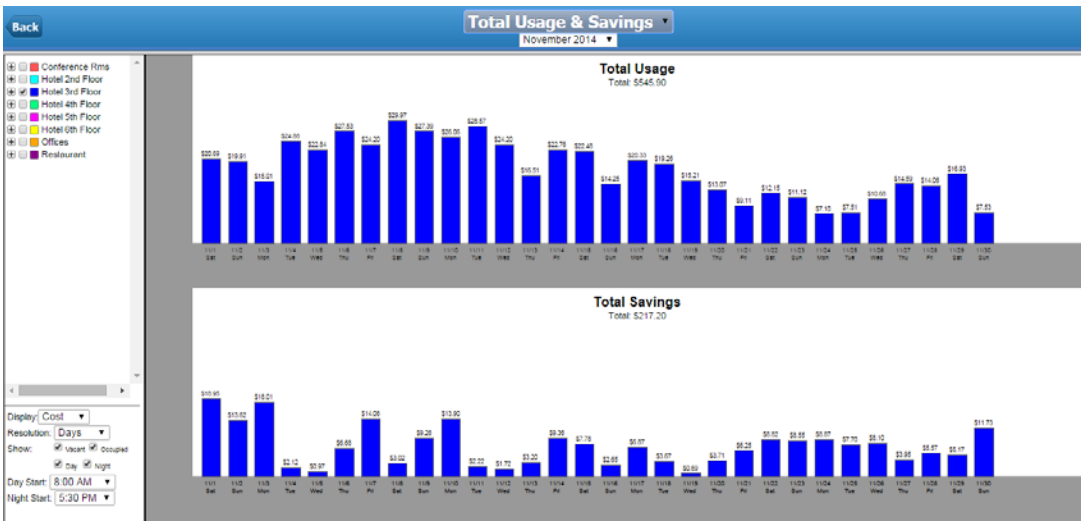
This information can be used to monitor room operation, prioritize maintenance activities, and optimize room set point schedules.

Table 3 - Performance Information Displayed Through the Management System

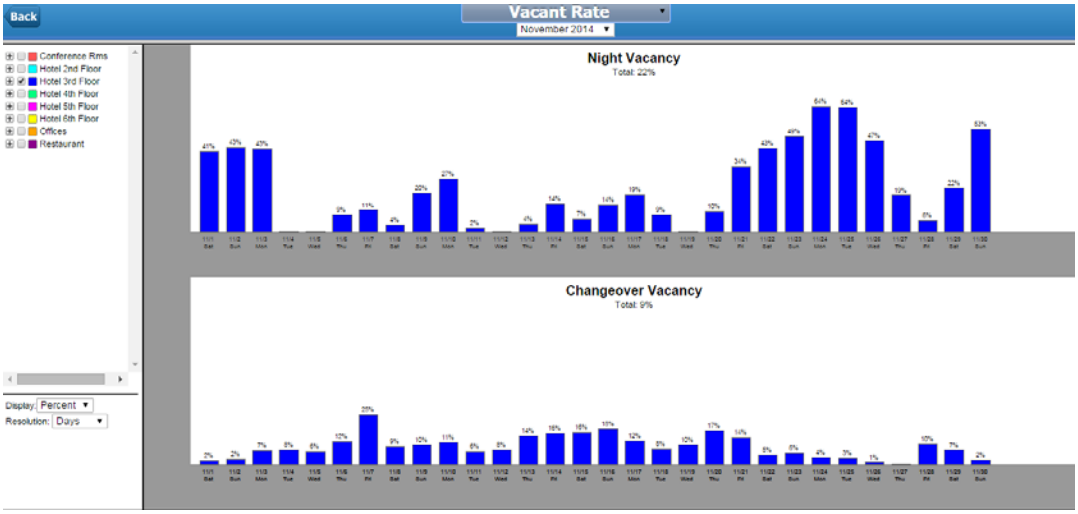
Ability to review occupancy, setting, and system status of any room



Ability to drill down to each room to see heating and cooling set points, system and fan status, schedule status, and the link to historical data.



Cool, heat, and total usage and savings can be display for a selected room/floor/building.



Vacancy rates can also be displayed for any given room/floor/building.

Table 4 - Performance Comparison Reports

Performance Comparison Report

July 25, 2011 - July 31, 2011

Location	Performance Rating	Potential Energy Recovery (Kwh)	Potential Savings
Room 227	1	229.7	$28.71
Room 438	1	352.4	$44.06
Room 224B	1	160.3	$20.04
Room 534	1	287.5	$35.94

Product Guarantee

There is a six month money back guarantee if the client isn't happy with the product or the predicted energy savings are not achieved.

Energy Savings Methodology

Energy Savings Basis

Energy is saved by allowing for a lower heating/higher cooling temperature set point when the room is not rented. This results in reduced room HVAC operation during unrented time periods. The variation in energy savings that can be achieved is based on some of the following variables:

- Property location (climate)
- Property occupancy levels
- Room HVAC unit operational efficiency
- Room loads - affected by building envelope and room plug loads (equipment)
- Baseline thermostat and set point (control) policy

Since the guest has full control of the thermostat setting when the room is rented, the baseline scenario (in terms of the existing thermostat, programming, and standard housekeeping practices/policies) must be considered when evaluating the business case for this technology.

Sales Process

Energy savings is estimated during the proposal process using the following process:

- Annual electric energy usage (kWh) and an energy rate ($/kWh) is collected. Gas usage can be collected if requested by the client.
- An average occupancy rate, average stay (number of nights), and average hours unoccupied due to changeover (hours between when a guest checks out and when a new guest checks in) is collected.
- The guest room energy is estimated as a percentage of the total property's annual energy. To be conservative, an estimate under 20% is always used.
- The total vacancy rate is calculated as (1 – average occupancy rate) + ((average occupancy rate/average stay) * (average hours unoccupied/24))
- The total vacancy rate is multiplied by the guest room energy to get energy and cost saved.

The current baseline condition (whether the hotel has pneumatic thermostats, programmable thermostats, etc.) is not factored into the savings estimate.

Baseline Energy Savings

The Pelican package includes another reporting feature: measuring and verifying energy savings (after the installation is completed) between rented and unrented rooms. Energy savings are calculated as the difference between the energy that would have been consumed had the thermostat been left at the setting the guest had been using and the energy consumed at the "economy setting" (setback/up conditions). Since each room in the property is individually monitored, Pelican utilizes data from similar rooms to establish an average baseline usage. The appendix includes a write-up on the effect of a housekeeping policy on energy savings. This process is described below:

- An individual (vacant) room's baseline usage or "guest rate of consumption" is calculated. This is captured as a HVAC unit's runtime usage in minutes.
  - The guest rate of consumption is the energy that would have been consumed had the thermostat been left at the guest setting during the vacancy period.
  - For each vacant hour, rooms similar to the individual room are used to establish a baseline room. A "similar" room is defined as an occupied room having the same set point, size (ft^2), and HVAC unit size. The number of similar rooms used in a baseline calculation will vary based on set point and time of day. Obviously a larger sample size (see the suggested sampling table below) improves the baseline accuracy and minimizes the effect of orientation, envelope differences, and room internal loads on this calculation. If there are no similar rooms, then the potential energy savings for that that room is not counted.
  - An average performance rating is calculated for the "similar" rooms as well as the baseline room. The performance rating is the "rate of temperature change" which is defined as the

number of degrees of change (during a run cycle) divided by the time to make that change (run time of that cycle). For example, if during the cooling cycle the temperature dropped by 0.5°F and the cycle ran for 3 minutes, the rate would be 0.5/3 = .1667 degrees/minute. This is calculated for heating and cooling operation. If the unit is off or if only the fan is operating, then that room is not counted in the energy calculation.

