

Herculean Performance and Energy Savings.

A side-by-side comparison of 2 packaged unit technologies in a major shopping centre has revealed significant energy savings offered by ActronAir's Hercules™ range.

Annual energy consumption savings of 45 - 55% were projected versus a 2 stage fixed speed system.



ActronAir®

Australian for air conditioning™

Herculean Performance.

ActronAir is uniquely placed to respond to the changing demands of the HVAC industry.

Research conducted by ActronAir found that Australian businesses and building owners were increasingly cognisant of reducing their carbon footprint whilst increasing their bottom line. Rising energy costs associated with HVAC equipment was also highlighted as a major concern.

Furthermore, research revealed that commercial buildings operate at part-load 98% of the time¹.

Following further consultation and collaborative work with key stakeholders and partners, ActronAir recognised the opportunity to revolutionise the >100kW rooftop packaged unit category.

It was from this research that the Hercules™ product was born.

Considered to be the most advanced, energy efficient packaged unit to ever be engineered in Australia, the Hercules™ range has been optimised for seasonal energy efficient performance.

Offering improved reliability, flexibility, noise emissions, occupant comfort, controls and BMS connectivity.

It is also an excellent alternative to chillers and VRF systems.

Theoretical testing via BEAVER Energy Modeling showed the Hercules™ to be 50% more energy efficient than a comparable, BCA-compliant unit with an IEER (Integrated Energy Efficiency Ratio) of 5.45, surpassing the ASHRAE 90.1 standard.

So when a rooftop packaged unit required replacement at a major regional shopping centre, ActronAir embraced the opportunity to conduct a direct “in field” performance comparison between Hercules™ and other technology.

The independently conducted field testing and energy analysis found that the performance of Hercules™ in the field surpassed initial research estimates.

Over the two week trial period, the Hercules™ packaged unit found daily energy savings of between 21% and 69%. Total energy consumption of 40% was observed.

Using regression analysis and weather data for the region, Ecosave project annual energy consumption savings in the order of 40 - 55%.

Narellan Town Centre.

Located in the Macarthur region west of Campbelltown, Narellan Town Centre is the area's largest shopping centre with over 100 specialty retail stores and majors such as Woolworths, Coles, Big W and a United Cinemas multiplex.

Most of these retail and mall spaces are serviced by rooftop packaged air conditioning units of varying ages.

Servicing ten specialty retailers and a common mall area adjacent to the Coles supermarket, a failed unit was replaced with a new ActronAir Hercules™ PKV1700T8R1 packaged unit with a rated cooling capacity of 169kW.

Following commissioning of the new unit, independent energy auditor Ecosave was invited to conduct an energy efficiency and performance comparison of the newly installed Hercules™ unit against an existing 145kW unit serving an adjacent area of the shopping centre.

The spaces served by each unit were deemed to be suitable for comparison, being similar in nature, size and cooling load based on site inspections.

Along with comparing the total unit performance, Ecosave also sought to compare component performance including that of each unit's indoor fans, outdoor fans, compressor loads and the space conditions.

Notably, each unit utilises different technologies.

The existing unit is a typical 2-stage fixed-speed rooftop packaged air conditioning unit. Air cooled coils are serviced by AC fixed speed condenser fans. Traditional belt-driven, forward-curved evaporator fans are used.

