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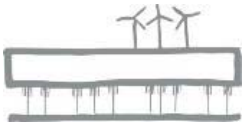
Assessment of demand-controlled ventilation in various countries and compliance frameworks: practical experience and difficulties encountered by a manufacturer

International Workshop on Ventilation and Airtightness in Buildings
Lund, Sweden – 16-17 March 2015 Yves Lambert / Ivan Pollet - Renson Ventilation



Demand Controlled Ventilation

Willem de Gids
VentGuide
Former TNO

DCV Workshop
October 2010
AIVC/Tightvent Brussels

Trends in Developments

Ventilation

- Demand Control
  - time control
  - presence detection
  - sensor control
  - zonal systems
- Energy
  - heat recovery/heat pump
  - pre heating of ventilation air
    - conservatories
    - solar wall/roof
    - dynamic insulation
    - ground heat exchanger

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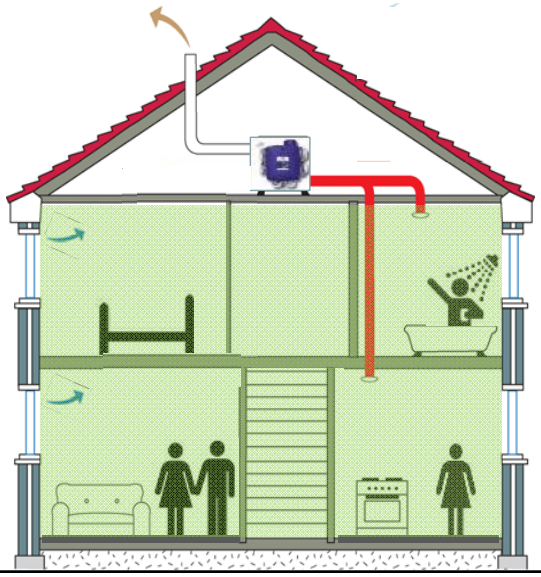
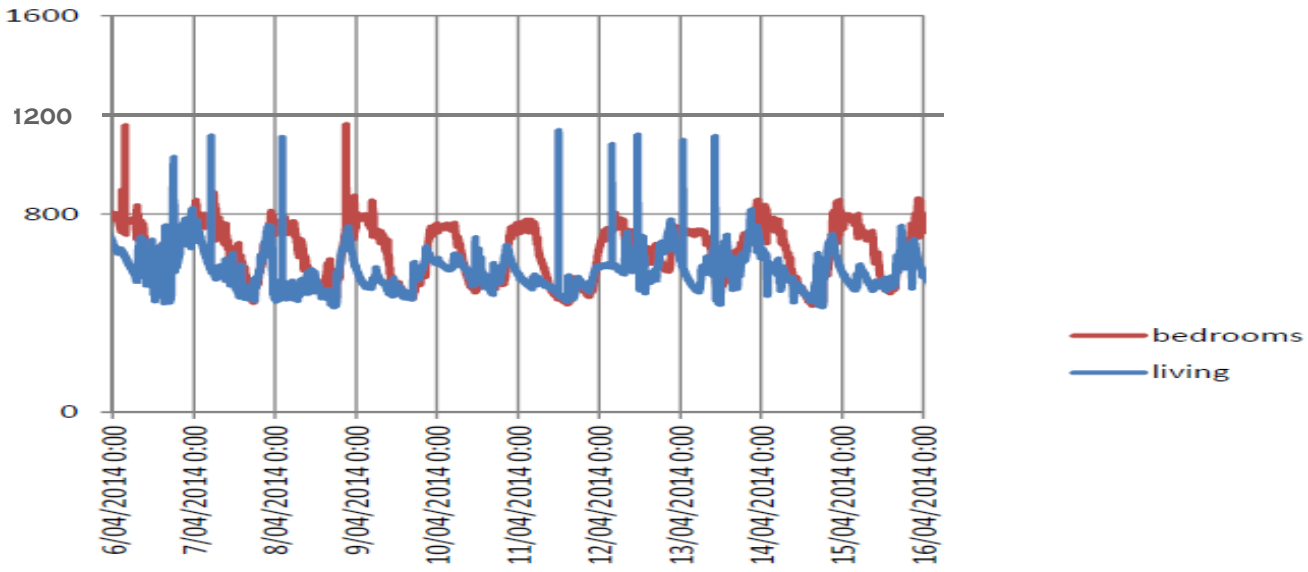
Principle of demand controlled ventilation (DCV)



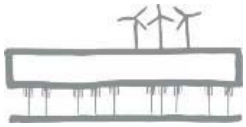
- Supply and/or extract rate is function of the pollution level (RH, CO_2, VOC, …)
- Continuous monitoring of IAQ and savings on heating and fan electricity consumption

