



# Federation of European Heating, Ventilation and Air-Conditioning Associations

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REHVA **Rue Washington 40, 1050 Brussels**  
**Belgium**

- [www.rehva.eu](http://www.rehva.eu)
- [info@rehva.eu](mailto:info@rehva.eu)
- Tel: +32 2 514 11 71
- Fax: +32 2 512 90 62



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# Design of energy efficient ventilation and air-conditioning systems

**REHVA Guidebook n° 17**

***Nejc Brelih (ed.)***

***Olli Seppänen***

***Thore Bertilsson***

***Mari-Liis Maripuu***

***Hervé Lamy***

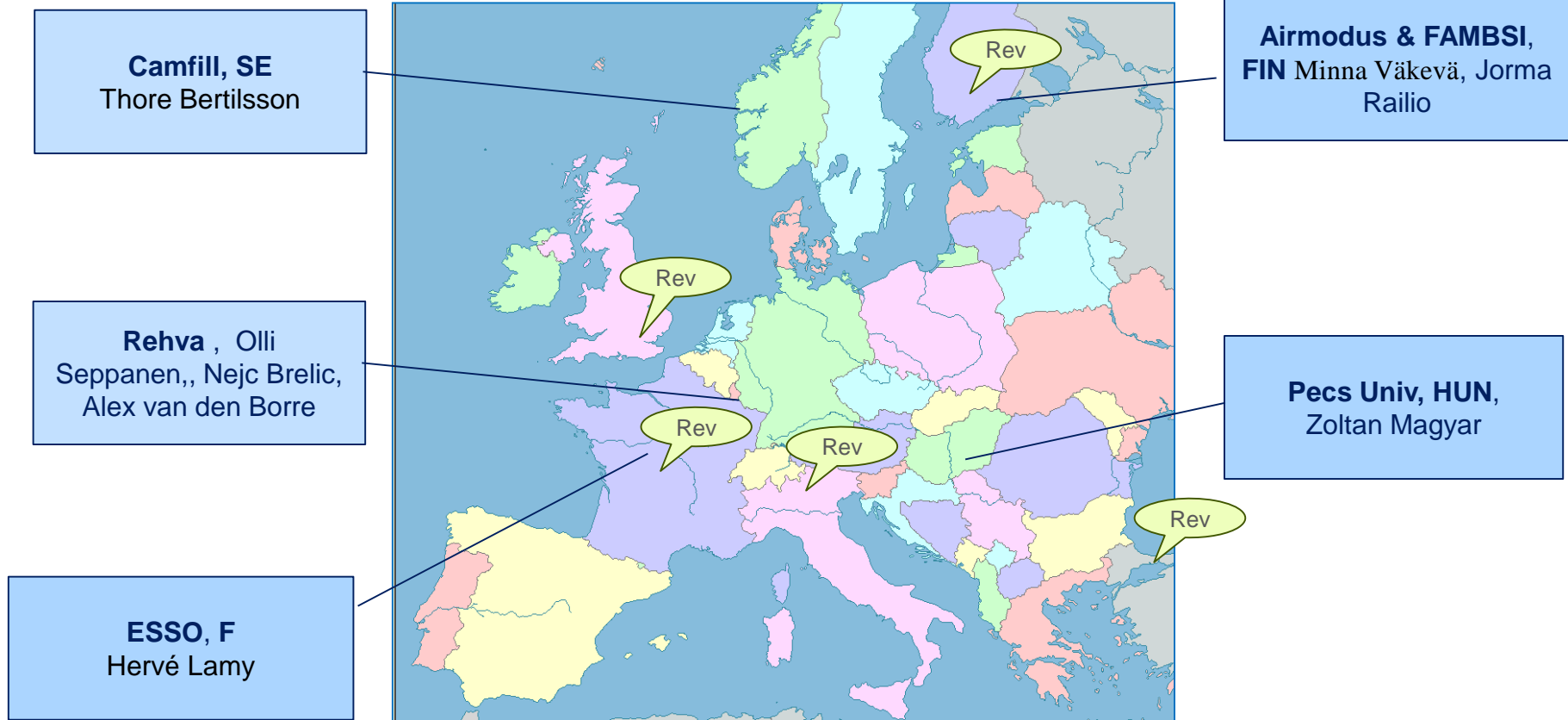
***Alex Vanden Borre***

# Why this Topic ?

In light of the future stringent EU energy regulations, **design of ventilation and air-conditioning systems** will play an increasingly important role. The traditional approach, with HVAC design being an indispensable phase of the project will have to be **integrated into the building design right from the beginning of the project.**

The major focus of the book is on the current state-of-the art equipment and systems. **Practical guidance** is offered for the selection, installation and operation of equipment, as well as information on the future design trends.

# Rehva Task – Guidebook 17



**Reviewers:** Ahmet Arisoy (Turkey), Derrick Braham (UK), Vincenc Butala, (Slovenia), Gianfranco Rizzo (Italy), Christian Feldmann (France), Risto Kosonen (Finland)

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# Aim of the Guidebook

Although the goal of building **nearly zero energy buildings** may appear difficult to achieve in less than 10 years from now, the good news is that the know-how is already available.

