



Shane Carmichael.

HEAT RECOVERY GAINS A FAN BASE

Heat recovery systems are gaining popularity thanks to commonsense technologies and ever-faster payback periods. SHANE CARMICHAEL explains how these systems can lead to significant energy reductions.

Heat and energy recovery is a fast growing technology used in the commercial building sector to reduce energy consumption and greenhouse gas emissions. The key drivers of this growth are the dramatically increasing costs of energy, coupled with the need for improved indoor air quality. Currently, heating, ventilation and air-conditioning (HVAC) is responsible for around 70 percent of Australian commercial buildings' energy usage, and 63 percent of greenhouse gas emissions.¹

Although forms of heat and energy recovery applications were developed during the 1980s and 1990s, they were never widely adopted in Australia because indoor air quality wasn't mandated or highly valued; second, the low cost of Australian energy made heat recovery a poor investment with long payback periods. For example, energy costs for industrial users in the 1970s were only around four cents per kilowatt hour, rising to 10-12 cents during the 1980s and 1990s. By 2010, there was an average of around 20 cents per kilowatt hour. With the impending Federal Government's proposed emissions trading scheme (ETS) or carbon tax scheme, energy distributors (NSW) warn of an alarming 64 percent increase in electricity costs over the next three years.²

SAVINGS IN ENERGY, PLANT SIZE

If we consider an example of heat recovery for heating (in winter), cold air from outside might enter the heat exchanger, for instance, at 6°C, picking up 75 percent of the energy from the already heated air leaving the building as exhaust. The cold outside air is then effectively preheated to 17°C through

the passive heat exchanger, simply capturing otherwise wasted energy. The 15°C temperature difference between indoor and outdoor air has now been reduced to only 8°C. This capacity saving generally provides a reduction in equipment plant size of around 40 percent, as well as ongoing reductions in running costs for the life of the equipment.

One of the main benefits of heat recovery technology is the energy saving aspect of pre-conditioning outdoor air, thus reducing peak energy loads. As a general rule of thumb, an air-conditioning system that utilises

- Section J of the Building Code of Australia (BCA)
- Green Building Council of Australia (GBCA) has employed a Green Star rating tool for commercial buildings based on building requirements for ESD principles and indoor air quality
- NABERS energy rating scheme
- Building Energy Efficiency Certificate (BEEC) for property owners of areas above 2000m² to disclose energy consumption before leasing or selling
- climate change and global warming have increased social and political awareness of the manmade activities affecting nature and the climate

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energy recovery technology will save approximately 40 percent of energy requirements (reducing operating costs) compared to a conventional air-conditioning system.

Air-to-air heat recovery devices consist of crossflow or counterflow plate heat exchangers and heat wheels, with the ability to transfer sensible or latent energy.

The use of heat recovery has been boosted by government and industry policies supporting sustainable measures and indoor air quality for commercial buildings as a necessary component of a carbon and energy constrained world. These policies include:

- Australian Standards for ventilation commenced in 1991 with AS1668 part 2, requiring outside air ventilation for buildings

- global treaties driving energy efficiency (Kyoto protocol, IPCC, Copenhagen). The Kyoto Agreement³ signed in 1990 requires Australia to restrict greenhouse emissions to 108 percent of 1990 levels by 2012. (Buildings consume some 30 percent of the world's resources, 10 percent of water and around 40 percent of the world's energy.⁴)
- corporate governance requiring Australian listed companies to report on energy usage
- non-renewable resources are depleting (80 percent of Australia's electricity source is coal)
- research and statistics have proven the positive effects of optimal indoor air quality on occupants' health and wellbeing (optimal indoor air quality

= improved morale and productivity. People spend on average 90 percent of their time indoors, and ideally 10-12 litres per second of fresh air per person is vital for their wellbeing.⁵⁾

- greater social acceptance to embrace a 'green image', including accountability for carbon emissions.

Apart from the core heat exchange technology discussed above, other essential energy efficiency components of a heat recovery system would include:

FANS & CONTROLS

Fan power in HVAC systems is one of the major energy consuming components. Fan power consumption can be reduced by installing variable speed drives (VSDs) on air-conditioning fans. The speed of the fan motors can then be controlled to match the amount of fresh air needed throughout the building, thereby reducing the energy use and operation costs by varying the amount of fresh air on demand. Generally, VSDs can save 30-40 percent on an HVAC investment annually.⁶

