IEA-EBC Annex 5
Air Infiltration and Ventilation Centre
AIVC

Arnold Janssens

Peter Wouters

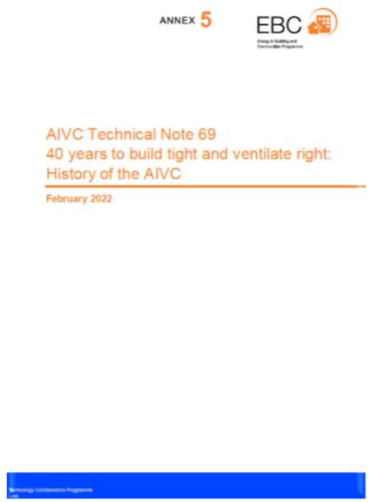
Operating Agents - INIVE

Belgium

AIVC - history

- IEA created in 1975 an international collaboration programme on energy conservation in buildings and community systems (**IEA-EBC**)
- **AIC** (Air Infiltration Centre) was created in 1979 as Annex 5
- 1986: **AIC** became **AIVC**

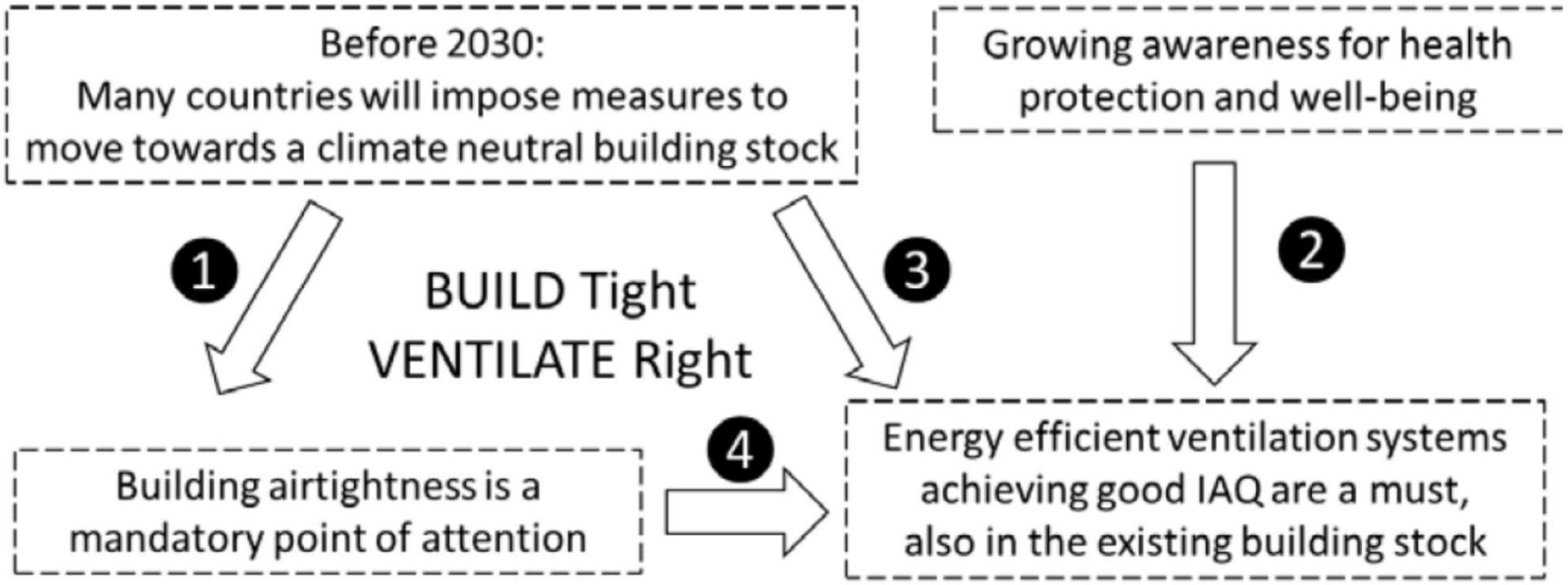
  The **'Air Infiltration and Ventilation Centre'**



The **vision** of AIVC is to be
the world's primary information centre
on energy efficient ventilation
for good indoor air quality in buildings.

