CASE STUDY: BELGIUM

The benefits of using heat recovery mechanical ventilation in retail applications

Heat recovery ventilation offers cleaner air with major energy and cost savings

In 2023-2024, Daikin undertook a year-long comprehensive study to quantify the benefits of heat recovery ventilation solutions. Designed to help inform customer choices on heat recovery technology equipment, the study compared two retail stores in Belgium in a real-life situation from the point of view of energy consumption and in-store air quality. Further analysis and simulation was undertaken to demonstrate savings in more extreme climate conditions.

About the study

The study compared two retail stores in Belgium, operating between 9am and 6pm, six days a week. Running costs and air quality, including CO_2 and PM values, were measured over the 12-month period.

The exercise considered two distinct test scenarios:

Scenario 1: Benchmarking (Store A), exhaust fan only

Measuring ventilation with a standard exhaust fan in place.

Scenario 2: Heat recovery ventilation (Store B)

Heat recovery ventilation fitted, delivering fresh air and additional energy savings.

To ensure an effective comparison, the sites were chosen for their similarity in building type, location and ambient temperature conditions, which ranged from 0˚C in winter to +30˚C in summer.

Both stores were equipped with the same type of air conditioning system.

Products and services in scope:

- Daikin A/C Units
- Compact L (heat recovery ventilation unit)
- AirSense Pro+ (Indoor Air Quality sensor)

RETAIL

Compact L heat recovery ventilation unit

Why air quality matters

With people spending an estimated 90% of their time indoors, indoor air quality is now recognised as a key issue in building design.

Air pollution in retail stores arises from many sources, including Volatile Organic Compounds (VOCs) originating from surfaces and cleaning materials, dust and emissions from equipment plus shoppers and staff who breathe out CO_2. Poor air quality can affect both physical and mental health.

Ventilation control is critical for maintaining air quality. Rising standards in energy efficiency in buildings have led to increased insulation and airtightness, risking a lack of fresh air circulation, which can further compromise air quality.

Poor indoor environment can also impact building owners through lower market and rental values or lead to costly remedial works to bring the building fabric and M&E systems back to standard.

Compact L Smart heat recovery ventilation unit

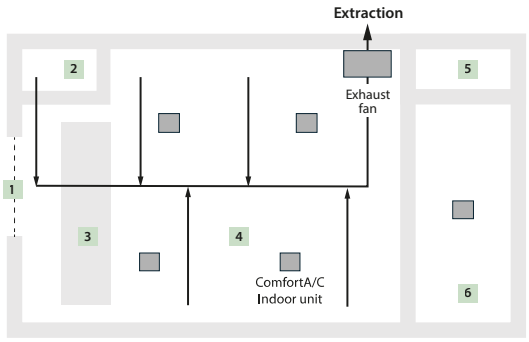
The Compact L heat recovery unit prevents energy loss from overventilation and recovery of heat for use in store. Double stage filtration provides a continuous supply of fresh, clean air.

Airsense Pro

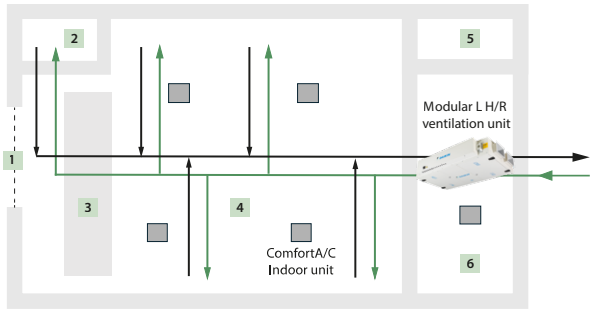
The Daikin AirSense Pro+ is an Indoor Environment Quality sensor able to monitor a wide range of parameters such as: air pollutants and conditions (PM2.5, PM10, CO_2, VOC, temperature, humidity) but also light, noise and electrosmog.

"When designing or refurbishing a retail or other commercial store application, always consider a well designed high efficiency heat recovery mechanical ventilation system, which will secure the supply of the required amount of fresh air at the right quality and with the least energy impact to the building!"

The floor layouts of the two stores:



Solution 1: Ventilation with no heat recovery



Solution 2: Ventilation with heat recovery

Extraction
Fresh air inlet

1 Entrance **2** Office **3** Cashier area
4 Sales area **5** Social room (breakroom)
6 Back of house - BOH (warehouse)

15%

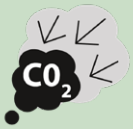
Energy consumpton reduction

7kW

Installed capacity savings

9.1k€

Total savings from using heat recovery ventilation unit



12%

$kgCO_2e$ savings

Study results

Energy Savings

The trials in these two stores in Belgium unequivocally demonstrated the energy savings realised by adding a heat recovery ventilation unit to existing systems. The benefits were two-fold:

- A **15% energy saving** when heat recovery units are installed compared to Scenario 1 with the exhaust unit alone.
- The installed cooling/heating capacity in the store equipped with heat recovery ventilation is by **7 kW lower compared** to the store with the exhaust fan.