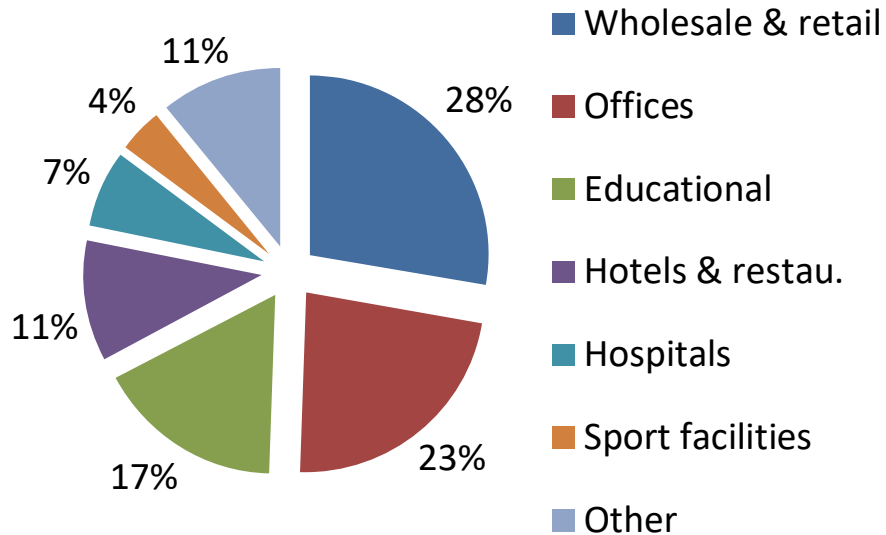
We hope that this guidebook will prove to be a valuable source of this knowledge and that after reading it the reader will be able to successfully use it in practice.

# Guidebook Contents

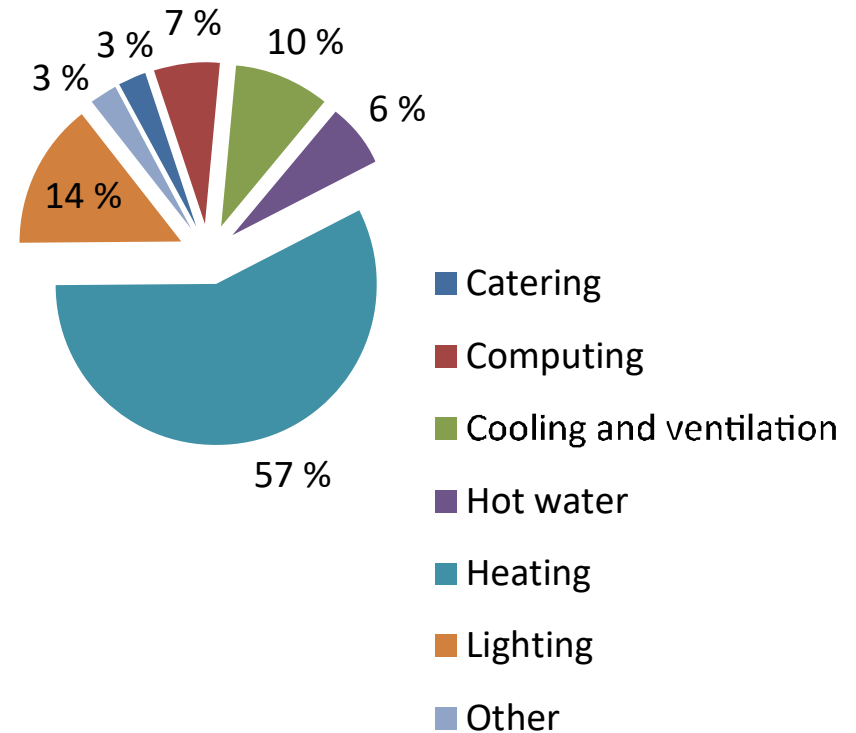
- |          |                                     |           |   |
|----------|-------------------------------------|-----------|---|
| <u>1</u> | <u>Terminology</u>                  | <u>8</u>  | <u>Demand controlled ventilation</u>    |
| <u>2</u> | <u>Energy &amp; buildings in EU</u> | <u>9</u>  | <u>Design and balancing of ductwork</u> |
| <u>3</u> | <u>Indoor environmental quality</u> | <u>10</u> | <u>Chillers and heat pumps</u>          |
| <u>4</u> | <u>Air handling units</u>           | <u>11</u> | <u>Pumps and hydronics</u>              |
| <u>5</u> | <u>Energy efficient fans</u>        | <u>12</u> | <u>Elect motors and variable speed</u>  |
| <u>6</u> | <u>Air filters</u>                  | <u>13</u> | <u>Solar shading equipment</u>          |
| <u>7</u> | <u>Air-to-air recovery systems</u>  |           | <u>References</u>                       |
|          |                                     |           | <u>Appendix 1: Simulation details</u>   |



