Energy efficiency and ventilation

information document edited by Aereco company

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The building sector is responsible for about 40% of Europe's total primary energy consumption. The **Energy Performance of Buildings Directive (EPBD)** is an important step for the European Union in order that it should reach the level of saving required by the Kyoto agreement, which commits to reduce CO2 emissions relative to the base of 1990 by 8 per cent, by 2010.

The national energy regulation assesses today most of the components which impact on the energy performance of the building, like heating equipments, insulation, glazing, etc. **But the energy impact of ventilation, although it can reach up to 50% of the energy consumption of the dwelling, is still not assessed.**

This document aims at giving some keys to compare different ventilation techniques and their consequences in terms of energy, cost and carbon savings. The UK is taken as an example.

Ventilation systems in the English building regulation

Part F, document [F1] (Means of ventilation) of the Building Regulations 2000 (2006 edition) describes four general ventilation systems to be used for the ventilation of dwellings:

1-Background ventilators and intermittent extract fans:
It provides continuous background ventilation via background ventilators and air leakage. Local extract fans are installed in 'wet' rooms and operate intermittently under either occupant or automatic control.

2-Passive stack ventilation:
Air is drawn into the dwelling via background ventilators. This is a local extraction system comprising of vents located in kitchens and bathrooms. They are connected via near-vertical ducts to ridge or tile terminal so that warm, moist air is drawn up the ducts through a combination of stack effect and wind effect. No fan motor, no energy consumption from this element.

3-Continuous mechanical extract:
The system continually extracts air from 'wet' rooms by mean of a ventilation unit composed of extract units connected to a fan. Replacement of dry air is drawn into the dwelling via background ventilators.

4-Continuous mechanical supply and extract with heat recovery:
The system continually supplies and extracts air via a fan incorporating a heat exchanger.

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Calculation of the energy impact of ventilation systems

The total energy consumption allocated to the ventilation (Ec,total) is the sum of two parameters:

- **the electrical power used by the fan**
- **the energy needed to heat up the incoming air during the heating season** (Ec,heating)

The evaluation of Ec,heating in this study results from a calculation based on a thermo dynamical software called "SIREN" *, which hypothesis** have been adapted to this study.

> *SIREN: this software has been created by CSTB (Centre Scientifique et Technique du Bâtiment), and is used to assess energy efficiency and indoor air quality according to ventilation and building technical parameters. Improved each year for more than 10 years, SIREN is notably able to assess demand controlled ventilation systems.
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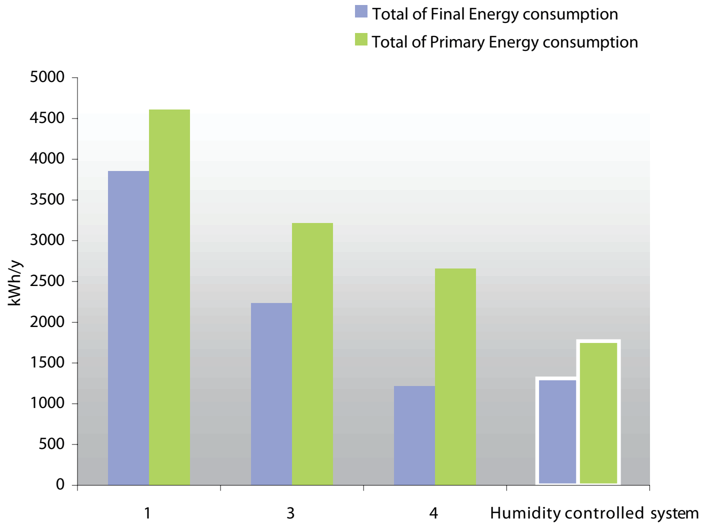
> **Hypothesis:
> The weather data used for the calculation was the one of London, with a heating period of 231 days. The dwelling is an example taken from Part F: a semi-detached house composed of five main rooms, one kitchen, one bathroom and one WC. Four person live in this house according to the scenario input of SIREN software (CO_2 and H_2O indoor emissions). The air leakage (4ACH) and the airflow for systems 1,3 and 4 are the one of the Part F. The humidity controlled airflow are based on Aereco's components characteristics.