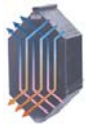
For all systems

CO_2 control in bedrooms/living: optimal IAQ

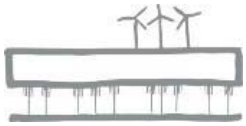


Measures to limit ventilation energy consumption



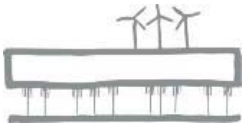
	Energy efficient fans	Demand Control (DC)	Heat Recovery
Natural ventilation			
Mechanical extract ventilation (MEV, System C)			 Air/Water
Full mechanical ventilation (MVHR, System D)			 Air/Air

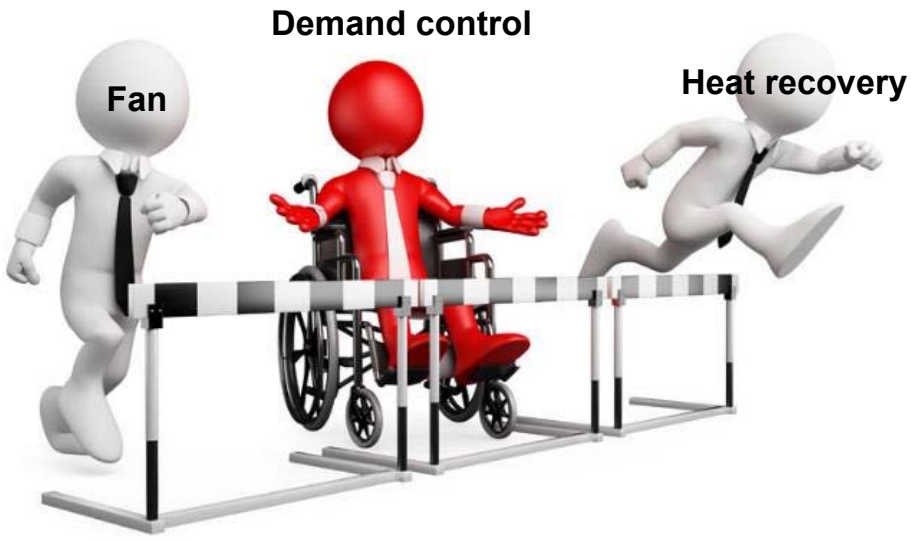
Measures to limit ventilation energy consumption



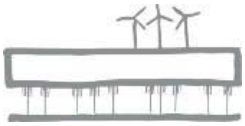
	Energy efficient fans	Demand Control (DC)	Heat Recovery
Natural ventilation			
Mechanical extract ventilation (MEV, System C)	How determine ? → specific fan power (SFP or SPI) EN13141 series	? No European standard/method Not standard into EPBD Innovative, but no recognition	 Via COP EN14511 Air/Water
Full mechanical ventilation (MVHR, System D)			Via efficiency EN13141 series or EN308

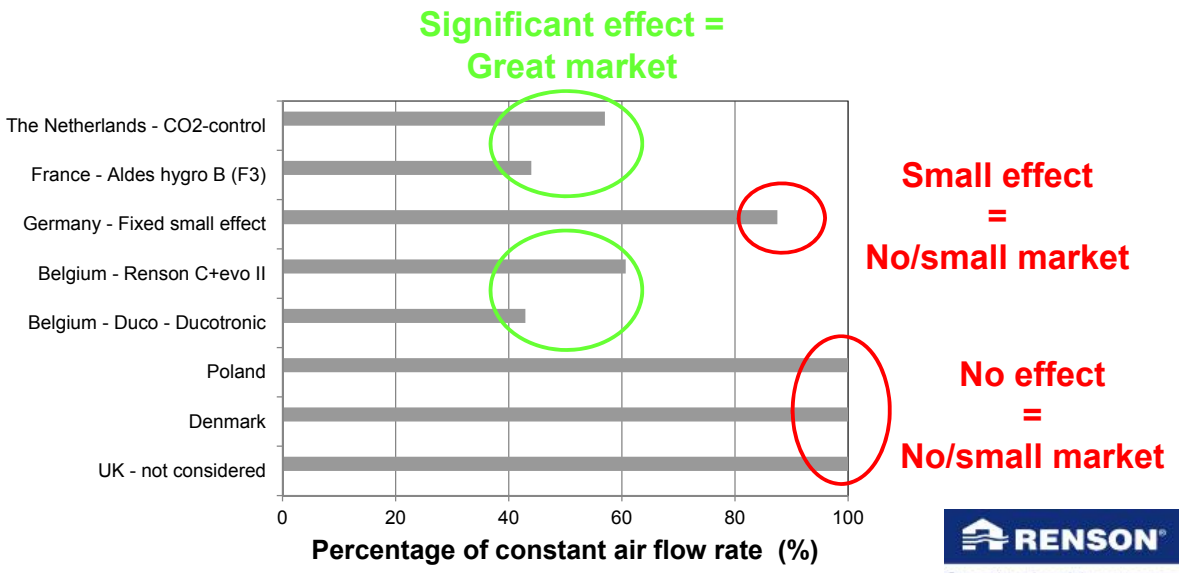
Unfair competition for innovative systems