Challenges for 2022-2026

- Improve performance of existing building stock
- Awareness for health protection



Focus fields and projects

Smart Ventilation

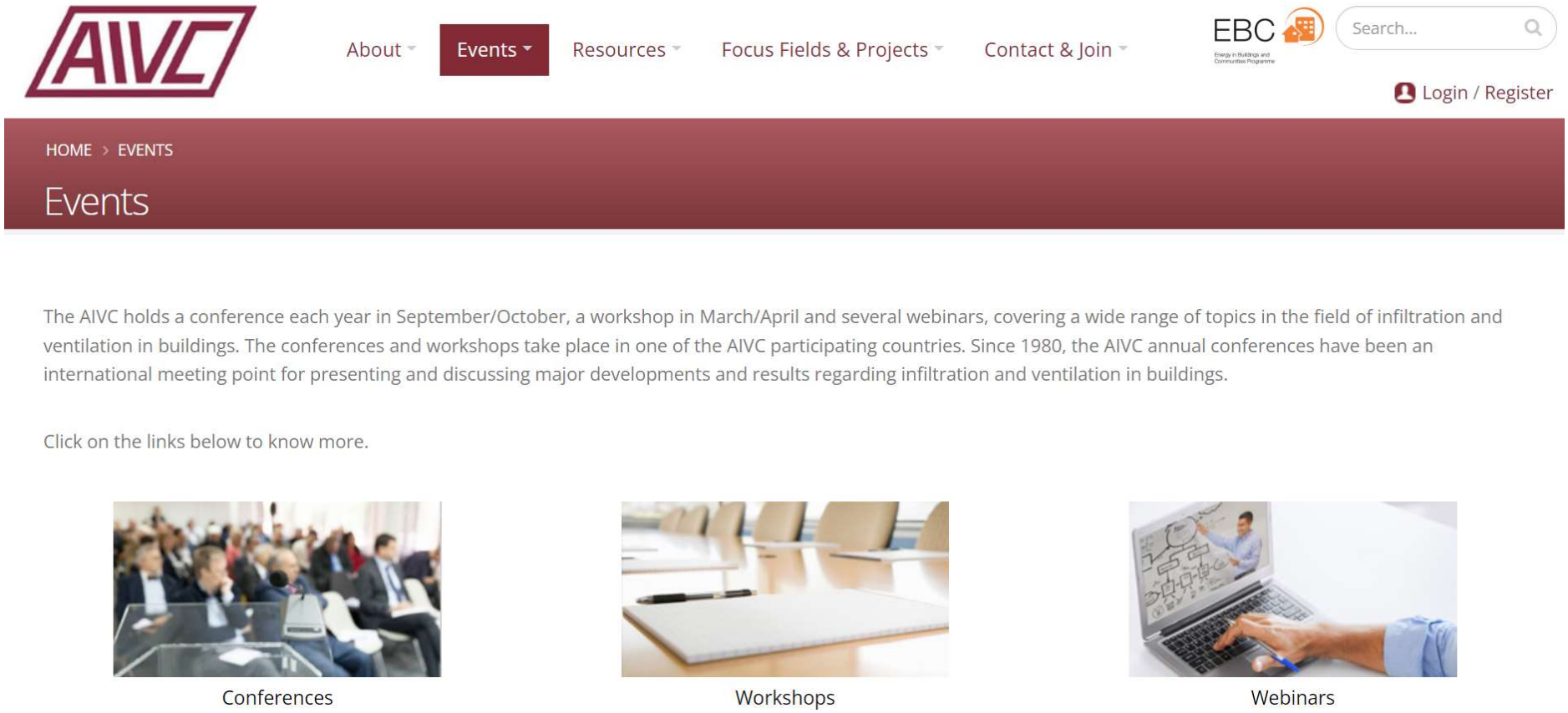
Resilient Ventilative Cooling

Building & Ductwork airtightness

Indoor Environmental Quality

AIVC activities are structured around projects to collect and disseminate knowledge, integrating activities and products such as publications, webinars, workshops etc.

www.aivc.org



- **Annual conferences** in collaboration with TightVent and venticool platforms
- **Annual workshops** in collaboration with local hosts on themes of local interest
- **Webinars** presenting results of projects or publications.