- The baseline run time is calculated by averaging the run times of similar rooms and adjusting for differing performance ratings
- *Weighted Run Time = Actual Run Time + ((Average Performance / Actual Performance) * Average Unrented Run Time) - Actual Unrented Run Time*. Where "average" is considered to be the average of similar occupied rooms, "actual" is defined as the actual vacant room, and "unrented run time" is defined as the run time for the portion of the hour the room is unoccupied (partial hours or partial fractions are accounted for in these numbers). The exceptions are:
  - if the Room was Rented, then *Weighted Run Time = Actual Run Time*
  - else if (Average Performance / Actual Performance < 0.5), then *Weighted Run Time = Actual Run Time + ((0.5 * Average Unrented Run Time) - Actual Unrented Run Time)*
  - else if (Average Performance / Actual Performance * Average Unrented Run Time <= Actual Unrented Run Minutes), then *Weighted Run Time = Actual Run Time*

- The actual runtime is known during the vacant scenario, using the setback conditions as chosen either by the pre-programmed schedule or through the central property management system
- The energy savings (kWh) is the difference between the baseline and actual runtimes multiplied by a pre-established kW factor.
  - Information is gathered on plant and equipment efficiencies. This information is either measured or taken from design/nameplate data and approved by the property's facility team.
  - Room unit fan power and either plant efficiency (chiller only, no balance of systems) or room unit cooling efficiency is included in the kW factor.
- Energy cost savings are calculated using an energy rate provided by the property or calculated from utility bills. This process is repeated for every room in the property to determine property level savings

The table below summarizes suggested sample rates, given a certain population size, to achieve specified confidence and precision criteria.

Table 5 – Sampling Statistics[1]

Precision	20%	20%
Confidence	80%	90%
Z-Statistic	1.282	1.645
Population Size	Sample Size	
100	10	15
150	11	16
200	11	16
300	11	17

[1] Table taken from IPMVP/M&V Guideline for Federal Energy Projects - Appendix D Sampling Guidelines.

DETAILED M&V TEST PROCEDURE

Monitored data for the following three properties were used in this review:

- Renaissance Aliso Viejo Hotel in Aliso Viejo, CA
  - 174 rooms (165 of the 174 rooms are identical size and HVAC size)
  - The property retrofitted all of the current guest room thermostats (digital, stand-alone, non-programmable thermostats w/ auto switchover) with Pelican's solution.
  - Each guest room has its own WSHP supplied by a 2-pipe water loop system.
  - The hotel did not have a housekeeping policy in regards to changing the thermostat setting
  - Installation was completed and system was active by June 2012
- Sheraton Memphis Downtown Hotel in Memphis, TN
  - 605 rooms (all the same size and HVAC size)
  - The property retrofitted all of the current guest room thermostats (digital, stand-alone, non-programmable thermostats w/ auto switchover) with Pelican's solution.
  - Each guest room has its own WSHP supplied by a 2-pipe water loop system.
  - The hotel did not have a housekeeping policy in regards to changing the thermostat setting
  - Installation was completed and system was active by April 2014
- Hilton Concord in Concord, CA
  - 341 rooms (all the same size and HVAC size)
  - The property retrofitted all of the current guest room thermostats (80% of the rooms had digital, stand-alone thermostats while the other 20% were being controlled directly at the PTAC unit[2]) with Pelican's solution.
  - Each guest room has its own heat pump PTAC unit with electric heat.
  - The hotel did not have a housekeeping policy in regards to changing the thermostat setting
  - Installation was completed and system was active by August 2012

Data Analysis and Observations

Detailed data, on three minute intervals, was provided for three months (April 1st through June 30th, 2014) for every room in the first two properties to illustrate that the technology indeed affects the room set point and unit operation as described. The following outlines the points that were monitored pre and post implementation of the retrofit:

Table 6 – Monitored Points

Point and Location	Information obtained
Tag information	Room number, floor # (location)
Room status	Rented or unrented status
Temperature	Room temperature

[2] The thermostats were installed as part of a PG&E program. The thermostats also contained motion sensors; however the hotel had deactivated them due to a high number of complaints. Additionally, due to the poor installation of these thermostats and the related wiring, many thermostats stopped working properly (~20%). So the hotel engineers started removing them and using the integrated PTAC thermostat.

Point and Location	Information obtained
Set points	Cooling set point and heating set point
System status	Auto, off, heat, cool
Fan status	Auto, on (continuous operation)
Set point source	Remote (PMS), station (user), scheduled (pre-programmed)

Sheraton Memphis Downtown

Some specific property installation/control notes are included below:

- April to Mid-June vacant guest rooms set to (in general):
  - 3:00pm – 11:00pm : 60°F Heat & 78°F Cool
  - 11:00pm – 3:00pm : OFF
- Mid-June to September, the hotel began a major renovation on the guest rooms. Three to five floors were renovated at a time: Pelican was requested by the hotel's engineering to set thermostats on these floors to the settings described below:
  - Non-renovated floors: same setback as prior months
  - Renovated floors: always ON at 72°F Cool
- October to November, due to HVAC water loop issues, Pelican was requested by the hotel's engineers to set ALL vacant guest room thermostat to 73°F Cool with no setback strategy. However Pelican worked with the engineers to develop a setback strategy that allowed the hotel to save energy, while helping reduce the negative impact the faulty water loop system was having on guest comfort. Pelican encouraged the facility team to setback the temperatures between 5:00pm-5:00am (adequate recovery times were ensured) and to implement a three hour temperature roll down process at 5:00am to reduce demand on the water loop system.
  - 5:00pm – 5:00am: 76°F Cool
  - 5:00am – 6:00am: 75°F Cool
  - 6:00am – 7:00am: 74°F Cool
  - 7:00am – 5:00pm: 73°F Cool

The charts below show the system in operation at the Sheraton Memphis hotel. When the room is rented, the guest controls the set point and the HVAC unit operates to maintain that set point. When the room is vacant, the set points adjust based on the source and the HVAC unit turns off. This particular room shows the variability that can be programmed into the schedule's set points. The graph also illustrates that when a room becomes rented, the "remote" (PMS selected point) immediately changes to a comfort (pre-set) setting so the guest arrives in a room with a properly maintained climate. The graph also shows an example of the cleaning crew overriding the thermostat setting; after 30 minutes the system confirms the rental status and if the room is still showing as vacant then the scheduled (or remote specified) set point is returned.