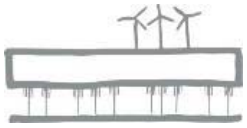


Recognition of residential DCV in different countries





Assessment and compliance



Assessment	→ Methodology/simulation	→ No European Standards National methodologies
		→ Eco-design assessment
	→ Test in laboratory (ITT)	→ Few European standards RH-controlled components others ?
Compliance	→ Test in production (FPC)	→ CE-marking
		→ National certification procedures
	→ Test in-situ	→ Upcoming national regulations

Assessment: methodology/simulation

Residential EN standards

→ EN15665

→ CEN/TR14788

Non-residential EN standards

→ prTR16798-4

Little useful info
Effect on energy consumption ?

Types of control

Table 10 — Possible types of control of the indoor air quality (IDA-C)

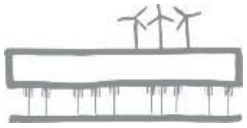
Category	Description	R Room Z Zone
IDA – C 1	The system runs constantly.	
IDA – C 2	Manual control The system runs according to a manually controlled switch.	R Z
IDA – C 3	Time control The system runs according to a given time schedule.	R Z
IDA – C4	Occupancy control The system runs dependent on the presence (light switch, infrared sensors etc.)	R Z
IDA – C5	Demand control (based on the number of occupants) The system runs dependent on the number of people in the space.	R Z
IDA – C 6	Demand control (based on air quality indicator) The system is controlled by sensors measuring indoor air parameters or adapted criteria, which shall be specified (e.g. CO_2, mixed gas, humidity or VOC sensors). The used parameters shall be adapted to the kind of activity in the space.	R Z

I shall be specified whether the type of control is

— Individual per each room R

— Centralised per each zone Z

Assessment: methodology/simulation



Residential and non-residential EN standards

→ prEN16798-7 (~EN15242)
→ CEN/TR16798-8

$$q_{V;ODA;req} = \frac{f_{ctrl} \cdot f_{sys}}{\varepsilon_V} \cdot q_{V;ODA;req;des}$$

Pre-normative !

Presence = CO_2 sensor ?

On/off control ?

Must be realistic

6.4.3.1.1 Required outdoor ventilation air flow rates for energy calculations

Required outdoor airflow rate	$q_{V;ODA;req}$	m3/h	2100.00	(7)	$q_{V;ODA;req} = \frac{f_{ctrl} \cdot f_{sys}}{\varepsilon_V} \cdot q_{V;ODA;req;des}$
Control factor	f_{ctrl}	-	1.00	(8)	*If VENT_OAFLOW_CTRL = CONST_OA_FLOW fctrl = 1*
				(9)	*if VENT_OAFLOW_CTRL = ON/OFF_TIME or MULTI_STAGE_TIME fctrl = fop;V*
				(10)	*if VENT_OAFLOW_CTRL = ON/OFF_SENS_OCC, if focc > 0 fctrl = 1 else fctrl = 0*
				(11)	*Else* $f_{ctrl} = f_{occ} + f_{sens} \cdot (1 - f_{occ})$

Assessment: methodology/simulation

Residential national methodologies

The Netherlands: VLA

Belgium: ATG-E

France: Avis Technique

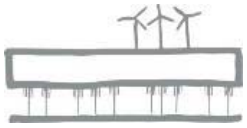
Other ?

Multi-zone airflow models (Contam, TRNFLW, …)

Many variables taken into account to be representative

- Outdoor climate (temp., RH, wind speed/direction, CO_2)
- Dwelling type
- Terrain roughness
- Orientation
- Building location
- Building air tightness
- Occupancy
- Characteristics ventilation system: reference air flow rates, control algorithms, …
- …

Assessment: methodology/simulation



Residential national methodologies: barriers

Specific control strategies are often not allowed/considered

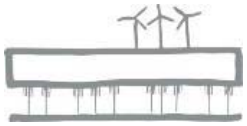
… although proven in practice

- extraction form living rooms
- control on RH or VOC
- control algorithms

Potential of DCV not recognised

Less innovation

Assessment: methodology/simulation



Residential and non-residential : ecodesign directive (2009/125/EC)