AIVC
Tight Vent Europe
venticool
the platform for resilient ventilative cooling
Home
About
Submissions
Registation/Social Events
43rd AIVC -11th TightVent
& 9th venticool Conference
October 4-5, 2023
Aalborg University, Copenhagen, Denmark
Ventilation, IEQ and health in sustainable buildings

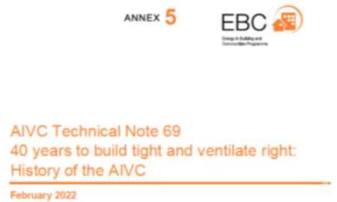
Recent publications

- AIVC Technical Note 69 on “AIVC 40 years – History of AIVC”
- AIVC Technical Note 70 on “AIVC 40 years – Technical progress”
- AIVC Technical Note 71 on “Durability of building airtightness”
- AIVC Technical Note 72 on “Rationale behind ventilation requirements”

- VIP 45.1-8: Trends in building and ductwork airtightness in various countries

- AIVC Literature List 35 “Overview of webinars in cooperation with Tightvent Europe and venticool platforms”

- International Journal of Venticool, special issue ‘Ventilation challenges in a changing world’



Recent webinars

- 13 September 2022 – Examples of resilient cooling solutions
- 20 September 2022 – Resilient cooling case studies and policy recommendations
- 7 November 2022 – IEA-EBC Annex 78: Substituting Ventilation by Gas Phase Air Cleaning. An industry webinar
- 15 November 2022 – Dumb buildings with smart users? Linking building performance & human well being
- 29 November 2022 – Use of super cool materials for efficient building ventilation and heat mitigation
- 12 December 2023 – IEA-EBC Annex 87: Energy and Indoor Environmental Quality Performance of Personalised Environmental Control Systems (PECS)
- 12 January 2023 – Sleeping environment IAQ and sleep quality
- 4 May 2023 - Building and ductwork airtightness trends and regulations in France, Belgium and Greece
- 9 May 2023 - Building and ductwork airtightness trends and regulations in Latvia, Spain and the Czech Republic
- 19 June 2023 - Alternative methodologies to evaluate airtightness

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Trends in building and ductwork airtightness in different countries

WORKSHOP "TOWARDS HIGH QUALITY, LOW-CARBON VENTILATION IN AIRTIGHT BUILDINGS"

MAY 19TH 2023

VALÉRIE LEPRINCE
CEREMA

NOLWENN HUREL
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Context : AIVC VIPs

