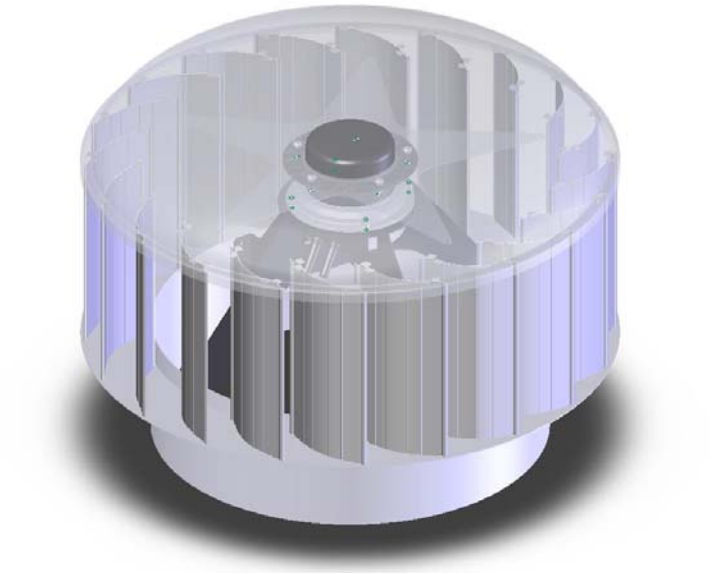
AIRAH excellence award for HVAC

ecopower

Hybrid Ventilation with EC technology



EDMONDS
Technologies for a Sustainable Future

ebmpapst

CSR Edmonds

ebm-papst Australia Pty Ltd

Summary

ecopower® hybrid ventilation is a dramatic new innovation for the market.

A vent is not just a component, but is integral to the workings of any building. Ventilation is required in all buildings as prescribed by legislation, to ensure acceptable living and working environments for our families, friends and colleagues.

Moving to 'Green Star' and building ratings for energy efficiency has forced building designers to focus on all sources of power consumption that can be reduced with the use of advanced technology. This includes mechanical ventilation.

A substitute for mechanical ventilation is natural ventilation which uses no power. Natural ventilation, and in particular wind driven ventilation, has been with us for many years. It is proven and well used but has limitations with respect to control of ventilation rates due to its dependency on ambient conditions. Chimneys, open windows and natural convection can also be utilised, but again with limited control.

Hybrid ventilation as embodied in the CSR Edmonds *ecopower* range, utilises natural ventilation along side high efficiency mechanical ventilation in the one unit. The *ecopower* design allows the wind turbine itself to be used as a centrifugal impeller when running in powered mode. No separate fan is required for the provision of mechanical ventilation. This utilises the best features of each while eliminating their relative drawbacks. The drawbacks of previously existing separate fan/natural vent combination units being blockage of the inlet throat by the fan and impedance of the fan performance by the natural vent.

	Power [W]		Noise @3m [dB(A)]	
	Hybrid	Axial Vent	Hybrid	Axial Vent
EP400	63% lower	160	9 dB(A) lower	55
EP600	76% lower	480	11 dB(A) lower	60

Table 1: Summary of exhaust rate, power and noise comparisons between *ecopower* EP400 and EP600 hybrid ventilators and standard axial mechanical roof ventilation units

Comparisons of performance against standard axial mechanical ventilation is shown summarised in Table 1 and detailed later in Table 3. CSR Edmonds and ebm-papst have worked together to develop the *ecopower,* more than halving power consumption and reducing noise by around 10dB(A) in comparison to standard axial mechanical roof ventilation units.

The *ecopower* is currently available in four sizes; 100mm, 150mm, 400mm and 600mm inlet throat diameters with a 900mm model soon to be released.

The EC (Electronic Commutation) motor technology itself is innovative and groundbreaking, creating new advances to benefit original equipment manufacturers and end users. These innovations include:

- Use of highly efficient DC motors that connect direct to AC mains, eliminating the need for expensive and high risk installations.

- 100% noiseless speed control from any sensor input, BMS (Building Management System) or internet access systems. The EC motor in the EP900 can operate in isolation, while also logging its operation for later analysis.

- Input voltage range of 200 to 277VAC and 50/60 Hz. The ventilation performance does not change, the motor is intelligent enough to know what the conditions are and adjust its performance accordingly.

This really is leading edge technology evolving ventilation technology.

An example case study demonstrates the potential savings that *ecopower* can provide. For a relatively small installation of 10 EP600 units, 75% cost and CO2 emission reductions are possible when compared with standard axial mechanical roof ventilation units. This equates to annual savings of $1763 and 12.3 tonnes of greenhouse gas emissions.

Compared with pure wind ventilators, *ecopower* is a demand ventilator that can provide a guaranteed ventilation rate when required, no matter what the prevailing wind conditions. This is important for many applications. In power mode, *ecopower* has a flow rate 3 - 5 times greater than the equivalent size wind ventilator operating at average capital city wind speeds.