COMMISSION REGULATION (EU) No 1253/2014

of 7 July 2014

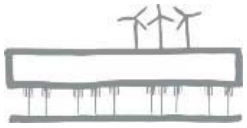
implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for ventilation units

ANNEX II

Specific ecodesign requirements for RVUs, as referred to in Article 3(1) and 3(3)

1. From 1 January 2016:
   - SEC, calculated for average climate, shall be no more than 0 kWh/(m².a).
   - Non-ducted units including ventilation units intended to be equipped with one duct connection on either supply or extract air side shall have a maximum L_{WA} of 45 dB.
   - All VUs, except dual use units, shall be equipped with a multi-speed drive or variable speed drive.
   - All BVUs shall have a thermal by-pass facility.
2. From 1 January 2018:
   - SEC, calculated for average climate, shall be no more than – 20 kWh/(m².a).
   - Non-ducted units including ventilation units intended to be equipped with one duct connection on either supply or extract air side shall have a maximum L_{WA} of 40 dB.
   - All VUs, except dual use units, shall be equipped with a multi-speed drive or variable speed drive.
   - All BVUs shall have a thermal by-pass facility.
   - Ventilation units with a filter shall be equipped with a visual filter change warning signal.

Assessment: methodology/simulation



Residential and non-residential : ecodesign directive (2009/125/EC)

ANNEX VIII

Calculation of the specific energy consumption requirement

The specific energy consumption SEC is calculated with the following equation:

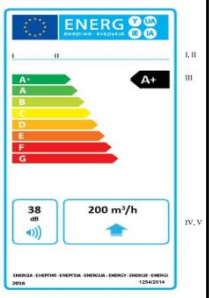
$$SEC = t_a \cdot pef \cdot q_{net} \cdot MISC \cdot CTRL^x \cdot SPI - t_h \cdot \Delta T_h \cdot \eta_h^{\ t} \cdot c_{air} \cdot (q_{ref} - q_{net} \cdot CTRL \cdot MISC \cdot (1 - \eta_t)) + Q_{defr}$$

where:

SEC ~ Fan consumption – Recuperated heating energy + defrosting energy

— SEC is Specific Energy Consumption for ventilation per m² heated floor area of a dwelling or building [kWh/(m².a)]:

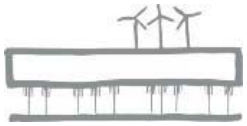
ventilation control	CTRL
Manual control (no DCV)	1
Clock control (no DCV)	0,95
Central demand control	0,85
Local demand control	0,65



~ National methodologies: CTRL ≤ 0,5

Potential of advanced DCV systems blocked by eco-design !

Assessment and compliance



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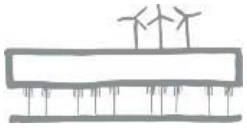
Assessment: test in laboratory (ITT)



Differences between countries

The Netherlands: not required, voluntary via

Belgium: - ATG-E: performed by manufacturer under supervision of third party
- new procedure under development

France: - performed by third party = CSTB
- severe test procedure

Other ?

A minimum of laboratory tests needed as a first step towards compliance

Assessment: test in laboratory (ITT)

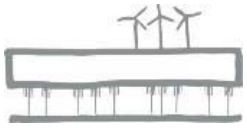
European test standards

RH (proportionally) controlled air supply/extract devices = OK (EN13141-9/10)

How to test ?
- CO_2-control
- VOC or odour control
- accuracy of sensors
- durability of sensors
- …

Lack of practical European test standards

Assessment and compliance



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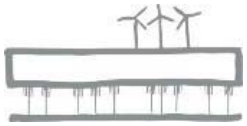
Compliance



Measurements in production

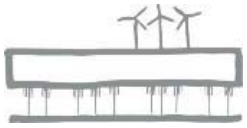
CE marking → European directives:
- machine
- low-voltage
- EMC

National certifications/approvals

- France: RH-DCV systems = obliged
- Belgium: ATG-E → ATG ? = voluntary
- The NL: ?

Growing impact as proof of quality

Compliance



Measurements in-situ

European standards → In field test methods

Growing number: EN12599 – EN14134 – EN16211 …

Growing impact as proof of quality

National initiatives:

- France: CPT – DTU = obliged from ?
- Belgium: STS = voluntary from 2016, in 2017 requirements
- The NL: Ventilatiekeurmerk = voluntary → no success: cost ↔ added value

Conclusions

- Demand control ~ **added value proven** in market for years
- Lack of European - national **DCV assessment methodologies**
- **Lab tests** more and more imposed, but lack of **European test standards**
- **Compliance** in production / in-situ: growing impact - interest of industry
- **Ecodesign** blocks potentials of DCV

Thanks for your attention !

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