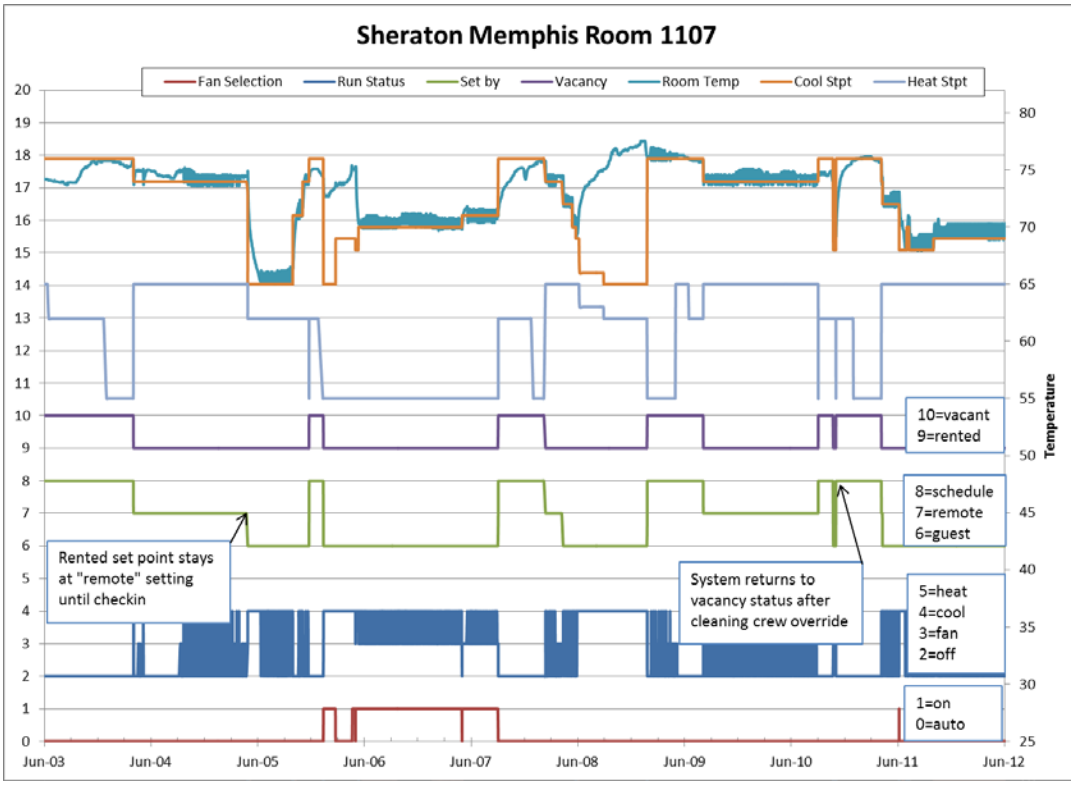


Figure 1 – Sheraton Memphis Operation

Renaissance Aliso Viejo Hotel

Some specific property installation/control notes are included below:

- 2013 and 2014 vacant guest rooms set to (in general):
  - OFF; because of a very mild climate and quick recovery rates, the hotel is able to successfully use a single economy setting of OFF.

The chart below shows the average room temperatures in vacant rooms.

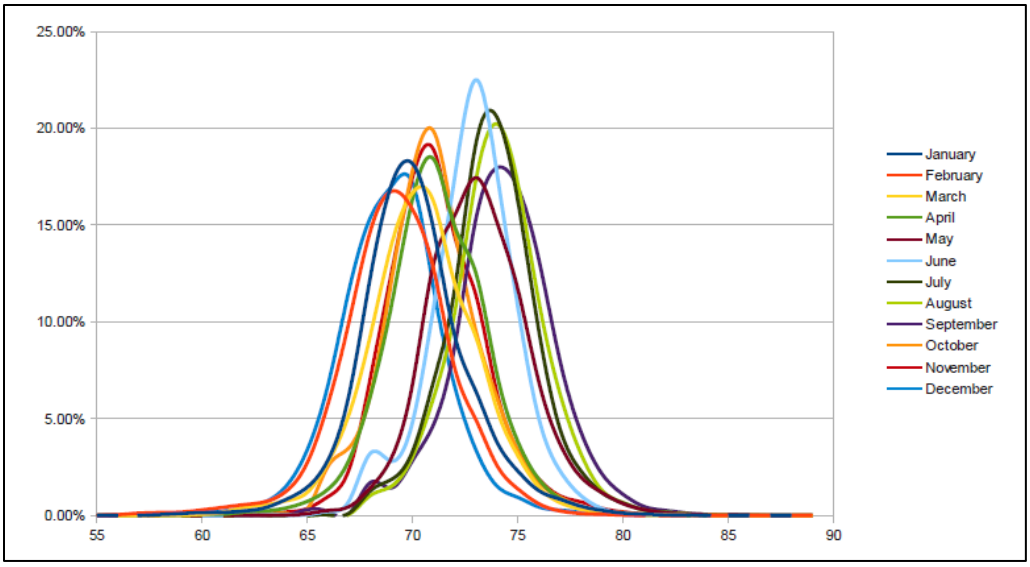


Figure 2 – Renaissance Aliso Viejo – Vacant Room Temperatures vs % of Time Occurrence

The charts below show the system in operation at the Renaissance Aliso Viejo hotel. When the room is rented, the guest controls the set point and the HVAC unit operates to maintain that set point. When the room is vacant, the HVAC unit turns off. The occupied (rented) set points are set remotely at 68°F (heating)/74°F (cooling) until the room is checked-in. The option to set the vacant set point through a pre-programmed schedule was not used on this particular room.