# Energy and buildings in Europe

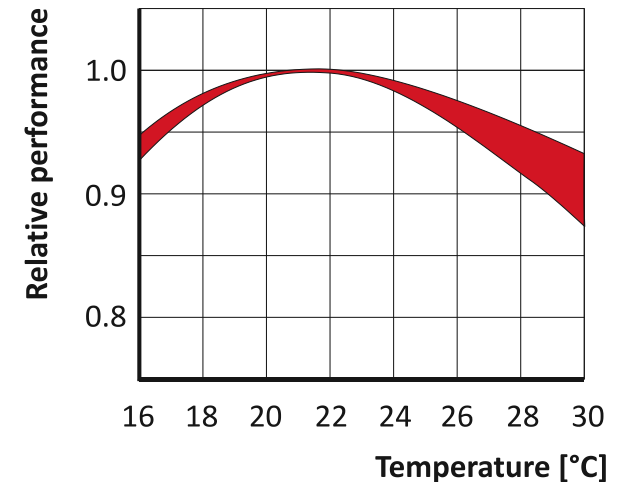
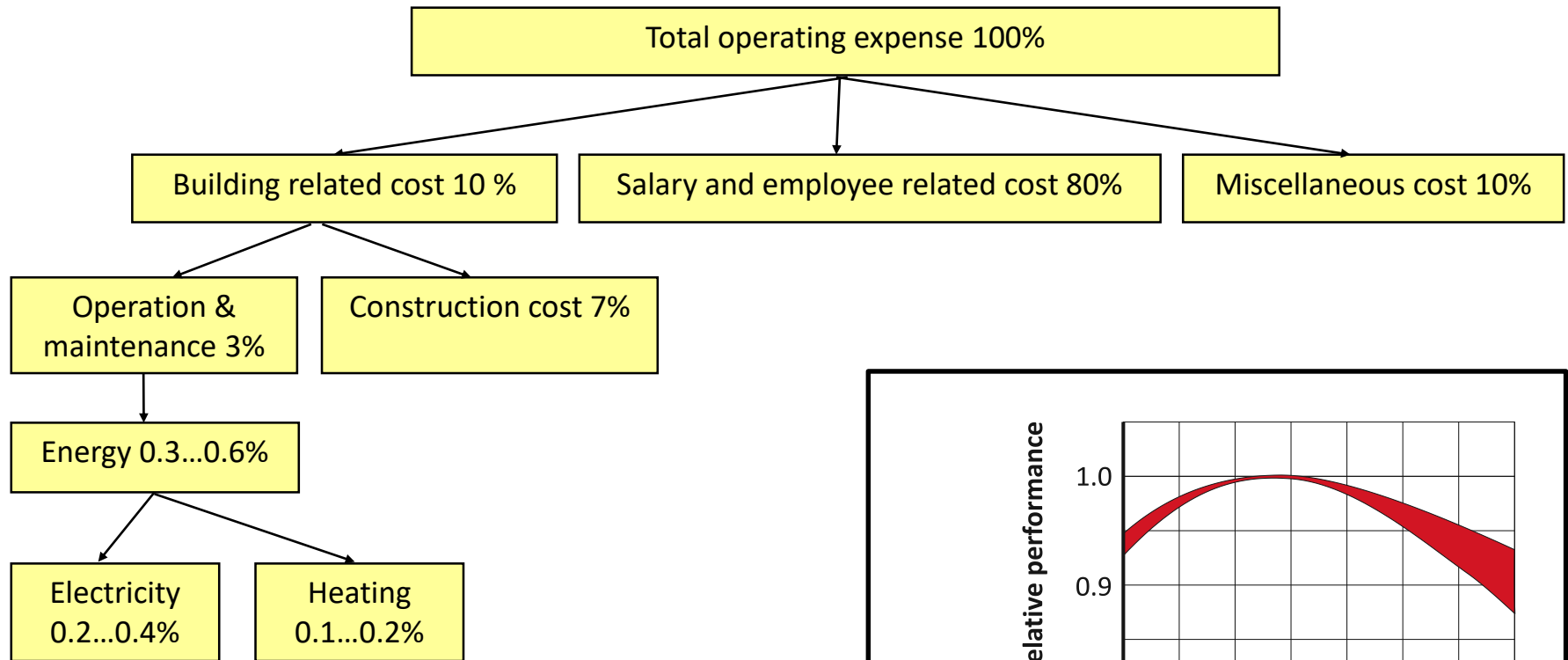


*Non-residential floor space for the European countries with industrial buildings excluded (source: BPiE).*



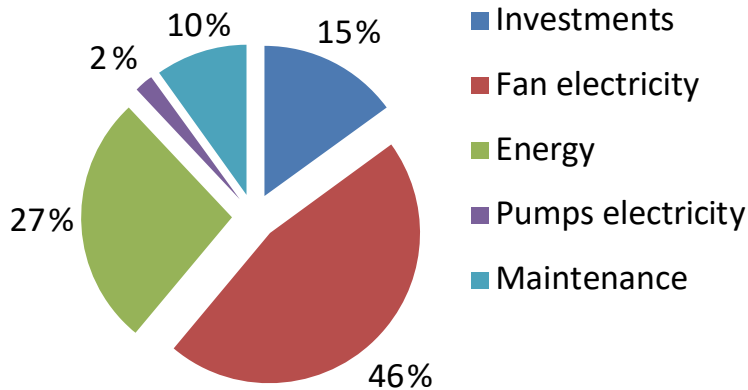
End use energy splits in British office buildings in 2006

# Indoor Environmental Quality

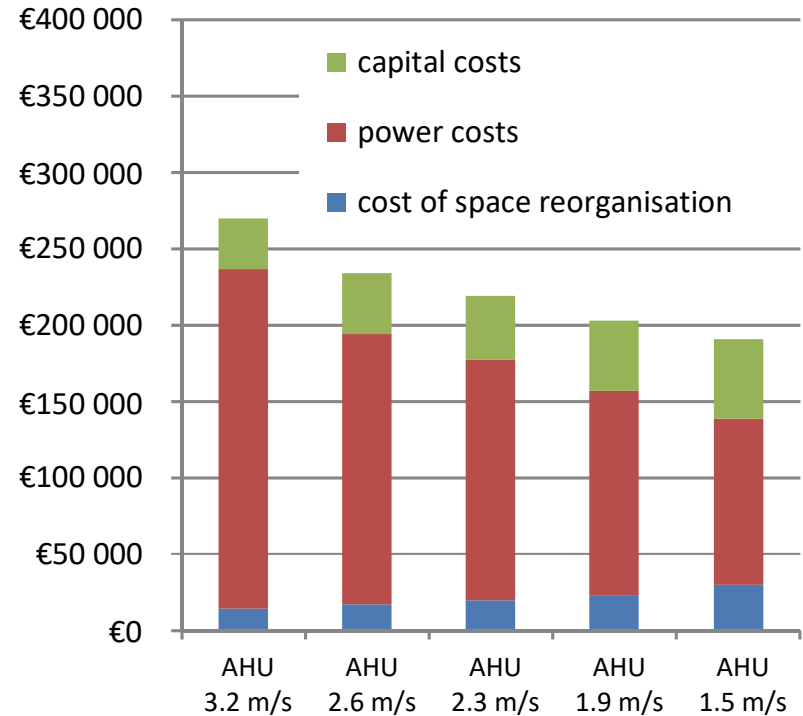
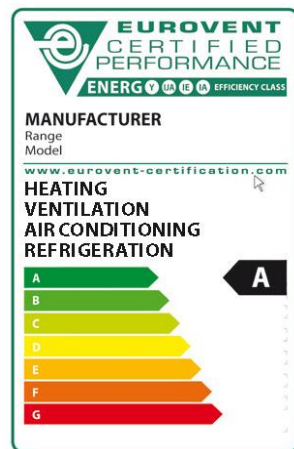