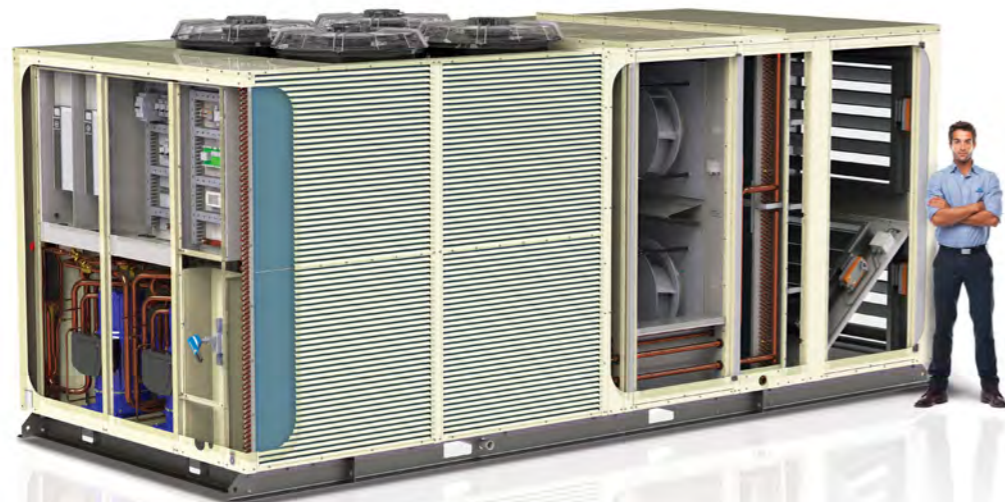
In comparison, the Hercules™ unit has been designed to specifically address issues of part load and energy efficient operation in commercial applications.

The variable capacity Hercules™ unit utilises variable speed drives (VSDs) to modulate the speed of the individual compressors. It also uses electronically-controlled variable speed backward-curved EC plug fans and EC outdoor fans.

Both units are controlled at high level through the existing BMS (building management system).

The operational hours, control set points and other control parameters affecting energy consumption were observed to be the same for both units with a supply air set point of 22.5°C.

HERCULES



¹ Based on AHRI 340/360 clause 6.2.2.



Summer Time Performance.

Performance logging was conducted over a two-week period in January 2014, during which time both units operated in cooling mode for the entire length of the trial.

High-accuracy ACR multi-channel data loggers were installed for the purpose of this analysis.

To provide a quantitative measure of cooling load, ambient temperature data from the Bureau of Meteorology (BOM) weather station in nearby Campbelltown was converted into cooling degree days (base 18°C).

Across the entire 14-day test period, the side-by-side analysis showed the Hercules™ unit to consume 40% less electrical energy (Figure 1). On individual days, savings of between 21% and 69% were observed (Table 1, Figure 2).