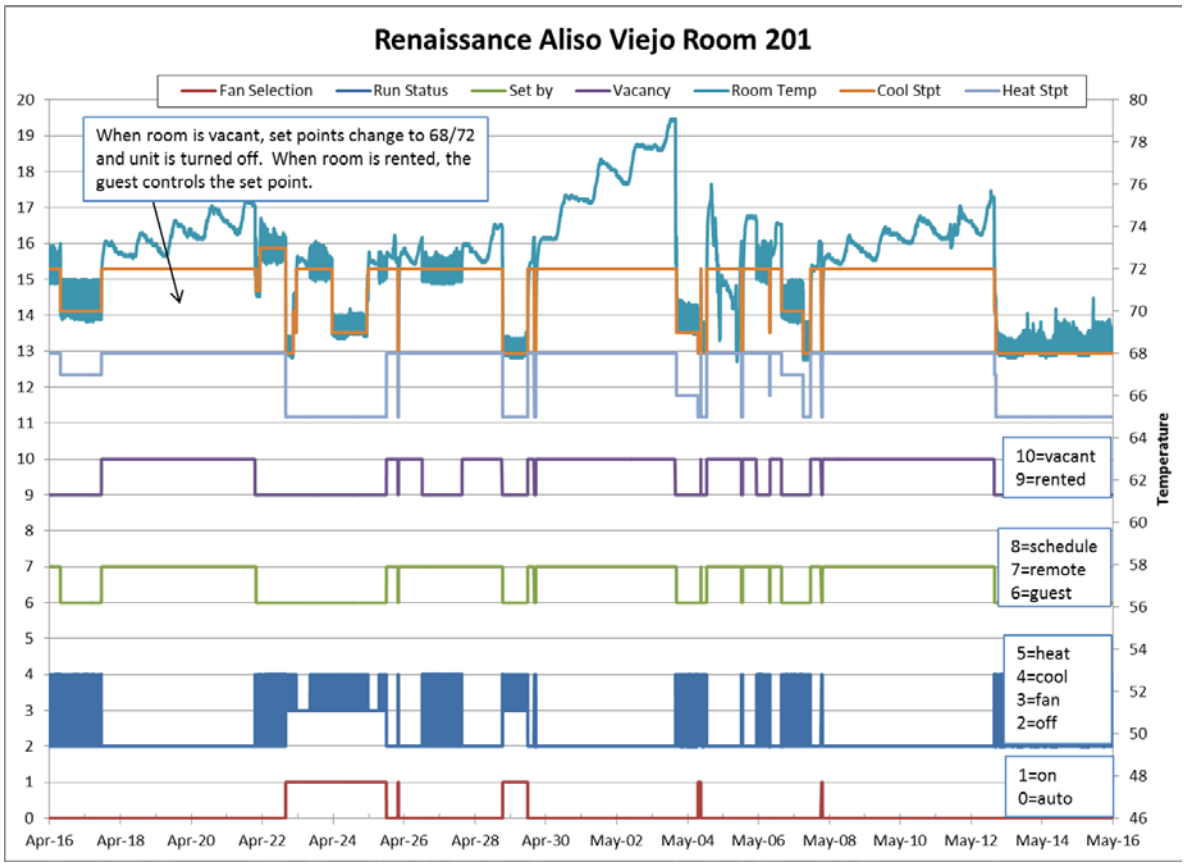


Figure 3 – Renaissance Aliso Viejo Operation

The chart below shows the recovery time to bring the vacant room to the set point.

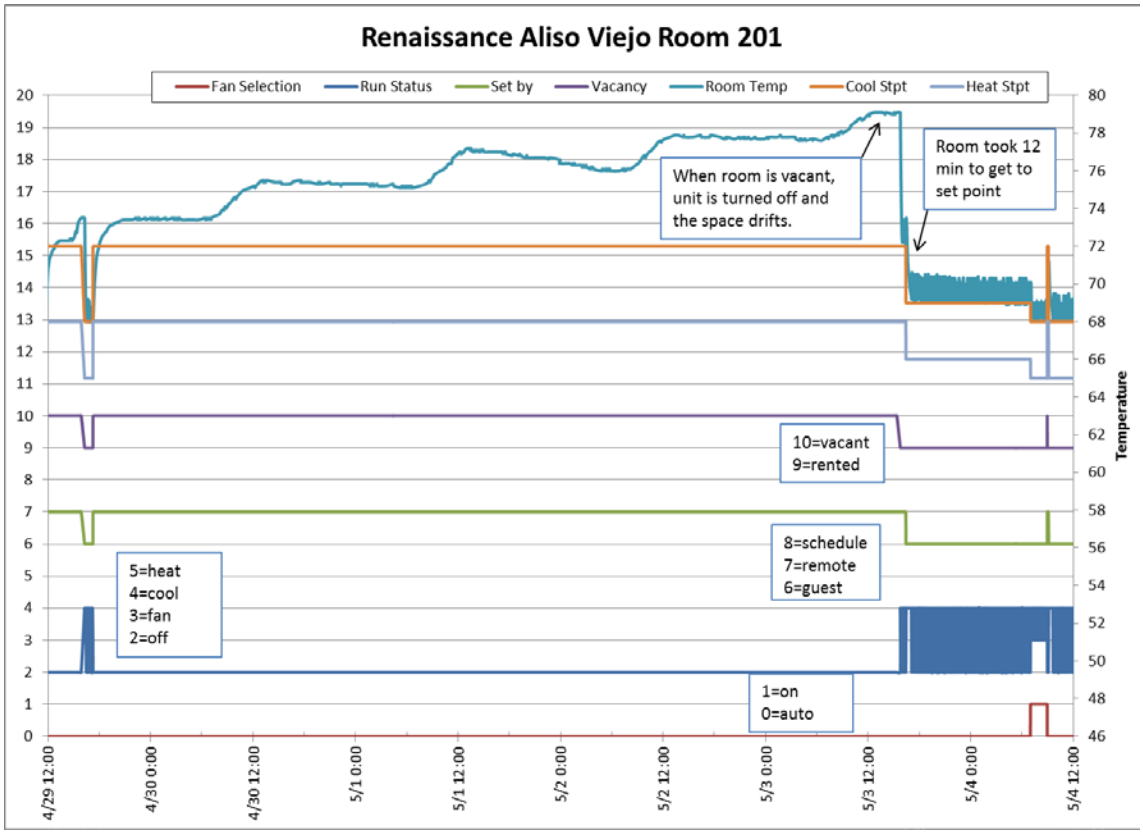


Figure 4 – Renaissance Aliso Viejo Operation

Hilton Concord Hotel

Some specific property installation/control notes are included below:

- vacant guest rooms set to (in general):
  - 74°F Cool
  - 64°F Heat

Energy Savings and Economics

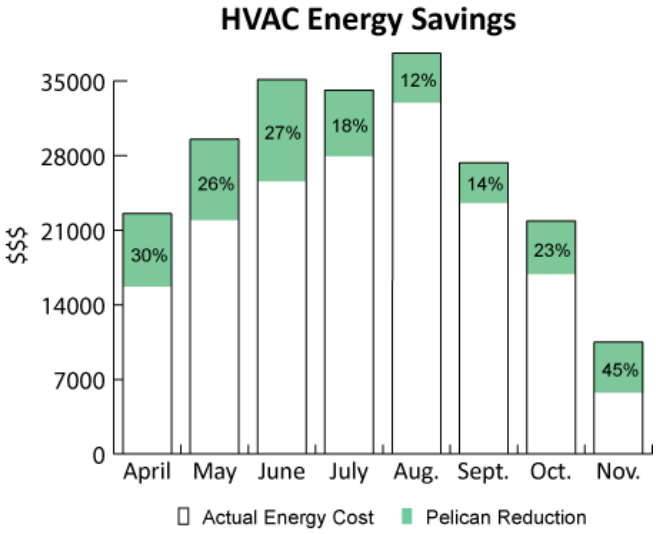
This section describes the energy savings as calculated for the various project phases (the methodology used to calculate energy savings for each process is explained in the "Energy Savings Methodology" section):