Building airtightness

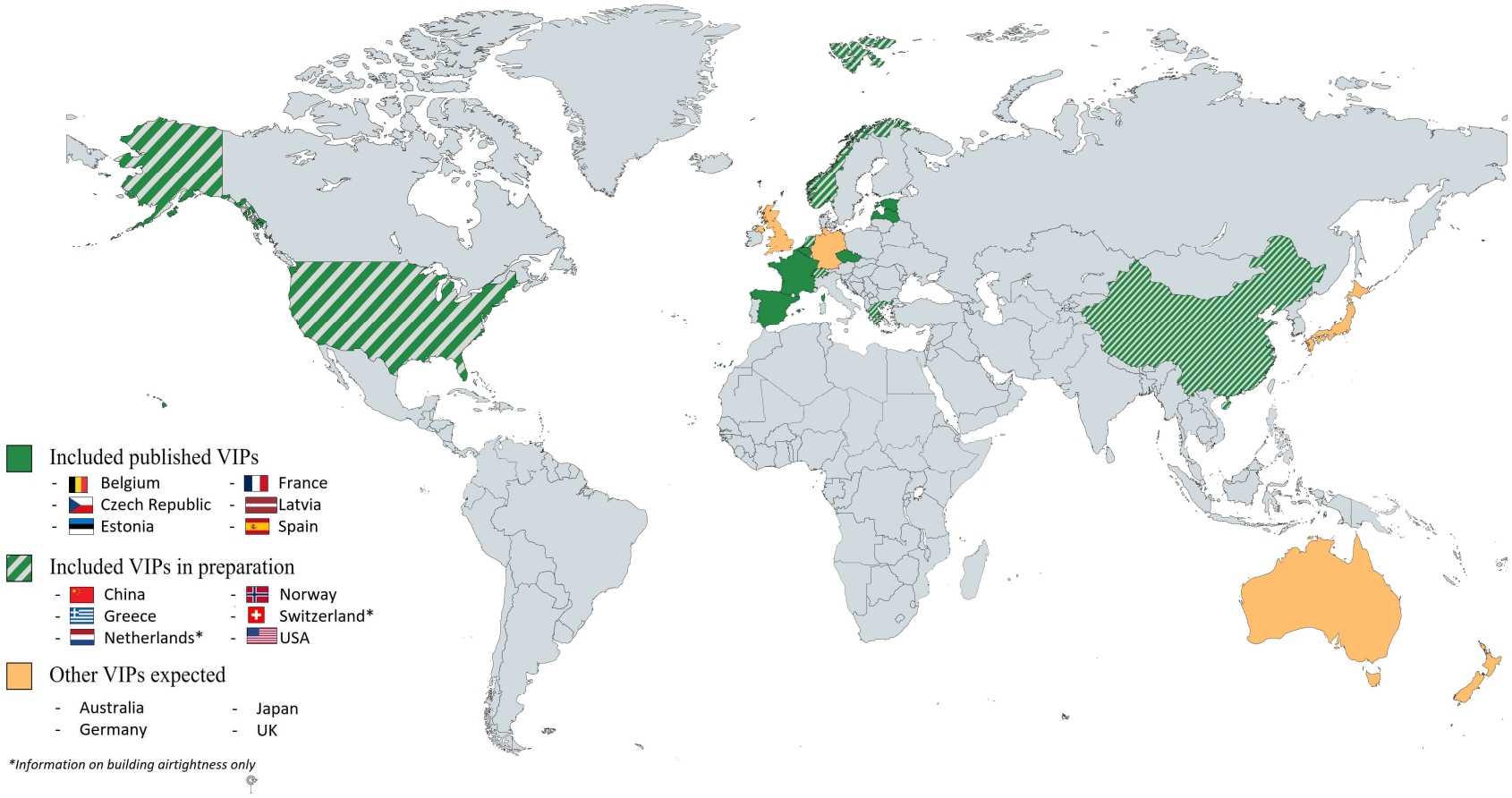
Ductwork airtightness

VIP series on Building & Ductwork Airtightness

Series of Ventilation Information Papers (VIP) published by the AIVC

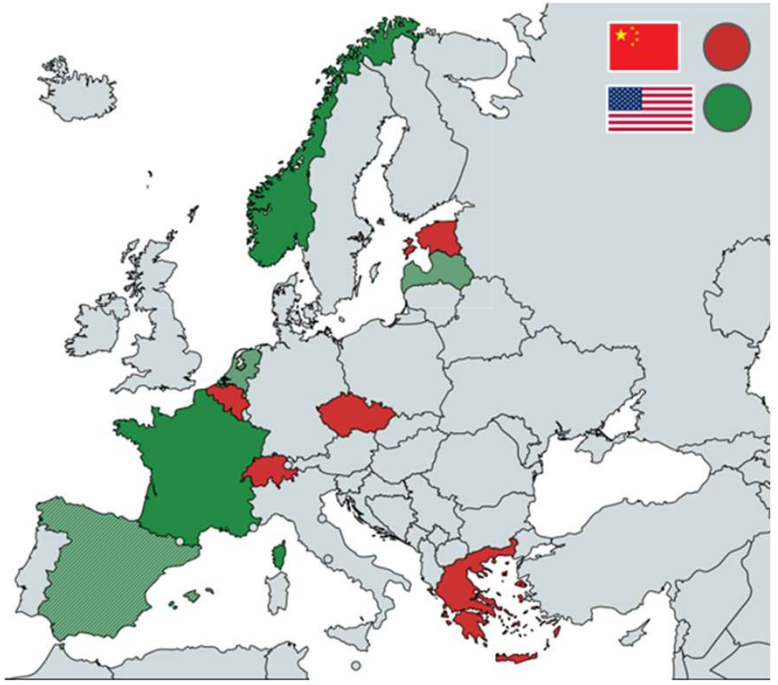
- Title: *"Building and ductwork airtightness - National trends and requirements"*
- Authors found in various countries via the TightVent Airtightness Associations Committee (**TAAC**) and the **AIVC** board members
- Template prepared: **similar structure** for all papers
- Already 8 **published papers**:
  - Estonia (VIP 45.1)
  - Spain (VIP 45.2)
  - Czech Republic (VIP 45.3)
  - Belgium (VIP 45.4)
  - Latvia (VIP 45.5)
  - France (VIP 45.6)
  - Greece (VIP 45.7)
  - China (VIP 45.8)
- Available on the **AIVC website**: https://www.aivc.org/collection-keys/vip
- Overview summary in preparation

Countries included in this overview (12)



Mandatory envelope airtightness requirements

Mandatory requirements?					
NO	YES				
	Country	Mandatory for:	Values		Mandatory justification ?
			Indic. (unit)	Max. values	
	FR	Residential buildings	$q_{4PaSurf}$ ($m^3/(h.m^2)$)	• 0.6 for single-family • 1 for multi-family	YES, by test or certified quality management approach
