EC Upgrade Case Study - 2013

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Scottish Parliament Building fan upgrade project, completed by ebm-papst UK Ltd and Airedale International Ltd

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Summary
This case study reviews how ebm-papst UK and Airedale Int worked together to provide The Scottish Parliament Building with approximately 50% reduction in power consumption on its computer room cooling, achieved by upgrading their Airedale aircon units to use ebm-papst UK EC fans.

The result was in initial savings of 11.5 tonnes of carbon per year and a payback period of 21 months.

Further savings are expected when the second phase of this project is implemented, when overall financial savings of £13,500 per year are expected, with a reduction in carbon emissions of 20tonnes per year.

Background
The Scottish Parliament is dedicated to reducing both carbon footprint and energy bills, Environmental Performance Manager David Fairhurst has already made significant improvements to the building in recent years having already achieved a reduction in carbon emissions of 25%. Following a presentation by ebm-papst UK on energy savings possible on existing HVAC equipment by upgrading to EC fans, Mr Fairhurst approached ebm-papst UK and asked that a survey be carried out on the Parliament Building's HVAC equipment.

ebm-papst UK identified the HVAC equipment that would offer the greatest potential for energy savings, and by working together with the original equipment manufacturer Airedale was able to provide the best solution.
It was decided that the computer room cooling offered the best potential for energy savings, therefore an initial trial was carried out on one Computuer Room Air Conditioning (CRAC) unit; following excellent results on the initial trial unit, further installations have been carried out on both CRAC and air handling units (AHUs).

This report considers savings achieved for the CRAC units, subsequent savings on the AHU's will be reported separately.

Mr Fairhurst said: "The Scottish Parliament is committed to reducing its carbon emissions by more than 40% by 2020. To achieve this we need to reduce electricity use by at least 40%. ebm-papst UK claimed that its fans would deliver at least this level of reduction and this claim has been proved to be true. EC fans are a step change technology, much like LED lighting, which has been a very welcome addition to our carbon management plan".

Site Survey
An initial site survey was carried out on the HVAC equipment, with measurements taken of power consumption and performance.

Based on the data collected, ebm-papst UK was able to ~~a~~ design a suitable EC fan solution and produced estimates of energy savings and paybacks.

The site survey looked at CRAC units, AHU's and fan coil units, and based on the estimated energy savings it was decided that the initial trial be carried out on one of the Airedale CRAC units (DF50CW).

Trial Unit
The trial was carried out on an Airedale DF50CW downflow CRAC unit.

Each computer room contains two air conditioning units, the majority of these being downflow units, which are installed on a raised floor.

The trial involved replacing the existing fan (AC belt driven blowers) with new EC backward curved RadiCal fans, and also re-locating the fans into the floor void(*).
The relocation of the fans into the floor void involved opening up the floor of the unit, and lowering the backward curved fans into the space, the EC fan is mounted in a custom frame which allowed for easy installation.

Once installed, the EC fans were set to meet the same airflow as the original AC fans - this was done by use of a simple potentiometer that provides a 0–10v control signal to the EC fans.
The current and power draw of the fans was then measured and compared with the original AC fans.

The trial resulted in a reduction in current draw of approximately 50%.

The original Fans

Two off AC forward curved belt drive blowers, positioned inside the unit.

The New EC solution

Two off EC backward curved fans, positioned in the floor void.

(*)For downflow units, if the floor void is deep enough, installing the fans in the floor void can provide additional energy savings due to the reduced operating pressure.

Full installation
Following the trial on DF50CW, which resulted in a reduction in current draw of approximately 50%, it was decided to continue and upgrade the fans in all the computer rooms.

A total of five computer rooms have now been upgraded with a single CRAC unit per room, however, each room has two CRAC units with one always on standby. The standby unit has not yet been changed to EC.

To achieve further energy savings ebm-papst UK has recommended that rather than have one unit on standby, a more efficient solution is to run both CRAC units at 50% performance (to give an overall matched airflow). Due to fan laws this will result in an additional 50% reduction in energy consumption for the same performance.

To satisfy the need for back-up in the event of one of the two units failing, the units will be linked via an upgraded Airedale control, which means tha the EC fans of one unit will automatically ramp-up to compensate for any failure of the fans in the other unit.

Results / Analysis
Power measurements were taken on all units before and after the upgrade to EC fans.
In all cases the airflow of the EC units was set to the same as the AC units.

Savings varied dependent on the size and number of fans per unit, the larger units which have two fans fitted showing more savings than the smaller units with only a single fan, however, the overall energy savings are still significant.

Measurements taken include: current draw, power draw and power factor.

Fan Type	Measurements			Annual figures		
	Current (A)	Power Factor	Power (kW)	Power (kWh)	Carbon (T)	Cost (£)
AC Fans	41.9	0.71	18.24	159,782	23.8	£15,978
EC Fans	15.2	0.91	9.38	82,169	12.2	£8,217
Savings	26.7	-0.2	8.86	77,613	11.6	£7,761
% Savings				**49%**		

Note:

i. *due to the improved power factor of the EC fans, the reduction in current draw is considerably greater than the reduction in power, therefore the below table shows both figures.*

ii. *Assumptions made for calculations*

Operation	*8760hrs / year*
Electricity cost	*10p/kWh*
kWh to CO_2	*conversion factor = 0.54522*
CO_2 to Carbon	*conversion factor = 0.2727*

Summary of Savings

Based on operation - 24 hours/day, 365 days/year

Savings (annual)		All five Units @ matched airflow
Energy saving)		49%
Energy	(kWh)	77,614
Value	(£)	£7,760
Carbon	(T)	11.5
Payback Period		21 months

It was also noted by the client that due to the higher efficiency of the EC fans, the motors run cooler and therefore the overall cooling load in the server rooms was reduced.

Further savings

In addition to the savings already achieved, further savings are expected by carrying out the following additional upgrade.

- **Running all units at 50% performance rather than leaving some on standby.**
  As mentioned, all comms rooms have two CRAC units, however only one of these operates at any one time, leaving the second unit on standby.

  The proposal is to run both units at 50% performance. Based on making these changes the estimated energy savings will be as follows;

  Saving - running 1 unit @ 100% performance 49% (annual savings = 11.5T Carbon & £7.7k)
  Saving - running 2 units @ 50% performance each 85% (annual savings = 20 T Carbon & £13.5k)

Conclusions

The initial upgrade of one CRAC unit per computer room has resulted in energy savings of approx. 50%, with an annual reduction of 11.5 tonnes of carbon and a financial saving in the region of £7,700 per year.

When the second phase of this upgrade has been completed and all CRAC units are running, rather than leaving half the units on standby, the estimated saving will be in the region of 20tonnes of carbon and £13,500 per year.