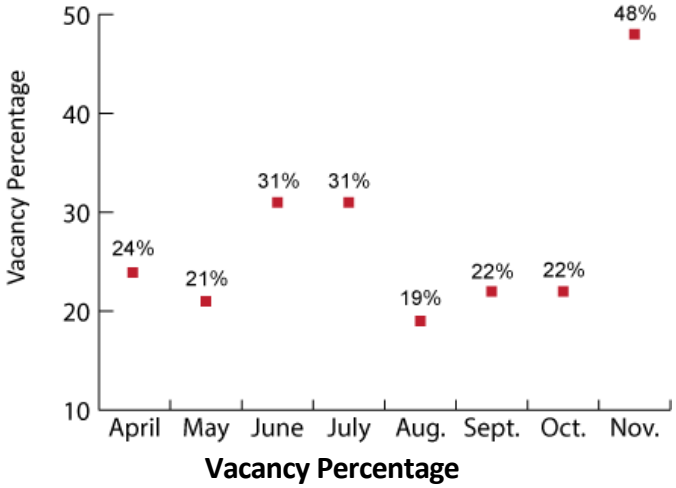
- Energy savings for the sales process
- The after installation energy savings (savings from comparing an unrented room to a rented room, both using the Pelican system; this scenario is assumed to have a similar results as savings from comparing the Pelican system to the prior standalone thermostat with no housekeeping policy)

Sheraton Memphis Downtown

During the sales process a savings of 692,095 kWh or $65,057[3] was estimated for this property. The savings estimate was calculated by apportioning 20% of the total facility electric use to guest room HVAC energy and applying the total vacancy rate of 40%. This savings translates to 40% of guest room electrical energy and 8% of the total property's electric usage. The total price for the retrofit was $99,575 which included a gateway, PMS interface, thermostats with humidity control for the 604 rooms, and the enhanced subscription service. This resulted in a 1.5 year simple payback. The cost per room was $165. The ongoing fee is $3.99 per year per thermostat ($2410 per year).

The after installation energy savings (savings calculated for an unrented room versus a rented room using the Pelican system) presented are summarized in this next section. The energy savings, for April to November 2014 (8 months), is $48,366 or 22% of guest room electric energy. The average vacancy rate for this period was 27%. While the vacancy rate was less than the vacancy rate assumed in the sales process analysis, the annual energy savings total would exceed the sales process savings by 11% (if this rate of savings continues for the next four months[4]). The resulting simple payback would be 1.4 years. The table below illustrates the details of the achieved savings[5].





Annual HVAC Energy Savings

[3] The following summarizes the inputs used to calculate this estimated savings: The energy rate used was $0.09/kWh. Total annual electric usage was 8,562,000 kWh. An average vacancy rate of 35% (occupancy rate of 65%) was used in addition to a 5% unoccupied level due to the changeover process.
[4] If this rate of savings continues for the next four months, the annual savings would be $72,549.
[5] The set points and system operation details were provided in the "Data Analysis and Observations" section. Additional information, on the calculation of energy savings, is provided in the prior section ("Energy Savings Methodology") and in the Appendix.

2014	April	May	June	July	August	September	October	November	Current Total (Average)
Savings	$6,851.12	$7,622.32	$9,524.80	$6,190.33	$4,647.87	$3,830.93	$4,990.24	$4,708.75	$48,366
Actual Energy Cost	$15,668.93	$21,926.40	$25,634.49	$27,968.10	$32,970.56	$23,520.23	$16,803.13	$5,789.41	$170,281
Percentage Saved	30%	26%	27%	18%	12%	14%	23%	45%	22%
Guest Room Vacancy	24%	21%	31%	31%	19%	22%	22%	48%	27%
Change-Over Vacancy	8%	8%	6%	5%	4%	4%	6%	4%	6%
True Vacancy	32%	29%	37%	36%	23%	26%	28%	52%	33%

Figure 5 – Sheraton 2014 Results

The hotel is currently experiencing comfort issues due to water loop temperature issues (the water source heat pumps are locking out due to high loop temperatures). Pelican provided additional services to the facility team to assist with identification of the problem (Pelican sent the hotel temperature sensors, thermostats, and a monitoring plan to collect data, free of charge, to assist the hotel team in diagnosing the loop temperature problems). They also worked with the facility team to optimize setback schedules to reduce the impact of these issues on guest comfort.

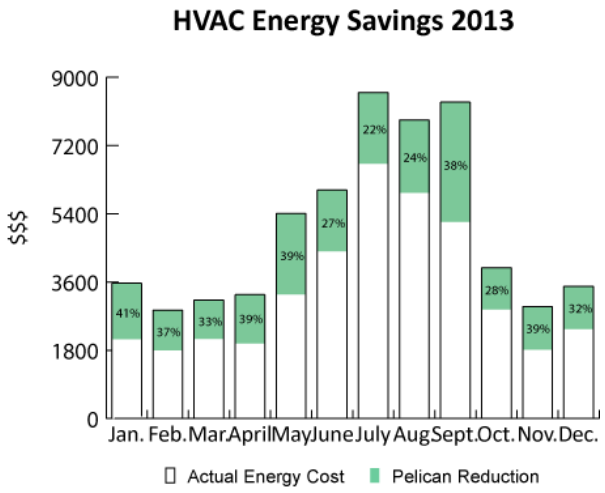
Renaissance Aliso Viejo Hotel

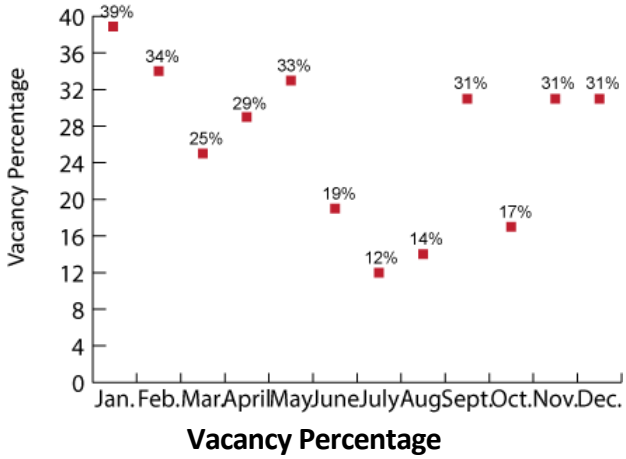
During the sales process a savings of 89,853 kWh or $12,542[6] was estimated for this property. The savings estimate was calculated by apportioning 10% of the total facility electric use to guest room HVAC energy and applying the total vacancy rate of 36%. This savings translates to 36% of guest room electrical energy and 4% of the total property's electric usage. The total price for the retrofit was $26,646 which included a gateway, PMS interface, thermostats for the 174 rooms, and the enhanced subscription service. This resulted in a 2.1 year simple payback. The cost per room was $153. The ongoing fee is $3.99 per year per thermostat ($694 per year).

