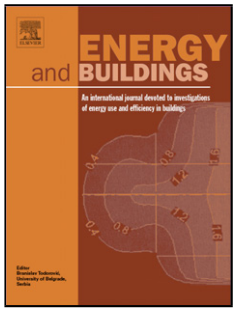

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Energy performance of GCC-specification LCC optimized dedicated outdoor air system configurations coupled to an air-cooled outdoor unit

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Highlights

- Compares five DOAS configurations of ERW, HW, reheat, and subcooler components
- Life-cycle costs from component cost/performance models, 8¢/kWh, hourly IWEC2 loads
- Air-subcooler cases: effectiveness range for ERW is 0.8-0.85 and for HW is 0.74-0.82
- DOAS with ERW, HW and reheating subcooler is cost-effective when annual FLEOH > 200
- HW across coil performs better than HW across supply/return streams in 24 climates

Abstract:

Direct expansion (DX) dedicated outdoor air system is shown to be a cost-effective energy efficient complement to ductless variable refrigerant flow and radiant cooling systems by providing conditioned ventilation air at the required set point temperature and relative humidity in an energy efficient manner. We compare five balanced flow dedicated outdoor air system configurations under typical office/lab ventilation loads coupled to an air-cooled outdoor unit for 24 Gulf Cooperation Council (GCC) locations representing GCC climates. All configurations use an enthalpy recovery wheel (ERW) to remove heat and moisture from intake air—before it reaches the active DX dehumidification element—by passive heat and mass transfer to the exhaust stream. It is found that of two run-around heat exchanger configurations, using a rotary heat wheel across the evaporator is a more efficient configuration than placing the heat wheel (HW) between the supply and return air streams. Furthermore, adding a subcooling coil for reheat in parallel to the HW results in higher efficiency than adding the coil in series with the HW. The Life cycle cost optimized ERW and HW effectiveness for the configuration with HW between supply and return air was found to be 0.86 while the ranges for run-around HW configurations with subcooling/reheat were found to be 0.8-0.85 for ERW and 0.74-0.82 for HW in GCC climates with significant dehumidification loads. Thus, the evaporator run-around HW may lower volume, mass and cost while providing higher overall efficiency.

Keywords: Air Handling Unit; Dedicated Outdoor Air Systems; DOAS; subcooling; reheat coil; efficient dehumidification; GCC climates; energy recovery systems; run-around heat exchanger

List of Symbols and Subscripts

Symbols		**Subscripts**	
$\dot{Q}$	Thermal load	$ERWX$	Air exhausted to outdoors by enthalpy recovery wheel's return stream side
T	Temperature	DB	Dry-bulb
w	Specific humidity	WB	Wet-bulb