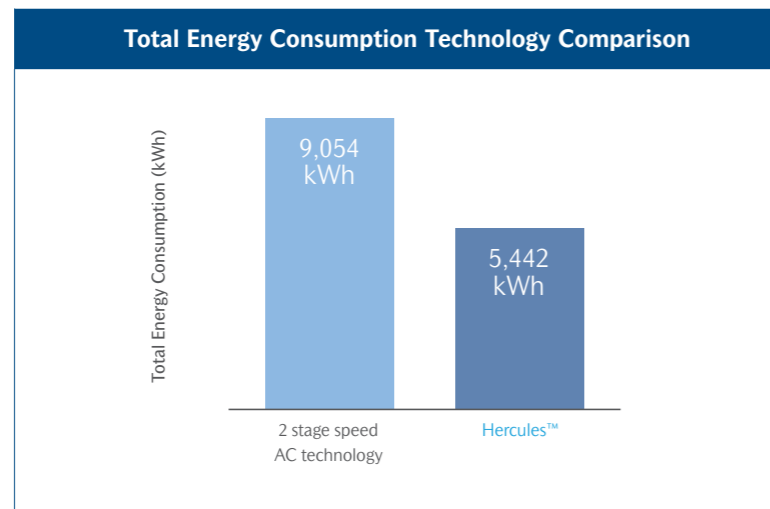


Figure 1: Total Consumption over Test Period

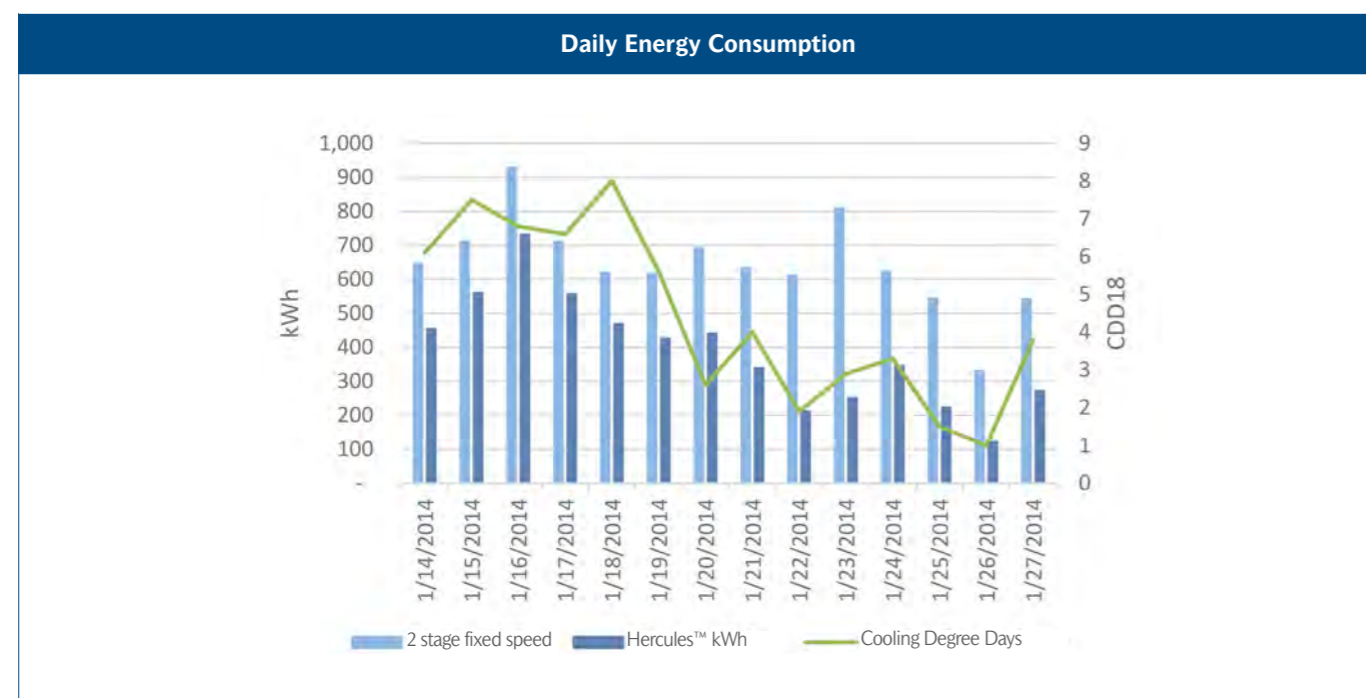


Figure 2: Total Unit Consumption over Test Period

Date	2 Stage fixed Speed kWh	Hercules kWh	Cooling Degree Days	Savings
14/01/2014	648	457	6.1	29%
15/01/2014	715	563	7.5	21%
16/01/2014	932	734	6.8	21%
17/01/2014	713	559	6.6	22%
18/01/2014	623	472	8	24%
19/01/2014	618	429	5.6	31%
20/01/2014	694	443	2.6	36%
21/01/2014	636	342	4	46%
22/01/2014	613	215	1.9	65%
23/01/2014	812	254	2.9	69%
24/01/2014	626	347	3.3	45%
25/01/2014	547	226	1.5	59%
26/01/2014	333	125	1	62%
27/01/2014	545	275	3.8	50%
Total	9,054	5,442	61.6	40%

Table 1: Total Unit Consumption over Test Period

To assess the correlation between cooling degree days (CDD) and energy consumption, a simple regression analysis was completed.

The hottest day during the trial saw a maximum temperature of 38.2°C recorded, with 8 cooling degree days (CDDs). On this day, the Hercules™ unit was found to consume 24% less electrical energy than the existing unit.

The coolest day saw a maximum temperature of 21.8°C recorded with 1 CDD. Here, the Hercules™ unit consumed 62% less electrical energy than the existing unit.

This revealed the stark difference in response to cooling loads by each unit.

While the energy consumption of the existing unit was not found to be significantly affected by the ambient conditions, the analysis found a strong correlation between the energy consumption of the Hercules™ unit and the cooling load. This was especially noticeable at part load conditions where the daily CDD is less than 4 (Figure 3).