The after installation energy savings (savings calculated for an unrented room versus a rented room using the Pelican system) presented are summarized in this next section. The energy savings for 2013 was $18,873 or 27% of guest room electric energy and 2014 (January through November) was $19,188 or 23%. The average vacancy rate for this period was 26% and 23% for 2013 and 2014 respectively. While the vacancy rate was less than the vacancy rate assumed in the sales process analysis, the annual energy savings total 2013 annual total exceeded the proposed savings by 50%. The resulting simple payback would be 1.4 years. In 2014, even with only 11 months of data, the energy savings total exceeded the proposed savings by 53%. The table below illustrates the details of the achieved savings[7].

[6] The following summarizes inputs used to calculate this estimated savings: The energy rate used was $0.14/kWh. Total annual electric usage was 2,500,000 kWh. An average vacancy rate of 30% (occupancy rate of 70%) was used in addition to a 6% unoccupied level due to the changeover process.

[7] The set points and system operation details were provided in the "Data Analysis and Observations" section. Additional information, on the calculation of energy savings, is provided in the prior section ("Energy Savings Methodology") and in the Appendix.

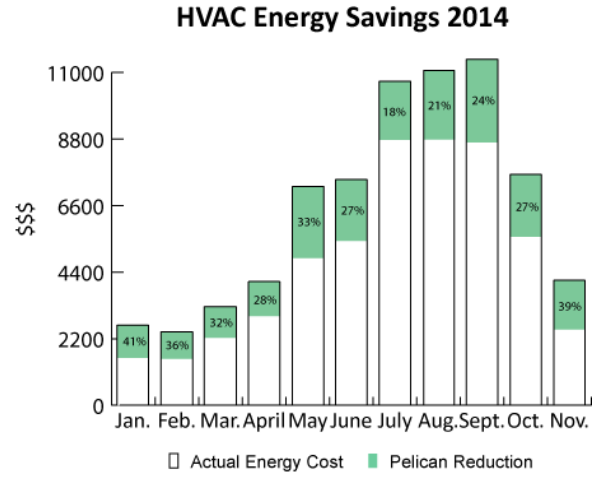


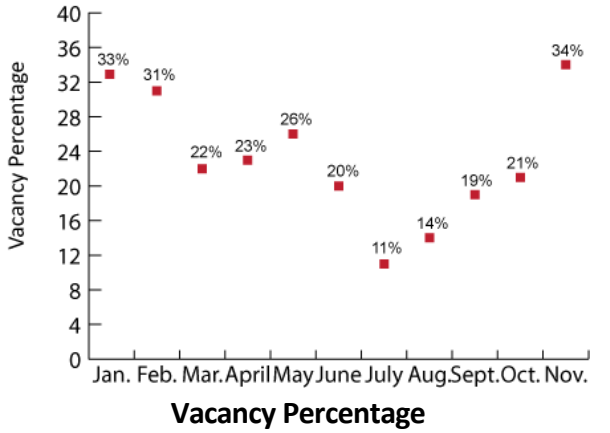


Annual HVAC Energy Savings

2013	January	February	March	April	May	June	July	August	September	October	November	December	Current Total (Average)
Savings	$1,467.35	$1,055.63	$1,022.03	$1,284.76	$2,136.00	$1,599.63	$1,893.37	$1,896.50	$3,142.33	$1,111.96	$1,136.37	$1,127.31	$18,873
Actual Energy Cost	$2,101.27	$1,804.26	$2,105.57	$1,983.92	$3,275.75	$4,427.69	$6,708.50	$5,978.56	$5,205.05	$2,869.75	$1,805.95	$2,361.23	$34,616
Percentage Saved	41%	37%	33%	39%	39%	27%	22%	24%	38%	28%	39%	32%	35%
Guest Room Vacancy	39%	34%	25%	29%	33%	19%	12%	14%	31%	17%	31%	31%	26%
Change-Over Vacancy	5%	5%	6%	5%	6%	8%	8%	8%	6%	7%	5%	5%	6%
True Vacancy	44%	39%	31%	34%	39%	27%	20%	22%	37%	24%	36%	36%	32%

Figure 6 – Renaissance 2013 Results





Annual HVAC Energy Savings

2014	January	February	March	April	May	June	July	August	September	October	November	December	Current Total (Average)
Savings	$1,084.37	$891.35	$1,033.34	$1,144.63	$2,367.17	$2,020.18	$1,941.30	$2,279.20	$2,755.13	$2,062.49	$1,609.16		$19,188
Actual Energy Cost	$1,542.57	$1,560.82	$2,204.26	$2,954.95	$4,898.16	$5,448.60	$8,772.37	$8,809.11	$8,684.40	$5,566.53	$2,525.45		$47,660
Percentage Saved	41%	36%	32%	28%	33%	27%	18%	21%	24%	27%	39%		29%
Guest Room Vacancy	33%	31%	22%	23%	26%	20%	11%	14%	19%	21%	34%		23%
Change-Over Vacancy	5%	6%	7%	6%	7%	8%	8%	8%	7%	7%	6%		7%
True Vacancy	38%	37%	29%	29%	33%	28%	19%	22%	26%	28%	40%		30%

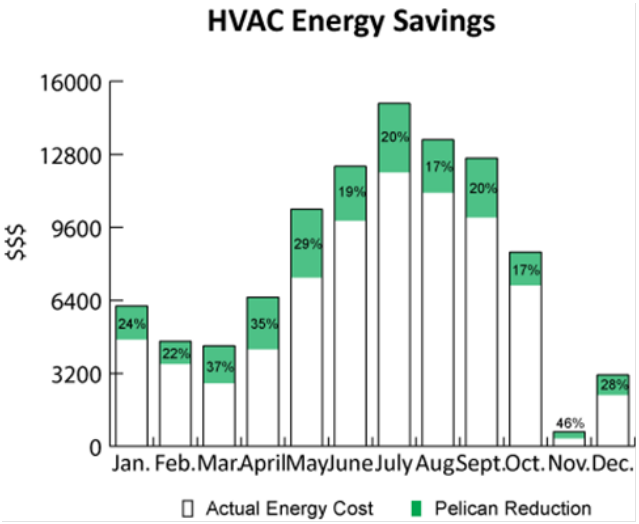
Figure 7 – Renaissance 2014 Results

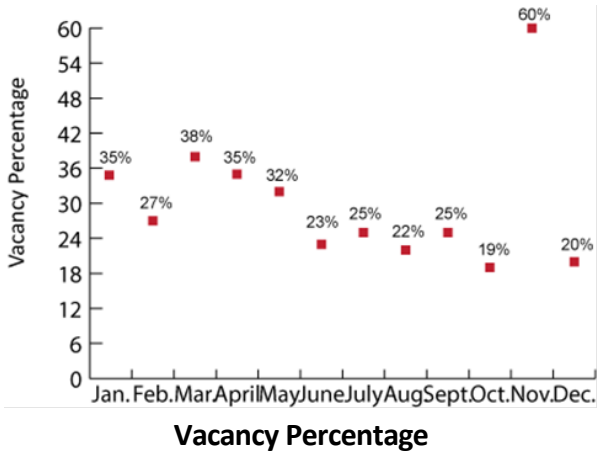
Hilton Concord Hotel

During the sales process a savings of 225,000 kWh or $31,500[8] was estimated for this property. The total price for the retrofit was $56,757 which included a gateway, PMS interface, thermostats for the 341 rooms (as well as thermostats for a few common areas), and the enhanced subscription service. This resulted in a 1.8 year simple payback. The cost per room was $166. The ongoing fee is $2.99 per year per thermostat ($1109 per year).