	LV	Residential houses, homes for the elderly, hospitals, kindergartens, and public buildings	q_{50} ($m^3/(h.m^2)$)	• 3,0 for natural vent. • 2,0 for mech. vent • 1,5 for heat recov. • 4,0 for industrial build.	NO
	NL	All buildings ?	q_{v10} (L/s)	• 200 up to 500 m^3, pro rata above • Stricter in EPC: about 0,6 /m^2 of floor	NO
	NO	All buildings	n_{50} (h^{-1})	• 1.5 for all buildings • target of 0.6 for dwellings	YES
	ES	Residential build. > 120 m^2, with mandatory controlled mech. or hybrid vent. system	n_{50} (h^{-1})	• 6 if Vol//Env. Area <2 • 3 if Vol//Env. Area >4 • Interpolation in between	YES, by test or calculation with a formula: $n_{50} = 0.629 \frac{C_0 \times A_0 + C_h \times A_h}{V_{int}}$
	US	Residential buildings in some states that have adopted the IECC energy codes	ACH50	• 3 nationally • 5 in few locations with very mild climates	YES, by test (sampling allowed for muti-family)



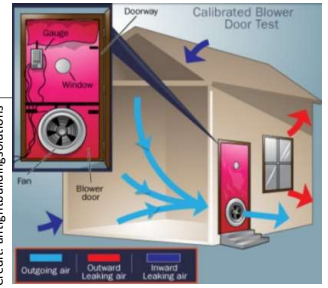
Requirements mainly in residential buildings

Why air tightness requirements (and testing)?

- To limit air flows that
  - Increase energy use
  - Lead to moisture issues and other building failures
  - Prevent proper HVAC operation, e.g., maintaining building pressurization
- To assess construction quality and identify flaws during construction process