..the contribution

This hybrid ventilation product is called *ecopower.* It is a new, innovative combination of natural ventilation and efficient mechanical ventilation. The natural ventilation mode functions through two processes. The first allows hot air to escape as a result of 'stack effect' buoyancy pressure. The second process results from the ambient wind driving the turbine/impeller unit thereby creating flow through a centrifugal suction process. The efficient power mode allows flow rates to be boosted when required by powering the EC motor to drive the turbine/impeller. This provides on demand response to meet prevailing needs.

Ventilation is a key requirement in any building. Before *ecopower*, the only solution, where natural and mechanical ventilation were required from a vent, involved installing an axial fan in the throat of a natural ventilator. This design had serious drawbacks. When not running in power mode the fan obstructed flow of the natural vent and when the fan was operating the natural vent impeded the fan performance. The *ecopower* design has eliminated this problem through the use of the wind turbine itself as a centrifugal impeller when running in powered mode. There is no separate fan required for mechanical ventilation. The *ecopower* is therefore more than a natural vent and more than just a fan. It combines the best of both technologies and eliminates their drawbacks into a cost effective and reliable hybrid vent that takes vent design to a new level in product evolution.

To achieve this revolutionary design required a powerful, efficient, robust and low free running resistance motor to allow the direct drive design to work at its best. These qualities were found in the latest range of EC motors from ebm-papst. Use of the latest DC motor techniques but with new leading edge technology and integrated commutation electronics result in a unit that can be connected directly to AC mains (for sizes 400 and larger). The EP900 will also incorporate intelligent speed control; so a simple sensor can be connected for full feedback control. A computer can be connected to the unit to programme the desired control function, and then unplugged; the unit will look after itself and advise if it has a problem.

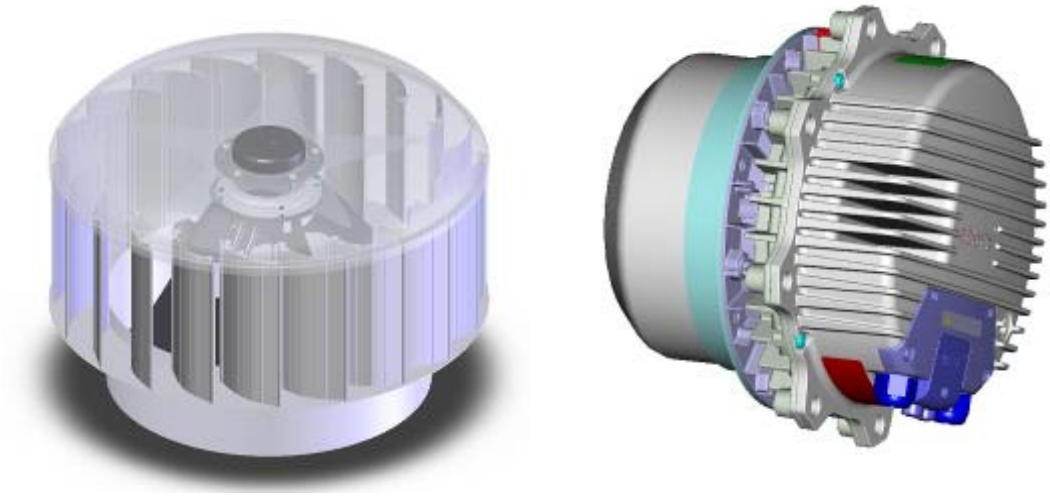


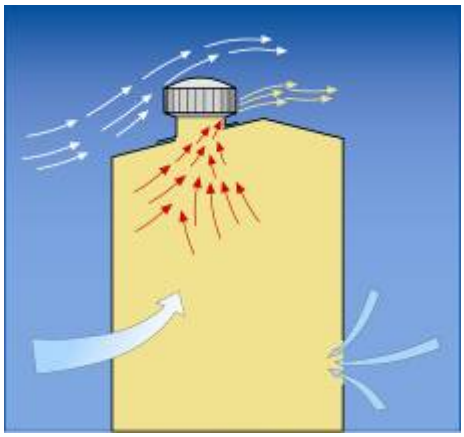
Figure 1: The *ecopower* with internally mounted EC motor

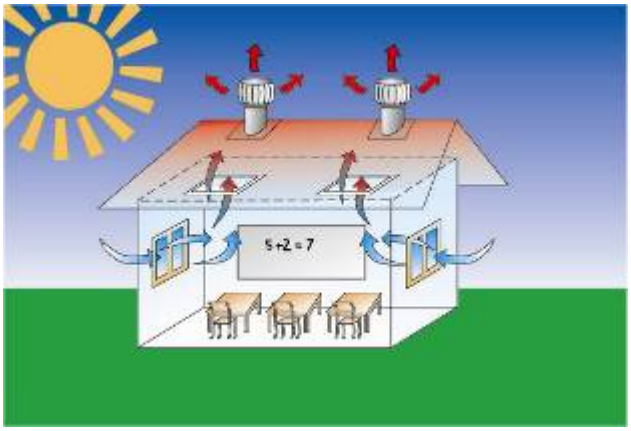
The *ecopower*, Figure 1, has been designed to address the main issues that concern users, namely:

- Energy costs.
- Maintenance costs.
- Noise.
- Reliable ventilation when required.