The after installation energy savings (savings calculated for an unrented room versus a rented room using the Pelican system) presented are summarized in this next section. The energy savings for 2014 was $21,044 or 23%[9] of guest room electric energy. The average vacancy rate for 2014 was 21%. The resulting simple payback was 2.7 years. *Note: There was no savings reported between the dates of November 5th, 2014 to December 19th, 2014 as the Pelican's PMS Interface was disconnected from the Internet due to the hotel switching service providers.*

The table below illustrates the details of the achieved savings[10].





Vacancy Percentage

[8] Pelican was brought in to ultimately address the thermostat control issues; the initial energy savings analysis (and 2011 annual energy usage was not available) but an estimate is provide based on these assumptions: an allocation of 15% of the total facility electric use to guest room HVAC energy, total property usage of 4.5 million kWh, a total vacancy rate of 25%, and an energy rate of $0.14/kWh. This estimate would translate to a savings of 38% of guest room electrical energy and 5% of the total property's electric usage.

[9] In the prior/baseline situation when there was a call for heat the PTAC would turn on both the Heat Pump and the auxiliary heat (electric heat, 3.75 kW) on at the same time. After Pelican was installed, they created an algorithm to decide when to use AUX Heat instead of always using it [if the Heat Pump cannot create a change in temperature of 5°F per hour, Pelican will turn on the AUX Heat. A Pelican thermostat makes this decision within 10 minutes of running the Heat Pump]. Some estimate of energy savings related to correcting this was included is the sales process, however the actual savings listed in this report do NOT include any savings related to optimizing this control.

[10] The set points and system operation details were provided in the "Data Analysis and Observations" section. Additional information, on the calculation of energy savings, is provided in the prior section ("Energy Savings Methodology") and in the Appendix.

Annual HVAC Energy Savings

2014	January	February	March	April	May	June	July	August	September	October	Current Total (Average)
Savings	$1,453.75	$998.37	$1,635.92	$2,276.77	$2,992.86	$2,371.76	$2,982.71	$2,314.50	$2,564.93	$1,452.17	$21,044
Actual Energy Cost	$4,700.41	$3,610.20	$2,270.72	$4,259.01	$7,398.00	$9,904.25	$12,052.43	$11,130.72	$10,077.02	$7,062.77	$72,466
Percentage Saved	24%	22%	37%	35%	29%	19%	20%	17%	20%	17%	23%
Guest Room Vacancy	31%	21%	33%	28%	25%	14%	17%	13%	17%	10%	21%
Change-Over Vacancy	4%	6%	5%	7%	7%	9%	8%	9%	8%	9%	7%
True Vacancy	35%	27%	38%	32%	32%	23%	25%	22%	25%	17%	28%

Figure 8 – Hilton 2014 Results

The implementation of Pelican helped the Hilton Concord received the 2013 Top Environmental Leadership GEELA Award from Governor Brown.

Compiled Results

To summarize the energy savings and costs for each of the three projects:

Sheraton Memphis		
System Cost	$ 99,575	
Ongoing Cost	$ 2,410	
Vacancy Control	Apr-Sep: scheduled 78 cool & off Oct-Nov: 73-76 cool	
	Sales Process	After Installation
Energy Cost Savings ($)	$ 65,057	$72,549 (projected annual savings)
Simple Payback	1.5	1.4

Renaissance		
System Cost	$ 26,646	
Ongoing Cost	$ 694	
Vacancy Control	Off	
	Sales Process	After Installation
Energy Cost Savings ($)	$ 12,542	$20,932 (projected annual savings)
Simple Payback	2.1	1.3

Hilton		
System Cost	$ 56,757	
Ongoing Cost	$ 1,109	
Vacancy Control	74 cool/ 64 heat	
	Sales Process	After Installation
Energy Cost Savings ($)	$ 31,500	$ 21,044
Simple Payback	1.8	2.7

Figure 9 – Compiled Results

CONCLUSIONS AND RECOMMENDATION

The approved Marriott guest room platform is the guest room control system that utilizes a door lock, PIR sensor, and integration into the central reservation system. The Pelican technology being reviewed integrates with the central reservation system but does not utilize the door lock and PIR sensor.

In summary, while this system does not capture the full energy savings potential that a full guest room control system would, it could be an attractive lower cost alternative. The product can be typically be installed at a cost under $165 per room. Based on data collected from the Hilton project, that contained conservative vacancy set points and control, the percentage of annual guest room HVAC electric energy saved ranged between 10-33%. The resulting simple payback for this project was 2.7 years. The additional reporting ability, continuous commissioning, and ongoing technical support are critical services that Pelican provides for the small annual (subscription) fee.

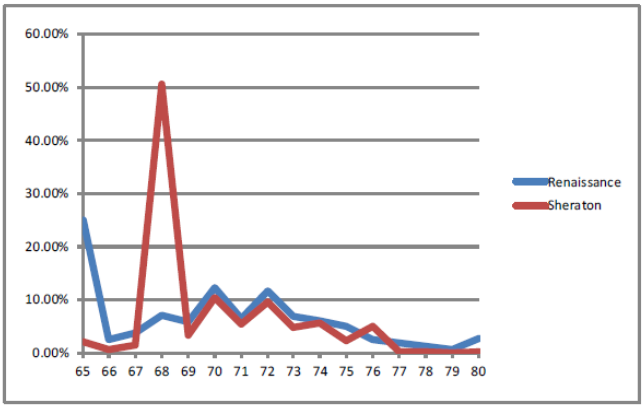
It was determined that there is sufficient energy savings available with an expected return on investment to meet Marriott's target goals. Based on the results of the Detailed M&V for this product, it is **recommended** that the Pelican Wireless solution achieves the Marriott "Approved Energy Solution" status. However to become a full Marriott Approved Energy Solution, Pelican Wireless must develop an energy saving calculator to be used in the sales process. The energy calculator accounts for site specific conditions including (but not limited to): location (local climate), typical occupancy, building construction, and internal loads (people, ventilation, and plug). The calculator is used to determine a site's specific energy savings given their site specific conditions. Once this calculator has been developed and approved, Pelican can be listed as a Marriott Approved Energy Solution.

