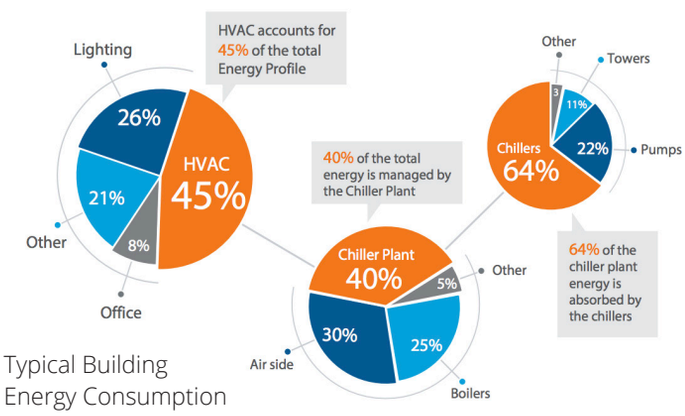
airmaster

Case Study //

Sheraton Mirage, Gold Coast QLD

The Sheraton Mirage Resort and Spa is an icon of Queensland's Gold Coast, built during the region's 1980s development boom. A recent multi-million-dollar refurbishment has not only returned the resort to its former glory, but has drastically improved energy efficiency too. Built in 1987 as the jewel in the infamous Christopher Skase empire, the Sheraton Mirage Resort and Spa remains the Gold Coast's only five-star beachfront resort. Fronting the Pacific Ocean on the naturally occurring Southport Spit, the resort continues to operate under the management of Starwood Hotels and Resorts, the parent company of the Sheraton brand. After being purchased outright by Pearls Australasia in 2010, the property has undergone a stunning multi-million dollar refurbishment that has returned its 295 guest rooms, lobby, reception, porte cochere, bars and restaurant to their former glory. Outside, the resort is equally spectacular with over three hectares of manicured tropical gardens surrounding a 5,000m² system of lagoons and the magnificent 750m² lagoon-style swimming pool that fronts the famous Gold Coast beach.

Location:	Gold Coast, Queensland
Building:	Resort Complex
Date Installed:	October 2013
Energy Savings:	$160,000.00
Gas Savings:	$93,944.00
Total Energy Savings:	$253,944.00 per annum



Typical Building Energy Consumption

Refurbishment //

Built over 30 years ago, the Sheraton Mirage Resort had lost its five-star edge and become an expensive and inefficient hotel to operate by 2011. Recognising the need for refurbishment, the resort's new ownership approved a $26 million refurbishment program to take in all public spaces as well as guest rooms, bars and restaurant. But to deliver a five star guest experience in today's market, the delivery of high levels of comfort and amenity also come with the expectation that the resort is also fulfilling its environmental responsibilities. "At the end of the day, you like to think the majority of people want us to be green, and want us to do the right thing by the environment," said Sheraton Mirage Resort's General Manager, Mark Sexton. Sexton says Starwood's overarching objective with sustainability is to reduce energy and water usage. The "30/20 by 20" initiative has set a target of reducing energy use by 30 per cent and water use by 20 percent by the year 2020 (from a 2008 baseline).

To ensure the resort meets these targets, a range of works were conducted that not only improved the resort's aesthetics and guest amenity, but also addressed energy efficiency. These included the installation of new LED lighting, sensors and controls; the replacement of guest room air conditioning controls and installation of movement sensors and window switches.

The resort's ageing mechanical services plant was not included in the original scope of works, nor was the building management system (BMS) – an old, proprietary system that had received limited upgrades over the years and progressed to obsolescence. But following a BMS failure prior to the busy Christmas period in 2012, these issues were quickly brought to a head. The failure resulted in the resort having to be manually operated until the problems were able to be rectified three weeks later. Not only did this place undue pressure on the management and maintenance team during a peak occupancy period, but it also resulted in a hefty repair bill. "It was then that we realised we were sitting on a time bomb," said Sexton.

Having recently won the resort's mechanical services maintenance contract, Airmaster was called on by Sexton to conduct a Level 3 Energy Audit.

Among the problems identified were a failing BMS and an existing chiller plant that was inefficient, prone to issues and had reached the end of its useful life. The chillers were also operating on obsolete, ozone-depleting refrigerants R11 (phased out in 1996 under the Montreal Protocol) and R22 (currently being phased out). "The audit painted a fairly bleak picture of the way things were," said Noel Courtney, Chief Executive Officer for Airmaster Australia, who has been intimately involved in the project from the beginning. "If the resort had experienced a catastrophic failure or a big leak in their chillers, it was doubtful we could have kept them going. So there was a risk to the business." In all, 30 energy savings measures were identified. At the top of the list were the chillers and building automation. Recognising the urgency, and with the resort well into its refurbishment program, Airmaster was asked to submit a proposal and budget. "At that time, we were looking at like-for-like replacement based on using higher efficiency chillers," said Courtney. "But once we established a budget, and funding approval was obtained, we went back with the intention of firming up our design.