Building airtightness test protocol

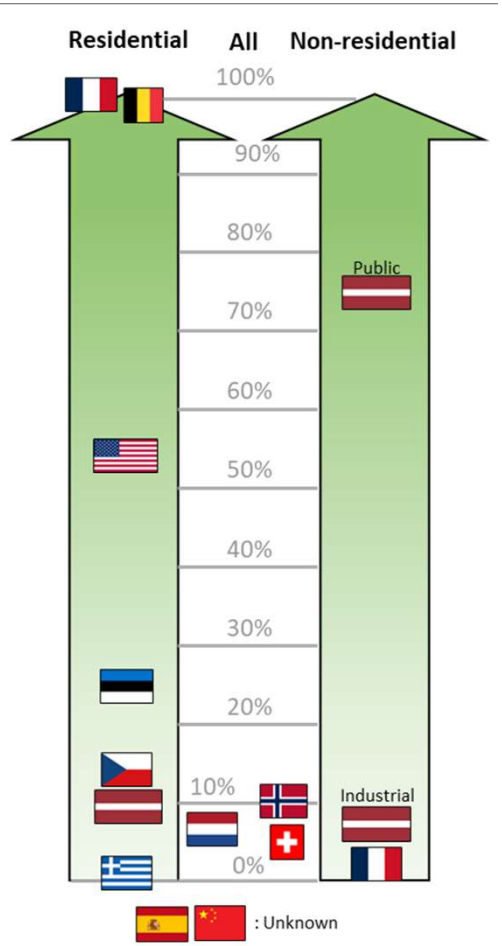
Country	National qualification for testers				National guidelines		
	Existing?	Mandatory?	Name	Number or %	Existing?	Name (year)	Specificities
BE	YES (Fl.)	YES ?	By BCCA and SKH	150 – 190 (Fl.)	YES	STS-P 71-3 (2014), mandatory only in Fl.	Tests in p^+ and p^- (or correction if not possible)
CN	NO	-	-	-	YES	T/CECS 704 (2020)	Tracer gaz method allowed
CZ	YES	NO	A.BD_CZ (mandatory for members)	15 (30-35%)	YES	annex of TNI 73 0330	Method for testing multi-family build.
						New Green Savings (NGS) guidelines	For buildings in this energy performance programme
EE	NO	NO	-	-	NO	-	-
FR	YES	YES	Qualibat	842	YES	FD P50-784	Application guide of EN ISO 9972
GR	YES	NO	Seminars by Aerosteganotita	10	NO	-	-
LV	NO	NO	Some qualified with Retrotec, FliB, ATTMA	11	NO	In accordance with LVS EN 9972:2016	
NL	NO	NO	Some qualified by SKH	10-15%	YES	NEN 2686	Tests in p^+ and p^-
NO	NO	NO	-	-	YES	There are simplified methods in use not complying entirely with ISO 9972	
ES	NO	NO	Trainings by manufacturers	?	NO	In accordance with UNE-EN ISO 9972:2019	
CH	NO	NO	qualified with FLIB	2 (~2%)	YES	Minergie airtightness guideline (RiLuMi)	for building and test preparation (test in accordance with EN ISO 9972)
US	YES	NO ?	energy auditor certification (ABNSI/BPI-1100-T-2014) by BPI	?	YES	Standard ASTM E779	for multipoint measurements
						Standard ASTM E1827	for single point measurements (50 Pa)
						More commonly used: ANSI/RESNET 380 or blower door manufacturer's instructions (more simple than ASTM standards)	