According to Ecosave, the relationship between electrical energy savings and cooling degree days is strong. For all days with less than 2 CDDs, energy savings above 50% were achieved by the Hercules™ unit.

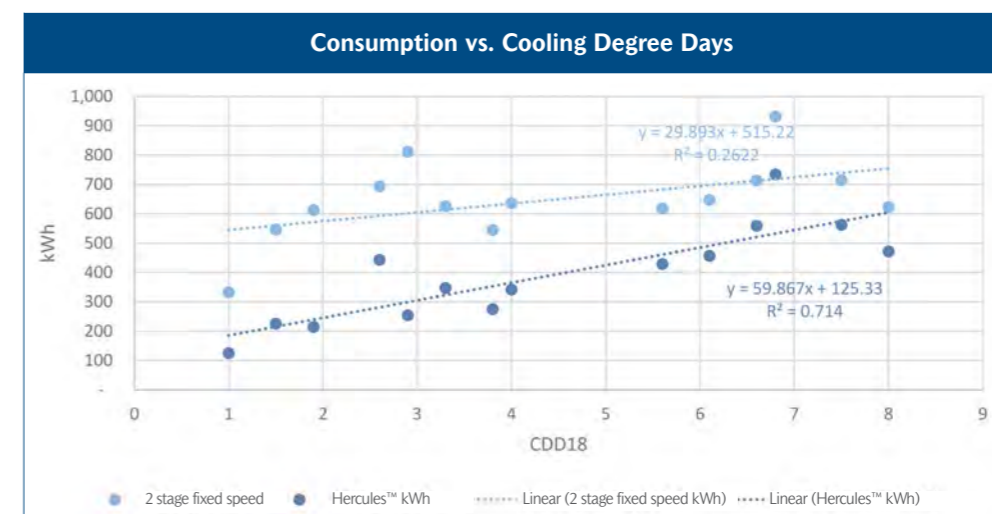


Figure 3: Total Consumption vs. Cooling Degree Days

Matching Load.

To qualify the total unit energy saving, as well as those of the individual components, daily load profiles were also examined. This indicated the ability of controls to better respond to demand and reduce energy consumption.

The sample day saw a cooling load of 1.9 CDDs with a maximum temperature of 22°C.

“This would present the units with a range of temperatures, well below the full capacity of both units, and typical part-load conditions experienced through the year,” Ecosave said.

Superior Comfort.

Comfort conditions were also measured on the hottest (38.2°C) day during the trial period, where the indoor space temperature was measured.

The space served by the existing packaged air conditioning unit was observed to reach a maximum temperature of 26.7°C; while the space being served by the Hercules™ unit reached a maximum temperature of 24.9°C. Both maximum temperatures were recorded at the same time of day (3:45pm).

Over the course of this day, the total energy consumption of the existing unit was recorded as 613kWh, while the total energy consumption of the Hercules™ was just 215kWh – a saving of 65%.

“The total load profile shows a clear distinction in the nature of operation of the two units – one operating at a number of fixed loads and the Hercules™ unit responding to demand with variable load. This variable response becomes evident when the load profiles of the individual components are examined, to quantify where the operational savings are being made.”

This represents a space temperature difference of 1.8°C which would have an obvious impact on occupant comfort and is significant given both units were under full load conditions.

Additionally, the measurement of temperature and humidity in the common mall areas across the trial period revealed the Hercules™ unit to have much less temperature deviation than that of the existing unit.

Proven Performance.

Ecosave projects the annual energy consumption saving to be in the region of 45% to 55%, depending on cooling load – similar figures to those revealed by ActronAir’s theoretical modeling.

ActronAir believe these results are conservative due to the following factors:

- Capacity was higher for Hercules™ 169kW vs other unit 145kW
- Test was conducted in Summer. Hercules™ delivers even higher efficiency at part-load performance
- Test was based on a Hercules™ standard unit. VAV option can provide even further comfort and energy savings

Furthermore, the analysis reveals the opportunity available to commercial building owners seeking to make significant energy savings by replacing aging equipment.

“There are substantial operational savings to be made and potentially sound commercial reasons to bring forward these capital upgrades,” said Ecosave.



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