A light-bulb moment //

Although a like-for-like replacement promised an immediate performance improvement, Airmaster identified opportunities to deliver further savings through the installation of two water-cooled chillers combined with an air-cooled Climaveneta ERACS chiller. Despite limited exposure in Australia, Airmaster had gained confidence in the Italian-made chillers across a number of installations where its ability to produce simultaneous heating and cooling had been proven. "Climaveneta build some clever equipment," explained Wayne van Aken, Airmaster's Branch Manager for Queensland. "What we liked is that they build a lot of the ERACS heat recovery units, they've been manufacturing these units for a long time, and they use common component brands that we are familiar with." "But most importantly perhaps, every machine is run and tested before it leaves the factory, so when we turn them on we know they start every time."

Following an examination of potential installation sites and the related costs of installing the air-cooled chiller, Airmaster moved to an alternative design featuring a water-cooled model that could be more easily retrofitted into the existing plant room. Commonly used in Europe where well-water is used as a heat sink, the Climaveneta Integra ERACS water-cooled chiller also offered some significant advantages, including the ability to produce free heating or cooling. This is achieved by a clever three-vessel design and advanced control logic that ensures cooling and heating loads are perfectly met. When these are simultaneous, the unit exchanges evaporation and condensation heat with the system cooling and heating circuits respectively. Where the cooling or heating load is constant, the result is either free heating or chilled water. When the load is not balanced, or when one of the two demands are missing, the chiller automatically switches to a third heat rejection source. It was this last point that led Courtney to consider the use of the resort's lagoon system as an integral part of what promised to be a highly efficient solution.

"One day it just dawned on me that we had a huge heat sink available to us," said Courtney of his light-bulb moment. "So I did a calculation on it and found there were over three million litres of water available in the lagoon. Three million litres holds a lot of heat." A further benefit was that the water-cooled chiller simplified installation. "It was still a three chiller installation, in identical positions within the plant room, so it kept the installation cost down and made all the connections relatively simple," said Courtney

Foot off the gas //

The audit also identified the method used to heat the resort's pool as being highly inefficient. Required to be maintained at a constant 27.5°C year-round (as per Sheraton's worldwide brand standard), the resort pool was heated by an ageing 400kW gas-fired boiler. One of five boilers servicing the site, the pool boiler operated around the clock to maintain temperature, and was responsible for up to 75 per cent of the resort's total annual gas consumption – a cost the hotel's management was keen to be rid of. The pool's heating demand was quickly recognised by Airmaster as an obvious target for the 55°C hot water produced by the ERACS chiller and regulated via a control valve and heat exchanger. The production of this hot water would in turn provide free cooling – and with a cooling load of around 400kW during winter and up to 2000kW during summer months, promised to deliver significant electricity savings to the resort. To optimise energy efficiency, Airmaster's design shifted the balance between high load and part load among the three chillers. The two incumbent high-load 1290kW chillers were replaced with two 1220kW TECS water-cooled main chillers, while the incumbent low-load 580kW chiller was replaced with the slightly larger 640kW ERACS unit. To ensure optimum performance, a brand new, open-source system was also proposed to replace the obsolete BMS, as were new plant controls specifically designed to operate with the Climaveneta chillers. At the property owner's request, Airmaster's design was reviewed by engineering consultancy Norman Disney & Young, who "rubber stamped" it. "It was important to the owners that the design was independently assessed," said Sexton. "It was a lot of money so was just due diligence. The solution we have here today is what was put up by Airmaster, and what was approved and vetted by NDY."

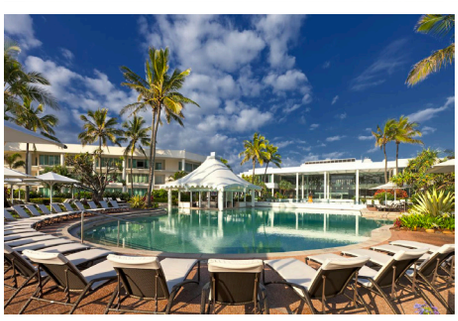
Theory to reality //

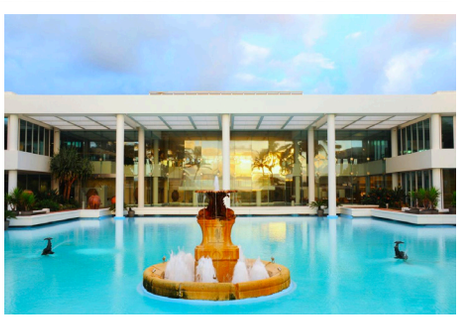
With the entire retrofit scheduled to be completed within four months, so as to keep interruption to the resort to a minimum, the team completed all preparation work in advance. This included the installation of new pipework, heat exchangers and pumps. "This meant that when the new chillers arrived on site, we could get the energy savings immediately," said van Aken. The installation of each chiller was conducted within a five day cutover period whereby one chiller was replaced at a time, with the other two providing chilled water and redundancy to the site. "We had to be prepared to move the schedule around to work odd hours, particularly when the resort was fully occupied or had conventions on," said Airmaster's Project Supervisor, Dominic Mazzoleni. "It's not like a commercial building where you've got a weekend and where you can start at Friday 5pm and have a chiller up and running by 8am Monday. Here, we had to do things one at a time, and keep chilled water to the facility every day of the week." Disruptive or noisy work was scheduled around the hotel's occupancy levels, and often performed after hours or on weekends. Weekly project management meetings kept all stakeholders informed of the project's progress and helped address any issues or concerns. "Because of the way we went about it, it was pretty seamless to be honest," said Greg Langley, Chief Engineer at the Sheraton Mirage Resort. "And because we were installing three units, and none of them served the whole complex, it was able to be managed well. Aside from a few nervous moments, there were no real hiccups during the change-over, and certainly none that affected guests."