Normalized performance in office work

# Air Handling Units, Fans & Filters



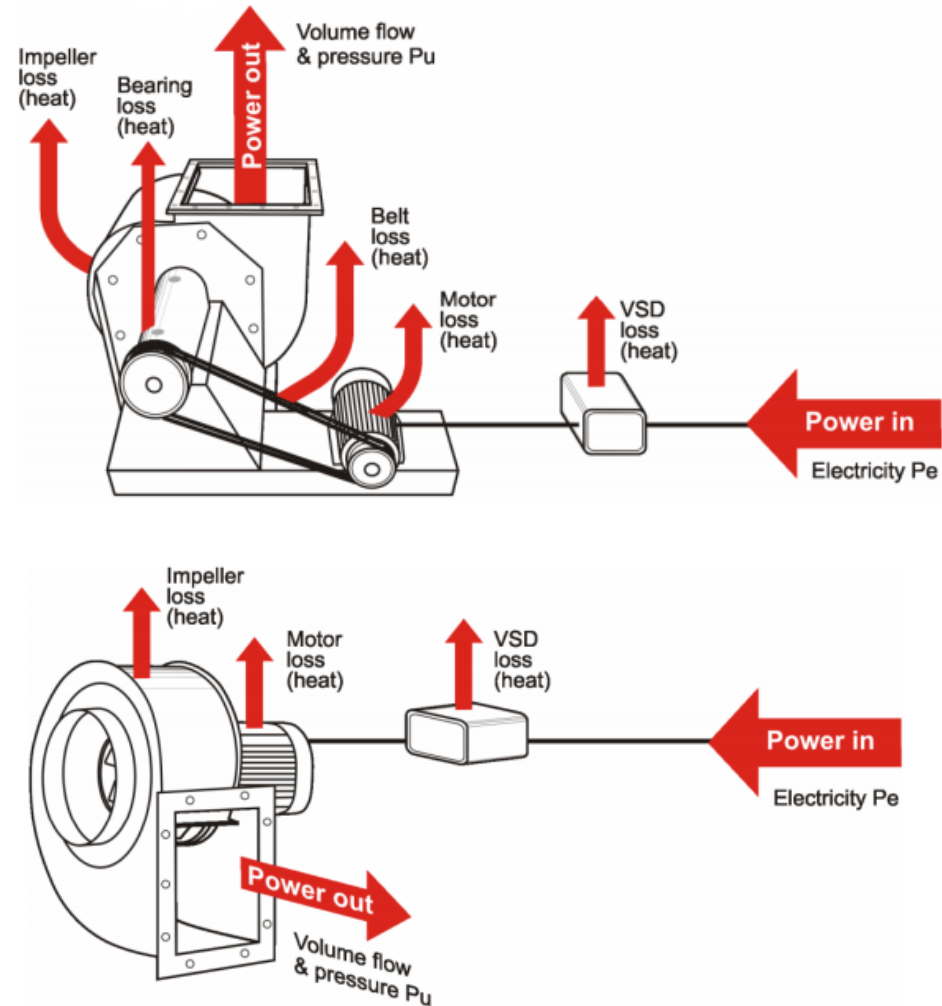
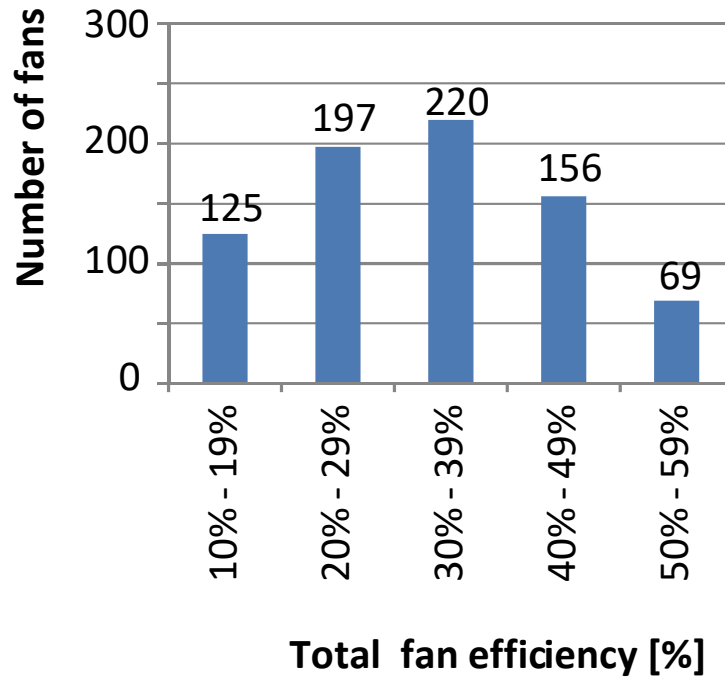
Typical split of life-cycle costs for AHUs in office buildings (Source: Eurovent)