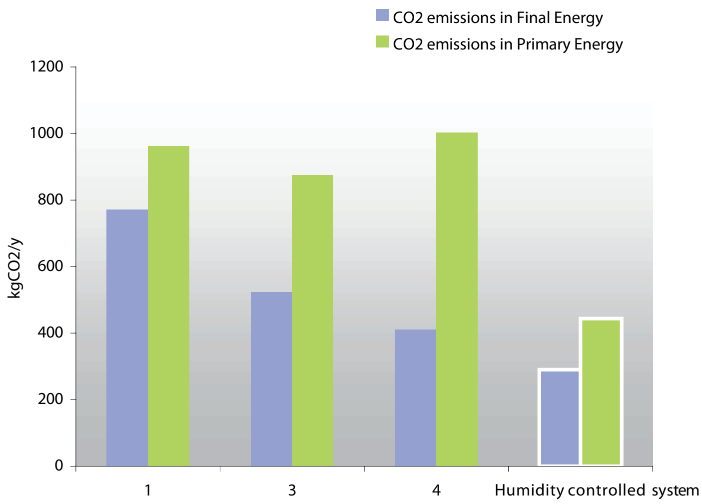
Calculations have been made for the different systems of the English building regulation, except the n.2 (Passive stack ventilation), which can not be assessed by the software in the current version.

As presented in the following page, we have dissociated two systems inside "Continuous mechanical extract": one is the standard, with a fix airflow (n.3), and one ("Humidity controlled") is a system which modulates according to the demand and to the occupancy.

ENERGY CONSUMPTION OF VENTILATION SYSTEMS



CO$_2$ EMISSIONS OF VENTILATION SYSTEMS



SAVINGS OBTAINED BY THE USE OF A HUMIDITY CONTROLLED SYSTEM

COMPARISON WITH:

		Background ventilators and intermittent fans (1)	Continuous mechanical extracts (3)	Continuous mechanical supply and extract with heat recovery (4)
Saving on energy cost (Final)	£/y	107	58	42
	%	61	46	38

VENTILATION SYSTEM LIFETIMES

Ventilation system Lifetimes/12 years	tCO2 saved by HC system (in Primary Energy)	tCO2 produced (in Primary Energy)
HC Vs System n.1	6,2	11,6
HC Vs System n.3	5,2	10,5
HC Vs System n.4	6,7	12
HC (Humidity controlled)	-	5,3

Energy consumption

On this chart (left), we can see that the humidity controlled ventilation system succeed in reducing the energy consumption (final and primary) drastically compared to systems n.1 and n.3, thanks to both a reduced fan consumption and a lower average airflow level.

The lower average airflow is obtanied by the use of humidity controlled extract units and inlets: when the ventilation needs are lower (dwelling empty or under-occupied), the airflow as the heat loss are reduced.

The humidity controlled system permits cutting down on the annual energy consumption by 66% compared to n.1, 41% compared to n.3.

The humidity controlled and the heat recovery (n.4) systems are nearly on a par in terms of final energy consumption. But considering the **primary energy consumption, the humidity controlled system saves 34%** (thanks to the low electrical consumption of its single fan).

CO$_2$ emissions

On a larger scale, the CO$_2$ emissions can be compared by multipliying the total energy consumption by the primary energy factor of the fuel considered (see left chart).

We can see that the **humidity controlled system has the advantage to produce less CO$_2$ emissions than all the other systems (from 29% up to 62% reduction)**, even the heat recovery (n.4). The humidity controlled ventilation system is definitely the most environment-friendly.

This advantage grows when the efficiency of the heat recovery is reduced due to poor maintenance.

The humidity controlled system offers the lowest environmental impact among all the available ventilation systems in the regulation.

Cost effectiveness

This table shows the cost-effectiveness of the humidity controlled system. The savings ensure a quick payback of the extra investment compared to n.1 or n3 systems. The high cost of the system n.4 (heat recovery) reinforces the economic vialibity of the humidity controlled ventilation system.

Humidity controlled ventilation system: the next energy saving solution for EPBD

All data and results are now available for the implementation of the humidity controlled ventilation system as a particularly relevant energy efficient solution. Its values are comparable those of **cavity wall insulation value** (tCO$_2$ saved = 6.92.)