PlantPRO //

According to Lucas Robinson, Project Manager of Building Automation for Airmaster Queensland, the biggest challenge in upgrading the obsolete BMS and plant control system was ensuring no interruption to the resort's services was experienced. For this reason, the project was split into two distinct parts – the BMS and the chiller plant management system – allowing the team to take advantage of advanced chiller optimisation and control using PlantPRO. Based on the Niagara framework, the PlantPRO chiller plant management system will manage the complex cold and hot water conditions used throughout the resort for air conditioning, hot water production and the heating of the resort pool. Developed in Australia, PlantPRO has recently been licensed by Climaveneta to provide its chiller plant management requirements worldwide. Its advanced optimisation capabilities use sophisticated sequencing and load control, along with free cooling or heating production from the ERACS unit, to drive lowest cost of production of both the hot and cold water systems.

In-built measurement and verification of the chillers and the complete plant allow for real-time continuous optimisation as well as fault detection and diagnostic capabilities. By combining variable primary flow control, smart sequencing and lift management optimisation, it has been able to drastically reduce energy consumption at the resort. Furthermore, all existing Johnson BMS controllers have been replaced with Tridium I/O controllers. Robinson says the Tridium Niagara framework is used at the management layer to oversee all of the systems in one seamless network. "Breaking it down, the BMS here doesn't need to be over complicated in any way – it's all about matching what the resort's requirements are," he said."The resort's management team is now able to track energy consumption, see that conditions have been maintained, see where there are issues or opportunities for improvement, and manage all this through the BMS front end."





Free cooling //

Six months since the installation of the new chiller set, and Airmaster's design has already exceeded expectations. Ongoing commissioning and fine-tuning through the defects period will continue to improve the performance of the entire site. The efficiency of the ERACS system has also easily met the resort's pool heating demand, but in doing so created the problem of not achieving enough free cooling at the start of the day to meet resort demand. This resulted in the need for one of the main chillers to operate. "Given the size of the pool boiler that we took offline, we assumed that the ERACS unit would have to run longer in the mornings to heat the pool, which would give us more free cooling," van Aken said. "But what we have found is that because we installed new heat exchangers and new pumps, and the plant is working to its optimum, we are heating the pool in just two to three hours." In response, Airmaster reconfigured the system to pre-heat the site's 40,000 litre make-up water wells that supply domestic and heating hot water across the resort. By pre-heating the incoming town water in the make-up wells to 50°C, the resort's boilers are now operating at a significantly reduced load to achieve the 55°C domestic hot water required. This opportunity has also created more free cooling from the ERACS unit, which Mazzoleni says was always part of the long-term plan. "We were just looking to use the extra heat to condition the guest rooms, but now we're using it to pre-heat the whole hot water system," he said. Whilst it is still early days, and commissioning continues, the energy savings delivered by the new chiller set and controls is proving significant. For instance, gas consumption across the site has fallen by a staggering 60 per cent compared to the previous year. "It's a lot of money that just came out straight away," said Sexton of the significant gas savings. "As soon as the boiler was turned off, the gas man must have thought we needed a new meter!"

Additionally, electricity consumption has fallen //

According to ongoing energy analysis being conducted by Bueno Systems, a 13 per cent reduction was experienced in January 2014 compared to the same period in 2013. This represents a monthly electrical energy saving of 93,255kWhe. These energy savings have also been delivered in the face of increased cooling load, with higher resort occupancy levels and above-average temperatures experienced on the Gold Coast with a higher number of cooling degree days. Overall, the project's payback period of 3.8 years looks like being readily achieved. "So far, we've realised all of the gas consumption savings we projected – and then some," said Courtney. "We've also had a significant reduction in electrical energy consumption, despite an 8 per cent increase in occupancy and an 18 per cent increase in thermal conditions measured through cooling degree day data." "But we are five months into commissioning and the major savings are expected in the peak and shoulder periods. So we believe we're completely on track to deliver everything we said we would, and more."

About Us //

Airmaster is an award-winning technical solutions company, delivering end-to-end management of heating, ventilation,air conditioning, industrial and process cooling and building automation across Australia and South East Asia. Based in Melbourne and with 12 branches Australia-wide, Airmaster's commitment to sustainability is achieved through a proactive, integrated approach to helping organisations achieve energy efficiency in innovative ways.

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