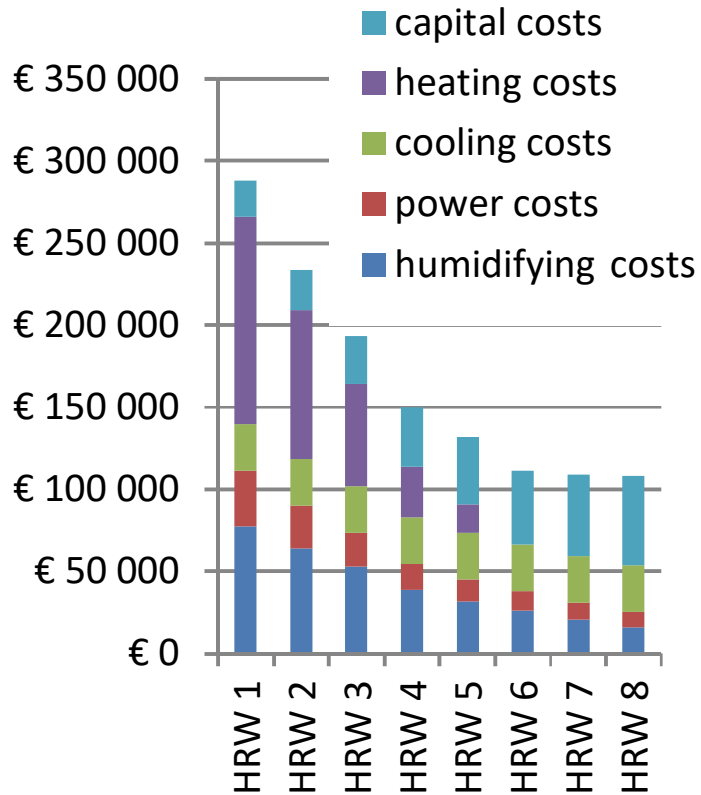
LCC analysis of 5 different sizes of AHUs with different face velocities – operating time 24 hours per day, 7 days per week (source: AL-KO).

# Air Handling Units, Fans & Filters

Results of total efficiency measurements of 779 fans in Sweden



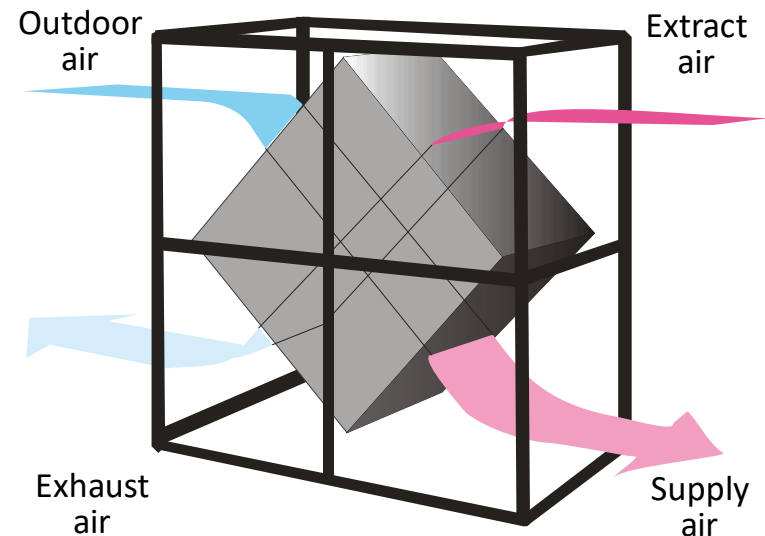
# Air-to-air Heat Recovery Systems



An example of a LCC analysis of heat recovery equipment (source: AL-KO).

Classification of heat recovery units according to EN 13053.

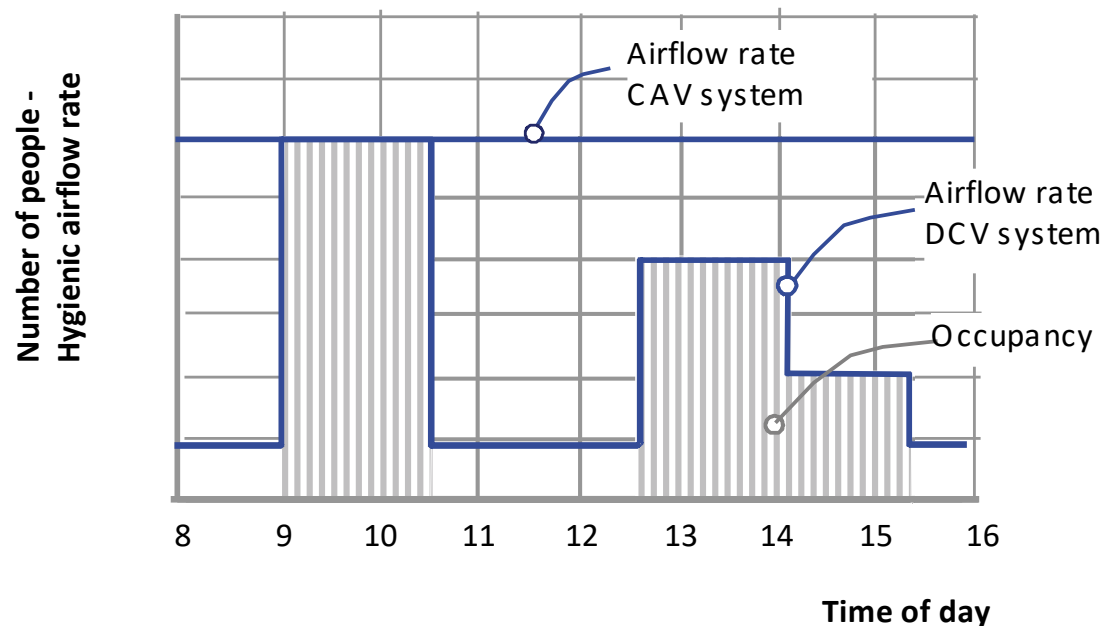
Class	Temperature effectiveness	Sum of pressure losses [Pa]	Coefficient of performance	Energy efficiency
H1	0.75	2 x 280	19.5	0.71
H2	0.67	2 x 230	21.2	0.64
H3	0.57	2 x 170	24.2	0.55
H4	0.47	2 x 125	27.3	0.45
H5	0.37	2 x 100	26.9	0.36