APPENDIX

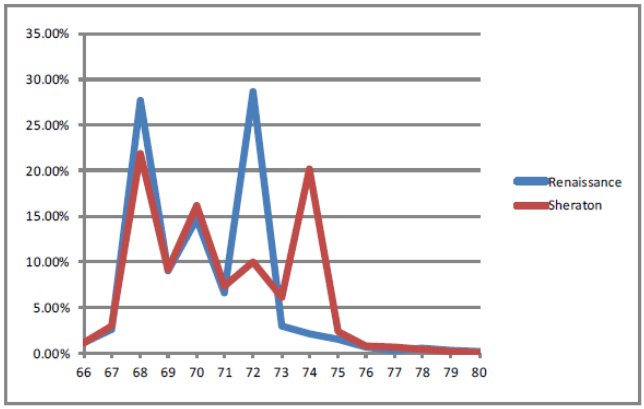
Baseline Thermostat Settings

Pelican utilized a year of operational data to better understand how guests set their thermostats while staying at a hotel. Pelican looked at the two properties reviewed in this report. Both properties did not have a housekeeping policy in regards to resetting the thermostat set point. The charts and tables show the frequency of occurrence for each heating and cooling set point at each property.

HEAT



COOL



SETTING	RENAISSANCE	SHERATON
65	24.96%	1.93%
66	2.42%	0.55%
67	3.66%	1.26%
68	6.95%	50.43%
69	5.67%	3.14%
70	12.29%	10.31%
71	6.29%	5.24%
72	11.66%	9.58%
73	6.67%	4.61%
74	5.92%	5.46%
75	5.00%	2.25%
76	2.46%	4.85%
77	1.80%	0.09%
78	1.24%	0.17%
79	0.47%	0.00%
80	2.54%	0.11%

SETTING	RENAISSANCE	SHERATON
65	0.00%	0.00%
66	1.17%	1.20%
67	2.56%	3.00%
68	27.67%	21.82%
69	9.07%	9.20%
70	14.70%	16.14%
71	6.56%	7.36%
72	28.69%	10.00%
73	2.96%	6.16%
74	2.16%	20.18%
75	1.46%	2.41%
76	0.69%	0.76%
77	0.36%	0.67%
78	0.50%	0.46%
79	0.28%	0.14%
80	0.18%	0.09%

Housekeeping Policy

Some analysis was done to determine the impact a housekeeping policy on the overall energy savings. Energy savings are calculated using operational data from the Renaissance Viejo property, the approach described in the "Energy Savings Methodology" section, and following these two assumptions:

- Facility with no setback controls or housekeeping policy: the calculations assume that during the unrented time periods, the room thermostats were left at the prior guest's setting. Usage is calculated as the usage that would have occurred if that setting was not adjusted during these unrented times.
- Facility with a housekeeping room policy: the calculations assume that the room thermostat's temperature is adjusted to reflect the housekeeping policy (typically 72°F cool and 68°F heat). Note this is a best case scenario calculation as it assumes that housekeeping is able to immediately adjust the thermostat to a policy setting at check-out time and that the reset policy has 100% compliance.

The results showed if there was a housekeeping setting policy at the Renaissance Club Sport Aliso Viejo, the savings estimates would need to be adjusted by -8.45%.

Additional Analysis Charts

The table below shows a sample data set for both properties. The table shows the number of "similar" rooms (labeled "rooms sampled"), the run minutes and performance rating for those baseline rooms (labeled "average"), the run minutes and performance rating for the vacant room (labeled "actual"), and the adjusted baseline run time (labeled "weighted run minutes"). Under room status, "In"=rented, "Out"=vacant, and "Mixed"=partial (both).

Table 7 – Performance Data for Sheraton Memphis

Name	Time Of Day	Room Status	Rooms Sampled	Average Run Minute	Average Performance	Actual Run Minutes	Actual Performance	Weighted Run Minute
Room 1007	5/3/2014 12:00	Mixed	29	23	0.13	1	0.04	24
Room 1007	5/3/2014 13:00	Out	27	23	0.16	0	0.04	23
Room 1007	5/3/2014 14:00	Out	20	26	0.13	0	0.04	26
Room 1007	5/3/2014 15:00	Out	19	28	0.13	0	0.04	28
Room 1007	5/3/2014 16:00	Out	21	28	0.13	0	0.04	28
Room 1007	5/3/2014 17:00	Mixed	19	28	0.13	0	0.04	1
Room 1007	5/4/2014 11:00	Mixed	12	19	0.14	23	0.04	35
Room 1007	5/4/2014 12:00	Out	10	18	0.17	0	0.04	18
Room 1007	5/4/2014 13:00	Out	11	21	0.18	0	0.04	21
Room 1007	5/4/2014 14:00	Mixed	10	23	0.14	51	0.04	52
Room 1007	5/4/2014 15:00	Mixed	9	34	0.09	3	0.04	35
Room 1007	5/4/2014 16:00	Out	11	35	0.11	0	0.04	35
Room 1007	5/4/2014 17:00	Out	11	36	0.09	0	0.04	36
Room 1007	5/4/2014 18:00	Out	13	35	0.09	0	0.04	35
Room 1007	5/4/2014 19:00	Out	12	29	0.11	0	0.04	29
Room 1007	5/4/2014 20:00	Out	12	26	0.11	0	0.04	26
Room 1007	5/4/2014 21:00	Out	12	26	0.11	0	0.04	26
Room 1007	5/4/2014 22:00	Out	13	27	0.11	0	0.04	27
Room 1007	5/4/2014 23:00	Mixed	12	28	0.11	0	0.04	24

Table 8 – Performance Data for Renaissance Aliso Viejo

Name	Time Of Day	Room Status	Rooms Sampled	Average Run Minute	Average Performance	Actual Run Minutes	Actual Performance	Weighted Run Minute
Room 201	4/1/2014 0:00	Out	4	1	0.17	0	0.55	1
Room 201	4/1/2014 7:00	Out	4	2	0.13	0	0.55	1
Room 201	4/1/2014 8:00	Out	4	7	0.22	0	0.55	3
Room 201	4/1/2014 9:00	Out	3	11	0.18	0	0.55	5
Room 201	4/1/2014 10:00	Out	4	8	0.21	0	0.55	4
Room 201	4/1/2014 11:00	Out	4	3	0.03	0	0.55	1
Room 201	4/1/2014 13:00	Out	3	4	0.05	0	0.55	2
Room 201	4/1/2014 14:00	Out	3	6	0.03	0	0.55	3
Room 201	4/1/2014 16:00	Out	3	10	0.08	0	0.55	5
Room 201	4/1/2014 17:00	Mixed	4	5	0.26	0	0.55	1
Room 201	4/2/2014 13:00	Mixed	4	1	0.35	2	0.55	4
Room 201	4/2/2014 16:00	Mixed	3	2	0.22	0	0.55	1
Room 201	4/5/2014 0:00	Out	11	4	0.67	0	0.48	4
Room 201	4/5/2014 1:00	Out	12	5	0.27	0	0.48	3
Room 201	4/5/2014 2:00	Out	13	5	0.27	0	0.48	3
Room 201	4/5/2014 3:00	Out	14	5	0.21	0	0.48	2
Room 201	4/5/2014 4:00	Out	19	3	0.29	0	0.48	2
Room 201	4/5/2014 5:00	Out	21	3	0.2	0	0.48	1