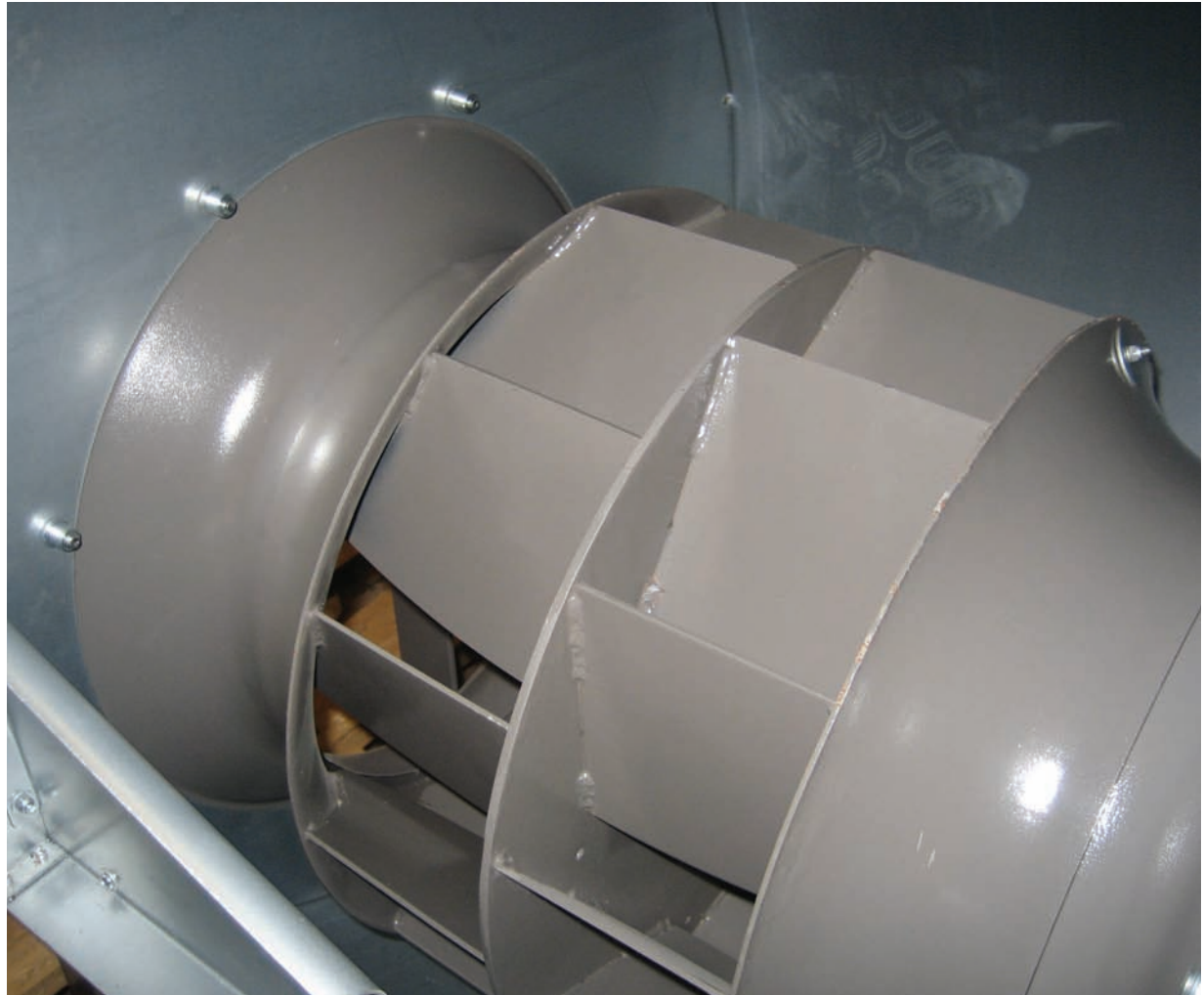
Backward curve fan design is more energy-efficient in most cases than a forward curve fan. Direct coupled fan and motors controlled by VSDs are a more energy-efficient method than fans driven by belts and pulleys. New EC plug fans are also proving to be an efficient option for use in HVAC systems.

INDOOR AIR QUALITY MONITORING

CO₂ sensors measure the carbon dioxide levels of indoor air and communicate with the HVAC system to adjust the amount of outdoor air introduced into the building. Detection is based on the measurement of CO₂ concentration in the air via infrared violent rays. This method allows for a balance between air quality and energy consumption.

ECONOMY CYCLE

When outside temperature conditions are mild (generally between 18-27 degrees), outdoor air sensors automatically detect this and allow the outside air to pass through the open dampers and into the building.



DEHUMIDIFICATION & FREE COOLING

In humid climates the use of an enthalpy heat exchanger for dehumidification can allow for the use of smaller HVAC equipment. Dehumidification of outside air through a heat exchanger significantly reduces energy consumption.

RETROFITTING

Ageing or obsolete air conditioning plants can be replaced by a modern heat recovery system. Alternatively, an easy way to enhance the efficiency of a functioning air-conditioning system is to simply add the heat recovery component. **FM**

Footnotes

1. Origin Energy Efficiency Fact Sheet: Heating Ventilation & Air Conditioning, 2008.
2. Electricity prices to rise by up to 64%, The Age, 18 March 2010. See the <http://news.theage.com.au>
3. Environmental Sustainable Buildings: Challenges & Policies, OECD Report, 2003.
4. Environmental Sustainable Buildings:

Challenges & Policies, OECD report, 2003.

5. Green Buildings in Australia: Drivers and Barriers, JL Wilson & E. Tagaza, The University of Melbourne, Business Outlook and Evaluation.

6. Origin Energy Efficiency Fact Sheet: Heating Ventilation & Air Conditioning 2008.

Shane Carmichael, NSW & ACT State manager for Air Change Australia, has more than five years of experience with heat recovery technology. He has completed a Bachelor of Engineering Mechatronics (Hons) and is currently undertaking a Master of Business Management at UTS.

Carmichael is an active member of the Australian Institute of Refrigeration Air conditioning and Heating (AIRAH), regularly attending events and seminars. He is also involved with other industry bodies such as the GBCA and takes a personal interest in the green building movement.

More information

Air Change

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