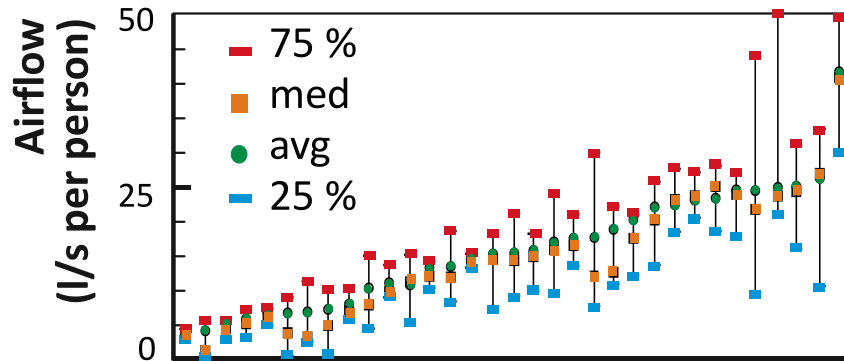
# Demand Controlled Ventilation (DCV)

Recommendations in a nutshell:

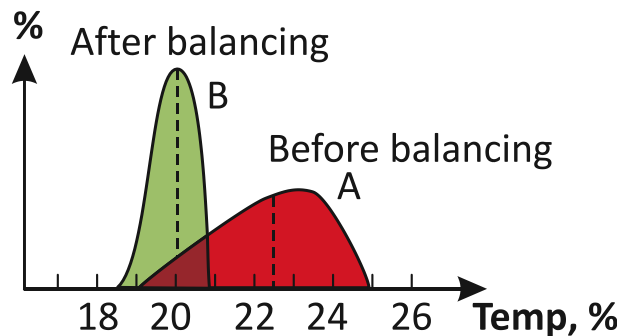
- DCV systems can be successfully applied for indoor air quality control in a number of different types of buildings.
- The most suitable is application in premises with varying occupancy density.
- The controlling sensor must be located in a place where it best represents and responds to the measured indicator.
- For best performance a DCV system should be designed, installed, commissioned and operated under a constant and complete commissioning process.



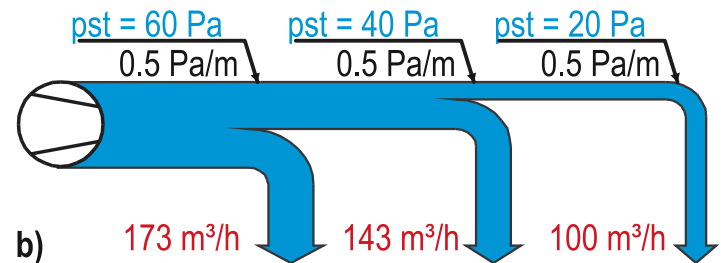
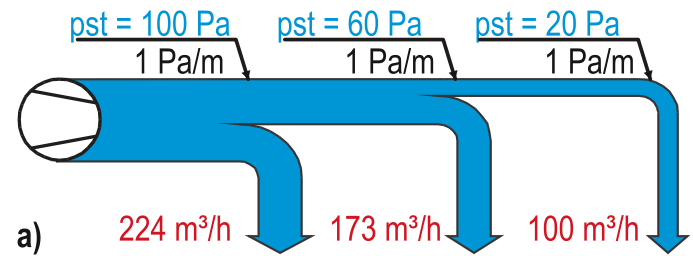
# Design and Balancing Ductwork



Range of outdoor air flows in 33 randomly selected mechanically ventilated office buildings in the Helsinki metropolitan area

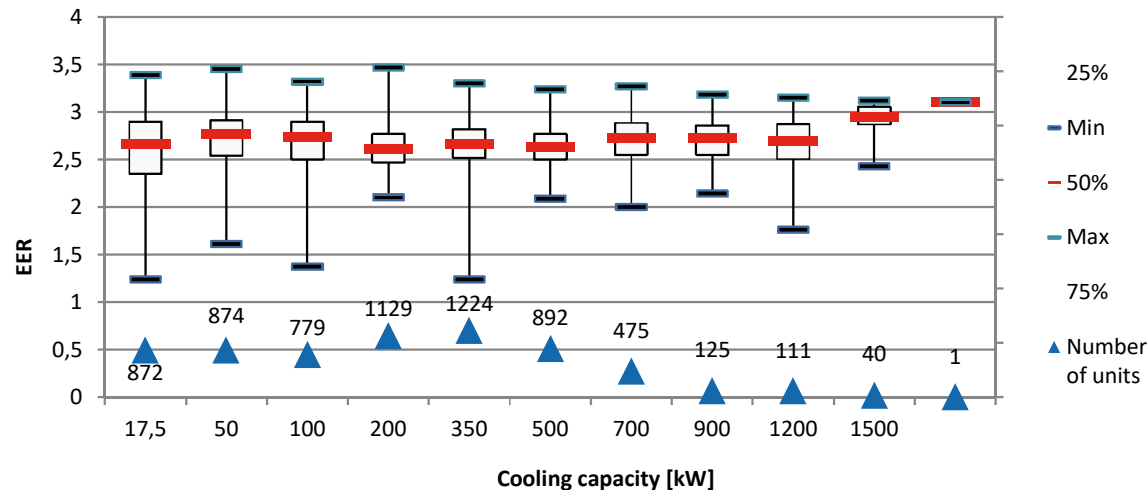
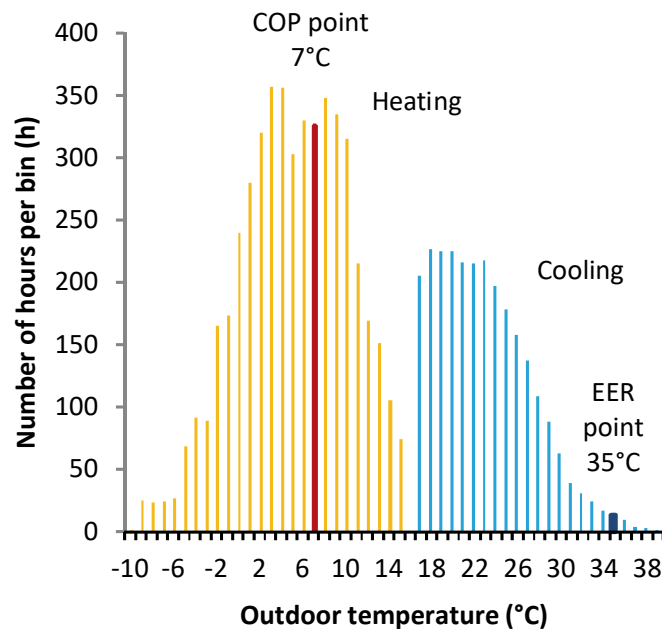