Capital Expenditure (CAPEX) vs Operational Expenditure (OPEX)

Despite the fact that the CAPEX (cost of A/C and ventilation equipment) of the store in Scenario 2 is higher versus Scenario 1, its lower OPEX allows not only to have a return on investment (ROI) in less than 9 years but to offer **additional savings of 9.1 k€** through the totality of the life-cycle of the installation.

Heat recovery in extreme climates

Our results from the study in Belgium prompted us to study the benefit of such a heat recovery ventilation unit in countries with extreme temperature conditions, namely Italy and Poland. Daikin's VRV Pro Simulator was used to gauge the comparative effectiveness of the heat ventilation unit, using data from the original study.

The extended study demonstrated even greater savings achievable in countries with extreme temperature conditions (Italy 0˚C to +35˚C, Poland -20˚C to +28˚C).

Poland

- CAPEX – Savings €362
- OPEX – Savings €1.355
- 22 years lifetime savings: €30.100

Italy

- CAPEX - Savings €3.017
- OPEX – Savings €638
- 22 years lifetime savings: €17.000

The following tables present the figures on energy savings and other parameters

Country [1]	**Energy Savings** [2]		**Δ CAPEX** [3]	**Δ OPEX** [4]	**Total savings through the lifecycle of the installation** [5]	**Sustainability** [6]	
	Energy consumption reduction	Installed capacity savings				$kgCO_2e$ savings (in absolute)	$kgCO_2e$ savings (%)
Belgium	15%	7KW	+5.827€	-679€ per year	9.1k€	12.496	12%
Poland	29%	7KW	-362€	-1.355€ per year	30.1k€	100.349	33%
Italy	22%	35,5 KW	-3.017€	-638€ per year	17.0k€	48.342	13%

Notes on calculation:

[1] Daikin Europe (DENV) performed real measurements in 2 stores located in Belgium. The measurements for Poland and Italy are based on the simulations done via the VRVPro Simulator together with some corrections and conclusions derived from the real measurements done in Belgium as a result of ambient conditions during the study period.

[2] Energy savings calculations are done on two parameters:

- Delta calculated on the energy consumed by all the HVAC equipment (The delta is calculated between stores with heat recovery ventilation unit (ALB07RCS) and one with only exhaust fan. This condition stands true for real measurements in Belgium and simulation done for Italy and Poland).

- Delta on the installed capacity of the A/C systems between the two stores.

[3] CAPEX of every store is calculated with a full material list including A/Cs, ventilation unit, and other accessories/options with their subsequent material and installation cost. The delta is calculated between stores with heat recovery ventilation unit (ALB07RCS) and one with only exhaust fan. This condition stands true for real measurements in Belgium and simulation done for Italy and Poland.

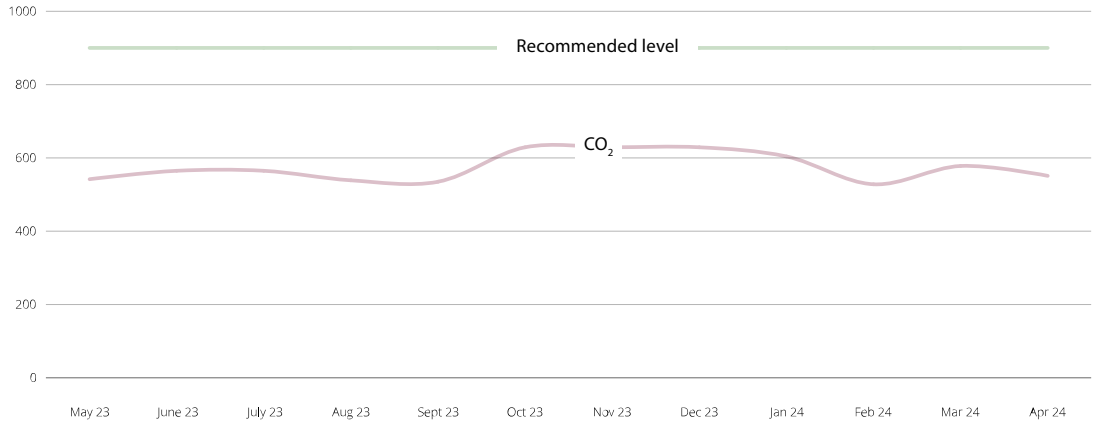
[4] OPEX is calculated based on the energy consumption measured per year multiplied by the euros/kWh of every country. Energy prices considered for countries are: BE(0.22 euros/kWh), PL (0.22 euros/kWh), IT (0.24 euros/kWh). The delta is calculated between stores with heat recovery ventilation unit (ALB07RCS) and one with only exhaust fan & the rest of HVAC equipments. This condition stands true for real measurements in Belgium and simulation done for Italy and Poland.

