

Savings with natural and mixed-mode ventilation

The Fraunhofer-Institute for Building Physics in Stuttgart has performed detailed energy calculations of an office building with an area of almost 3,000m² / 32,291.73ft² equipped with either natural (NV), mechanical (MV) or mixed-mode (MMV) ventilation. The building performance was investigated in three different locations in Europe; Copenhagen, London and Munich



Indoor air quality (CO₂) and thermal comfort (operative temperature) were evaluated in the report¹, in accordance with the European Norm “EN 15251” Category II.

The indoor climate was kept identical for all three ventilation principles as this would make the consumed energy more comparable.

Category	Operative Temperature (Winter)	Operative Temperature (Summer)	Operative Temperature (Transient)	Carbon Dioxide Level during the year
II	20°C ≤ t ₀ ≤ 24°C	23°C ≤ t ₀ ≤ 26°C	20°C ≤ t ₀ ≤ 26°C	≤ 900 ppm
	68°F ≤ t ₀ ≤ 75.2°F	73.4°F ≤ t ₀ ≤ 78.8°F	68°F ≤ t ₀ ≤ 78.8°F	

Requirements to the operative temperature and carbon dioxide level according to [EN 15251] Category II

Energy consumption

The figure on the right shows the primary energy consumption (sum of heating and fan electricity demand multiplied with primary energy factors for 2015) for the three ventilation principles. The result shows that natural ventilation uses 9–11 kWh/m²/year, mechanical ventilation 20–25 kWh/m²/year and mixed-mode ventilation 7–8.5 kWh/m²/year. Mixed-mode ventilation enables energy savings of 20–25% compared with natural ventilation and 60–70% compared with mechanical ventilation.²

Based on the Fraunhofer IBP energy calculations the CO₂ emissions and the economy seen over a 20 year period were calculated:

CO₂

In comparing the CO₂ emissions from electricity use and heating it can be seen that natural and mixed-mode ventilation emits much less CO₂ compared to a mechanical system during one year. The mixed-mode ventilation emits approximately 20% less than natural ventilation.

Economy

A Life Cycle Cost (LCC) over a 20 year period has been performed, which includes the capital cost, maintenance of the systems and the operational cost

Primary energy consumption

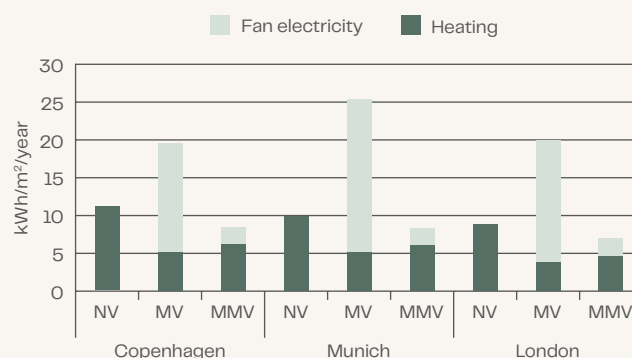


Figure 1: Data based on Fraunhofer IBP calculations and assumptions

CO₂ emission

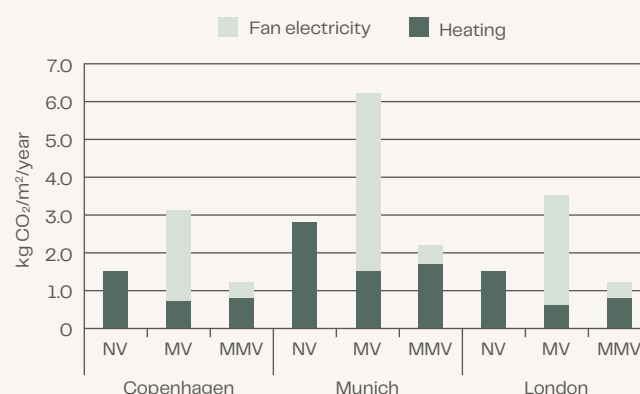


Figure 2: Calculations of CO₂ values carried out by WindowMaster



(electricity and heating). Over a 20 year period the natural ventilation system is 5 times cheaper than the mechanical system. The mixed-mode system is 2.5 times cheaper than the mechanical system.

Based on the energy calculations by the Fraunhofer IBP it was found that natural and mixed-mode ventilation reduce the energy, CO₂ emissions and Life Cycle Cost compared to a mechanical system. Each of the two systems has pros and cons and WindowMaster can help you choose the optimal system that fits your purpose/building.

Contact WindowMaster for further details about the report contents and calculations.

Life Cycle Costs

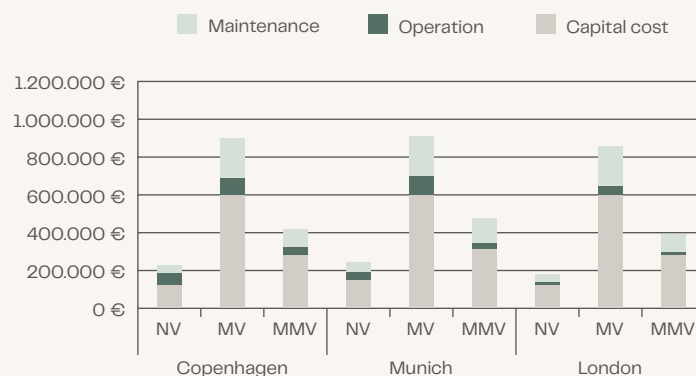


Figure 3: Calculations of Life Cycle Cost carried out by WindowMaster

1 Fraunhofer IBP report no RK 013/2012/295

2 WindowMaster has calculated the energy performance for the mixed-mode ventilation based upon improvements suggested by Fraunhofer IBP

WindowMaster aspires to protect people and the environment by creating a healthy and safe indoor climate, automatically ventilating spaces with fresh air through facade and roof windows in buildings. We offer the construction industry foresighted, flexible and intelligent window actuators and control systems for natural ventilation, mixed mode ventilation, and smoke ventilation – of the highest quality.

WindowMaster employs highly experienced cleantech specialists in Denmark, Norway, Germany, United Kingdom, Ireland, Switzerland, and the United States of America. In addition, we work with a vast network of certified partners. With our extensive expertise built up since 1990, WindowMaster is ready to help the construction industry meet its green obligations and achieve their architectural and technical ambitions.

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