. Distribution of room temperatures



# Chillers and Heat Pumps

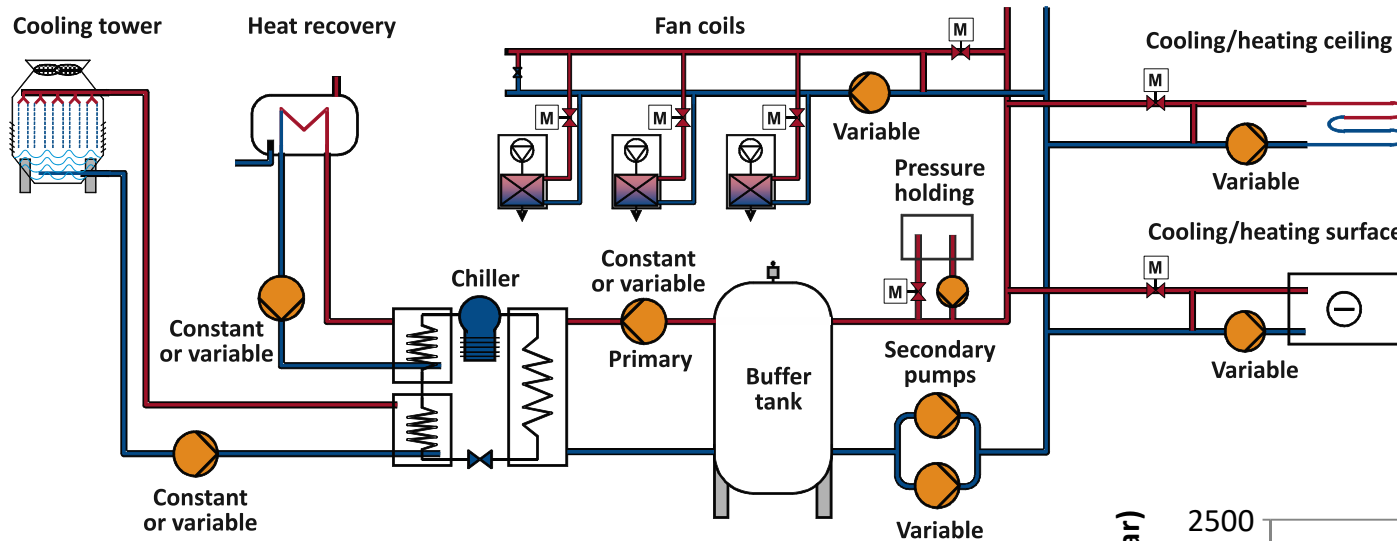
Number of hours per one degree of outdoor temperature for the typical cooling and heating seasons in average European climate (e.g. Paris, London, Berlin, Vienna). COP and EER points show the standard temperatures for the calculation of COP and EER according to EN 14511.



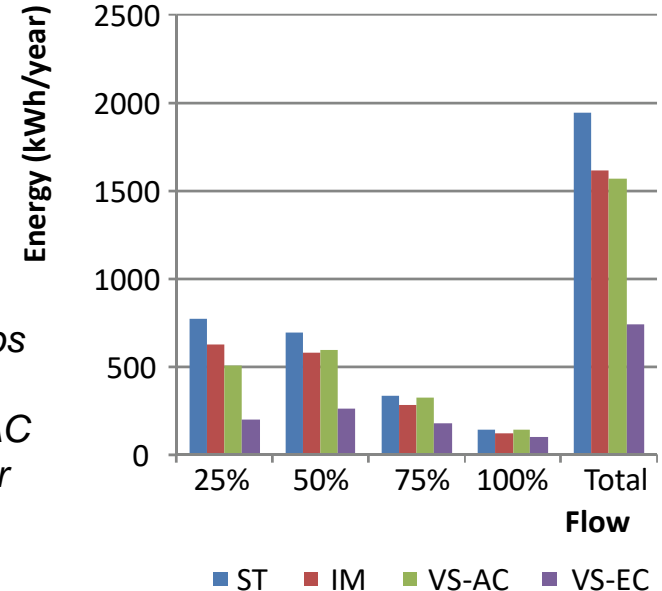
Air-cooled chillers – EER distribution in Eurovent database from year 2010 (Rivière, 2011).