In order to address these issues real innovation has been used in all stages of the design. The use of the direct drive EC motor reduces energy use, virtually eliminates maintenance costs and greatly reduces noise. The turbine/impeller unit with large inlet throat area allows for large flow rates at lower power consumption levels.

As illustrated in Figures 2 and 3, *ecopower* can use its combined natural and power modes to ventilate and cool buildings such as classrooms. The power mode provides guaranteed ventilation rates regardless of the wind conditions. This is of significance in all Australian climates and especially high humidity environments where air movement is essential for cooling.





Figures 2 and 3: Air flow patterns achievable in buildings with hybrid ventilators.

The combination of both mechanical and natural ventilation allows for greater cooling effects to be achieved. This is shown in Figure 4 where cooling rates can be improved by 300% to 500% using the higher flow rates of the power mode over natural ventilation alone.

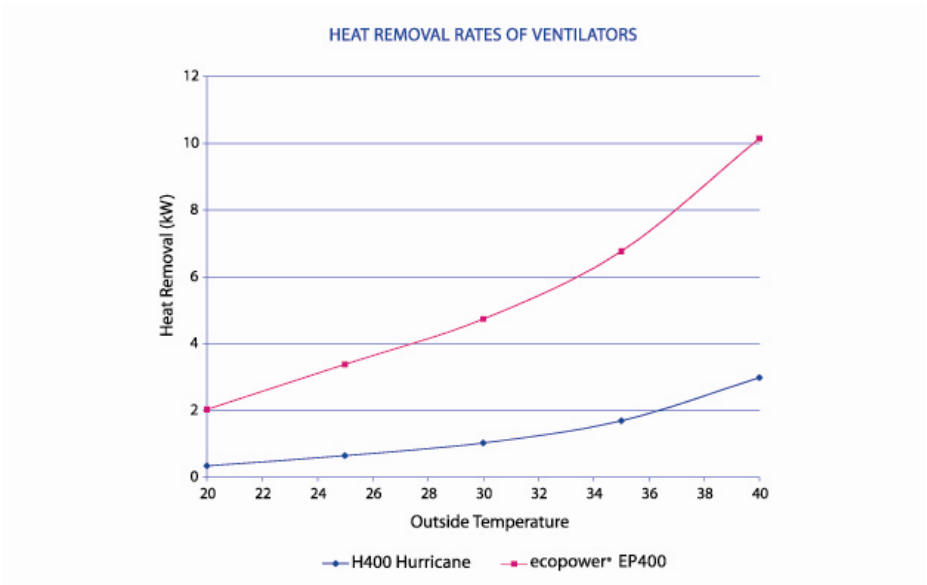


Figure 4: Heat removal rates of natural Edmonds Hurricane ventilators in comparison to powered *ecopower* units

The motor technology itself is innovative and groundbreaking, creating new opportunities for original equipment manufacturers and end users to explore. This advance in motor technology provides a simple use of high efficiency DC motors that connect direct to AC mains eliminating expensive and high risk installation issues.

Figure 5: The EC motor showing cut away of on board electronics and hard magnet motor

The motor design (Figure 5) is a world-wide product with one design with an input voltage range of 200 to 277V AC and 50/60 Hz. The ventilation performance will not change; the motor is intelligent enough to know where it is and adjust its performance accordingly to operate at the set speed regardless of voltage or frequency. It is no longer necessary to stock different products for different systems.

Utilising the control functions of the EC motor, hybrid ventilation systems can now be integrated into standard building management systems and controlled using standard sensor inputs.

Dramatic advances are available in the integral control functions of the motor thereby providing 100% noiseless speed control from any sensor input, BMS or internet access systems. The EC motor used in the EP900 can operate in isolation, while also logging its operation for later analysis. The motors can be controlled remotely via building management systems providing either a 0-10V or 4-20mA control input to the motor. This allows minimum ventilation rates to be achieved by ensuring minimum rotation rates but enabling the ventilation rate to be increased when heat load or greater ventilation rates are required.

The *ecopower* can be used with sensor units which have variable control inputs so stand alone units can be used to stack ventilate a car park when the CO levels are being closely monitored.