[5] Expected total savings is calculated as Δ CAPEX + (Δ OPEX calculated over a lifespan of 22 years) (lifetime of Sky Air Unit source: eco Invent energy grid intensity)

[6] The reduction in whole life carbon emissions for all three countries has been calculated by taking into account the Environmental Product Declaration (EPD) of a similar Daikin A/C unit installed at the case study site in Belgium. The B6 calculations, which refer to the reduction in energy consumption, are based on the energy mix of the countries: Belgium (0.26 kg CO2e/kWh), Poland (1.05 kg CO2e/kWh), and Italy (0.39 kg CO2e/kWh), as provided by the Ecoinvent 3.8 database.

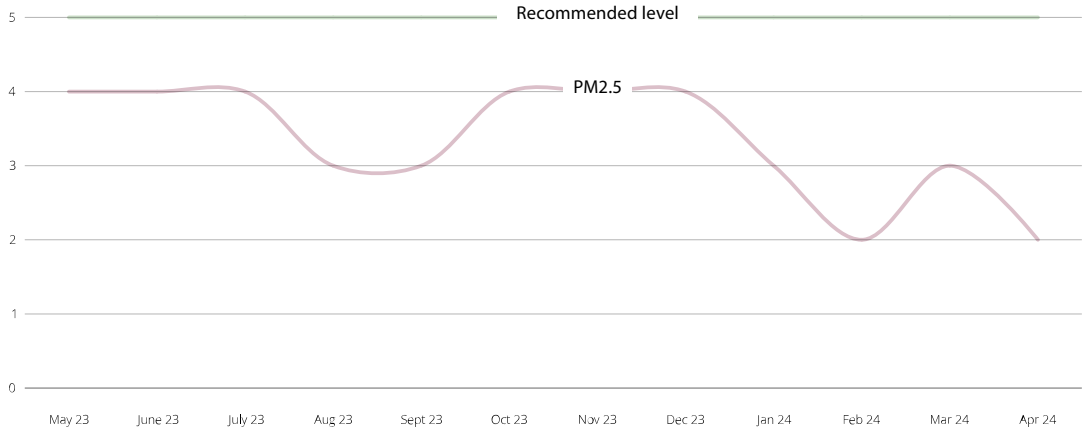
The exercise highlighted the role played by heat recovery ventilation systems in creating a healthier indoor environment. The following graphs represent the average results of CO_2, PM 2.5 and PM10 recorded during the study against the recommended yearly values.

CO_2 (ppm) Levels Measurement



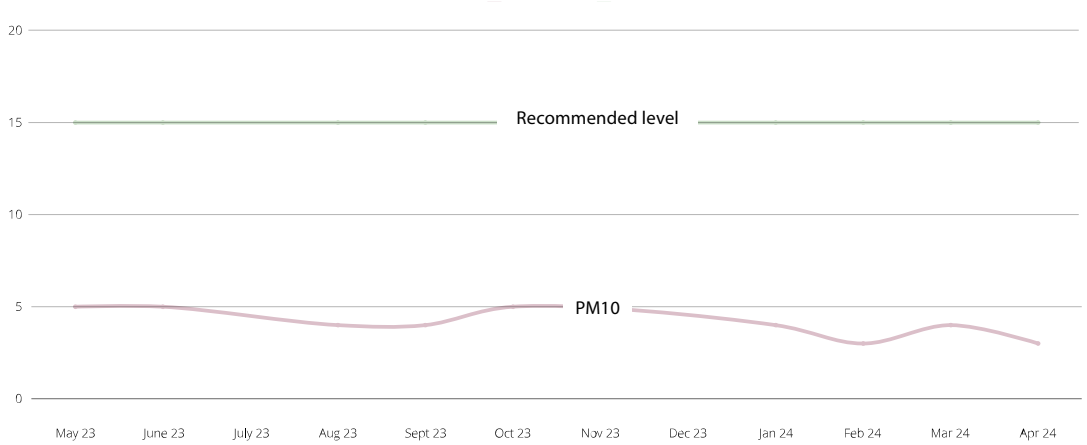
Levels of CO_2 were **below the recommended concentration of 900 ppm** as per Eurovent report, 2024.

PM2.5 (µg/m³) Levels Measurement



The average readings of PM2.5 are **considerably below the recommended values** of 15µg/m³ over a calendar year as per WHO Air Quality Guidelines (AQGs) and estimated reference levels (RLs), according to 2021 report.

PM10 (µg/m³) Levels Measurement



The average readings of PM10 **are considerably below the recommended values** of 5µg/m³ over a calendar year as per WHO Air Quality Guidelines (AQGs) and estimated reference levels (RLs), according to 2021 report.

At Daikin, we provide a total solutions, from A/C systems to ventilation and to sensors for getting the readings and the measurements. This case study demonstrates how adding a heat recovery unit to existing A/C systems will deliver energy savings and reduce capital and operating costs over the lifetime of HVAC equipment. Additionally, improving the sustainability of buildings in terms of CO_2 emissions and offering good indoor air quality will improve their commercial appeal.

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