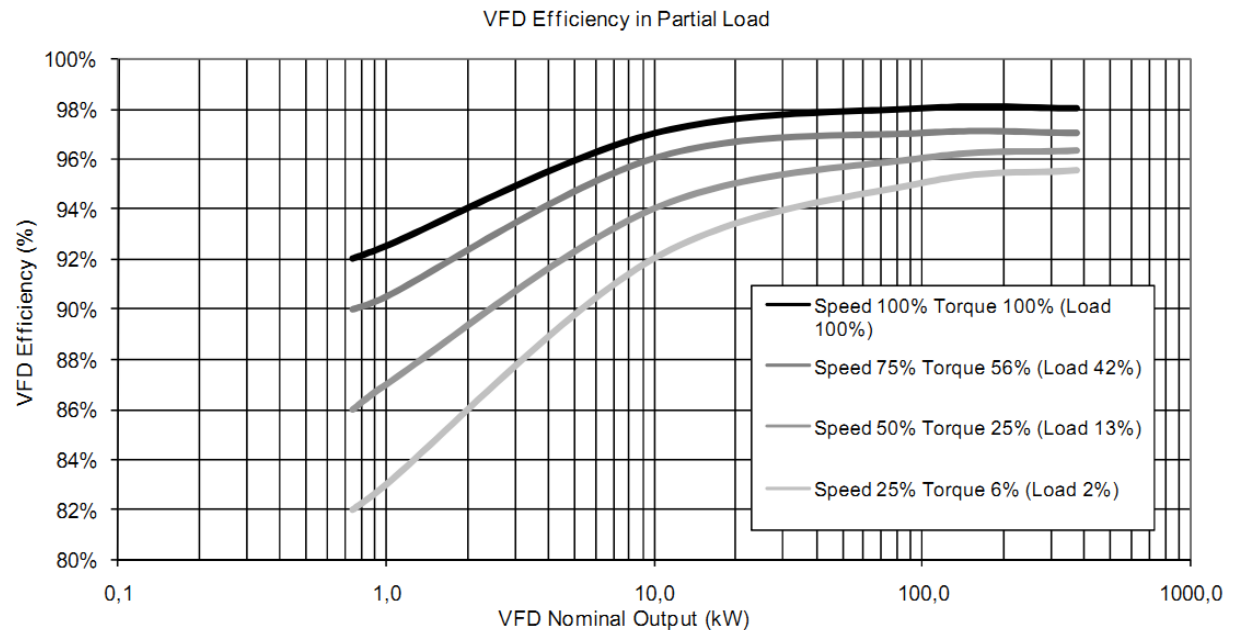
# Pumps and Hydronics



*Energy consumption of four different circulation pumps (ST – a standard single-speed pump; IM – a single-speed pump with improved hydraulic efficiency; VS-AC – a variable speed pump with an asynchronous motor and a variable frequency drive; VS-EC – a variable speed pump with EC motor)*

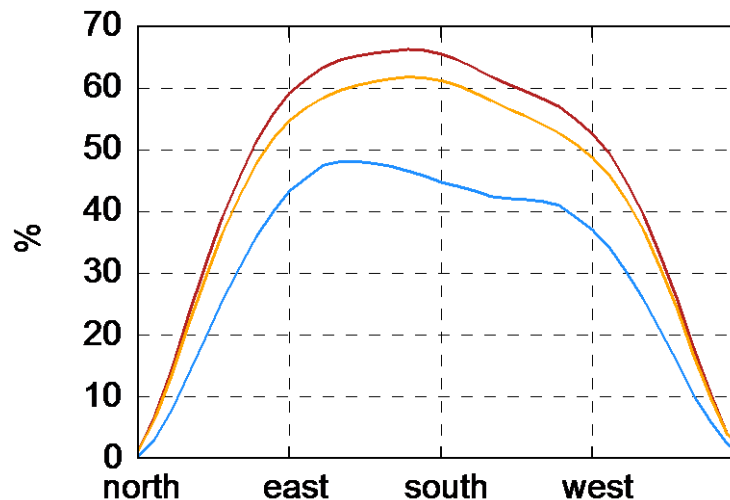
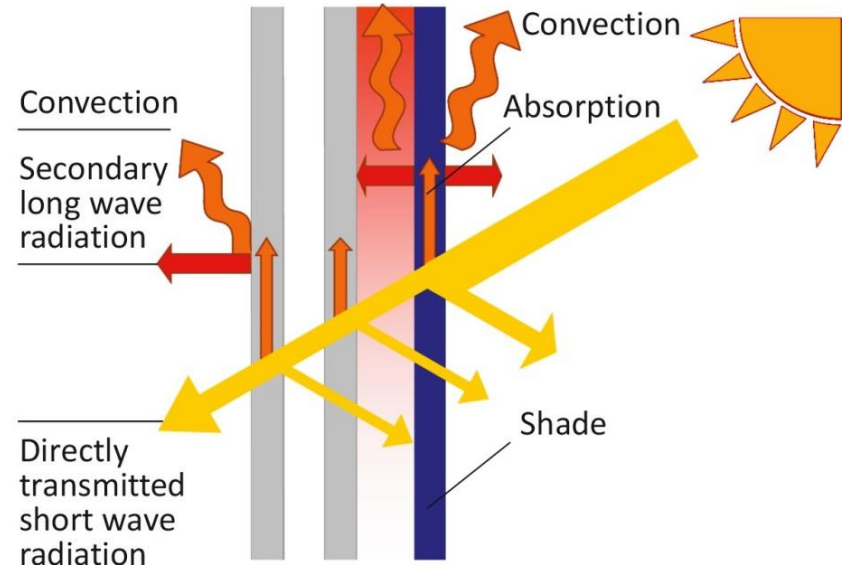


# Electric motors and variable speed drives



Typical efficiency of indirect three-phase voltage source converters with a passive front-end (IEC 60034-31).

# Solar Shading Equipment



The reduction of primary energy used for heating, cooling and lighting with automatically controlled solar shading compared to energy use without shading for double glazing (red line), low-e glazing (yellow line) and solar control glazing (blue line). A simulated case for an office in Madrid

**Thank you  
for your  
attention**

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