Indeed the *ecopower* can self regulate by means of an anemometer. In this case the anemometer measures the wind speed and hence the ventilation rate while in natural ventilation mode and then switches the unit to powered mode when the wind speed drops.

In harmony with the development spirit of *ecopower* the EC motor controls over 100% of its speed without loss of efficiency and without an increase in noise. This is a marked improvement with respect to most speed control systems utilised with AC motors.

..the performance

Natural ventilation, and in particular wind driven ventilation systems, have been with us for many years. They are proven and well used but have limitations with respect to control of ventilation rates. Chimneys, open windows and natural convection can also be exploited but again with limited control of ventilation rates.

Hybrid ventilation combines natural ventilation with high efficiency mechanical ventilation. It provides the best of both worlds by overcoming the limitations of each. In power mode, *ecopower* has a flow rate 3 – 5 times greater than the equivalent size wind ventilator operating at average capital city wind speeds.

The *ecopower* is available in four sizes and further, larger units will be released shortly. The details of the range are shown in Table 2. This shows that ventilation rates up to 4280m^3/hr are currently available. Supply voltages in both AC and DC are catered for allowing both solar and standard power systems to be used.

Model	Supply Voltage	Exhaust rate [m^3/hr]	Power [W]
EP100	6V DC	100	3.5
EP150	9V DC	200	10
EP400	240V AC	2400	68
EP600	240V AC	4280	116

Table 2: The range of *ecopower* products

A comparison between the powered performance of the *ecopower* and standard axial roof ventilation units in Table 3 highlights the differences. Massive reductions in noise: 9-11 dB(A) and power consumption: over 60% can be achieved. But, this is only in powered mode, in natural ventilation mode NO power is consumed.

Product	Exhaust rate [m^3/hr]	Power [W]	Noise @ 3m [dB(A)]
300mm, 2p, 1~ Axial fan	2160	160	55
EP400	2400	68	46
Improvement		63% lower	9 dB(A) lower
450mm, 4p, 1~ Axial fan	4280	480	60
EP600	4280	116	49
Improvement		76% lower	11 dB(A) lower

Table 3: Table showing exhaust rate, power and noise comparisons between *ecopower* EP400 and EP600 hybrid vents and standard axial mechanical roof ventilation units

An example case study is illustrated in Table 4, demonstrates running cost savings and CO_2 emission reductions of 75% based on the use of coal-fired electricity. In this example this equates to a $1763 annual saving and 12.3 tonne annual reduction in greenhouse gas emissions. The *ecopower* not only uses less power in powered mode but can also run for a shorter period due to the availability of continuous ventilation in natural mode. This allows for similar air change rates over a day compared to the mechanical unit which must run for a longer period.

Product	No. of units	Exhaust Rate	Run Time	Annual Energy Consumption [kWh]	Annual Energy Cost @ 10c/kWh	CO_2 emissions @700g/kWh [tonnes]
EP600	10	same	8hrs power 16hrs natural	3387	$338.70	2.4
Standard Mechanical Axial Roof Fan Unit	10	same	12hrs on 12hrs off (no ventilation)	21024	$2102.40	14.7

Table 4: Energy cost and emission comparison between *ecopower* and standard axial mechanical roof ventilation unit.

..the achievements

Verification of fan performance has been achieved in a test rig according to AS4740:2000. This has given building service designers the confidence to reduce their existing power bills.

Two notable but differing projects are the Mercure Hotel Sydney Airport and Alexandra Hills State High School QLD as shown in Figures 6 and 7.

Figure 6: *ecopower* installation on ventilation shaft on Mercure Hotel Sydney Airport.

Figure 7: *ecopower* installation in Alexandra Hills State High School QLD.

The installations in the Mercure Hotel involve substitution of *ecopower* for axial fans on classic natural ventilation chimney stacks which service bathrooms on each floor. Some of the existing belt driven centrifugal mechanical ventilation units were replaced with EP600s and noise and power consumptions reduced considerably Ventilation performance rates have been assessed as satisfactory

The installation at Alexandra State Hills School has dramatically improved the environment in the auditorium. Minimum ventilation rates were required for a multi occupancy building but further improved cooling ventilation was required for peak conditions. Again EP600 were used with simple temperature control to allow high efficiency and low carbon foot print cooling.

Some of the many additional *ecopower* installations include State Records, Penrith, Marist Bros. School, Kogarah, churches, where the demand ventilation feature is important during services, Bethany College Kogarah, and shortly at Bunnings Hoxton Park and Barker College, Hornsby NSW.

..other awards or industry recognition

ebm-papst and EC technology has won the following awards:
COOLworld (Au) Excellence and Green Innovator awards 2008
ARH Expo (US) innovation award 2008 and 2004
Cooling Industry Award (UK) 2005
H+V (UK) award 2006
ACR (UK) award 2005

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