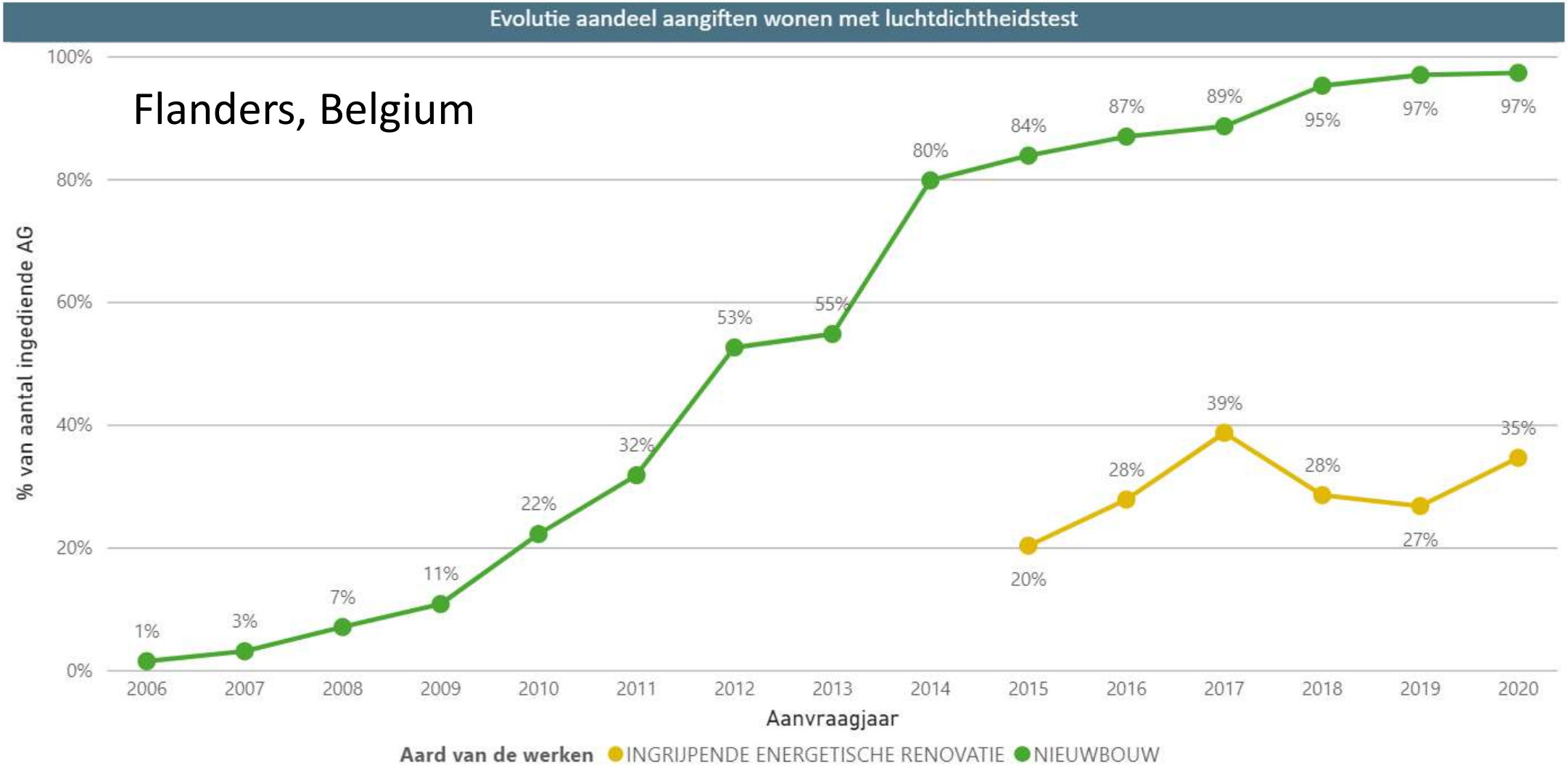
Credit: airtightbuildingsolutions

Building airtightness tests performed

Country	Residential buildings	Non-residential buildings	Public database		
			Existing?	In charge:	% of tests
BE	New: alm. 100%	-	YES	Flanders: VEKA	100%
	deep retrofit: ~ 25%			quality frameworks like BCCA	All from this QF
CN	unknown	-	NO	-	-
CZ	<15%	-	YES	A.BD_CZ	~ 3%
EE	~ 25%	-	NO	-	-
FR	100%	very few	YES	Qualibat (since 2007)	100%
GR	very very few	-	YES	Aerosteganotita	?
LV	5-15%	public: 70-80%	NO	-	-
		industrial: 5-10%			
NL	5-10%		NO	Some data gathered (Retrotec's rCloud, SKH scheme, Uni. of Twente)	
NO	~ 10%		NO	-	-
ES	Unknown		NO	One-time effort: 400 cases (INFILES Project)	
CH	~ 5%		NO	survey of Minergie	
US	>50% (depends on the states)	-	NO	Old one from LBNL (150 000 entries)	

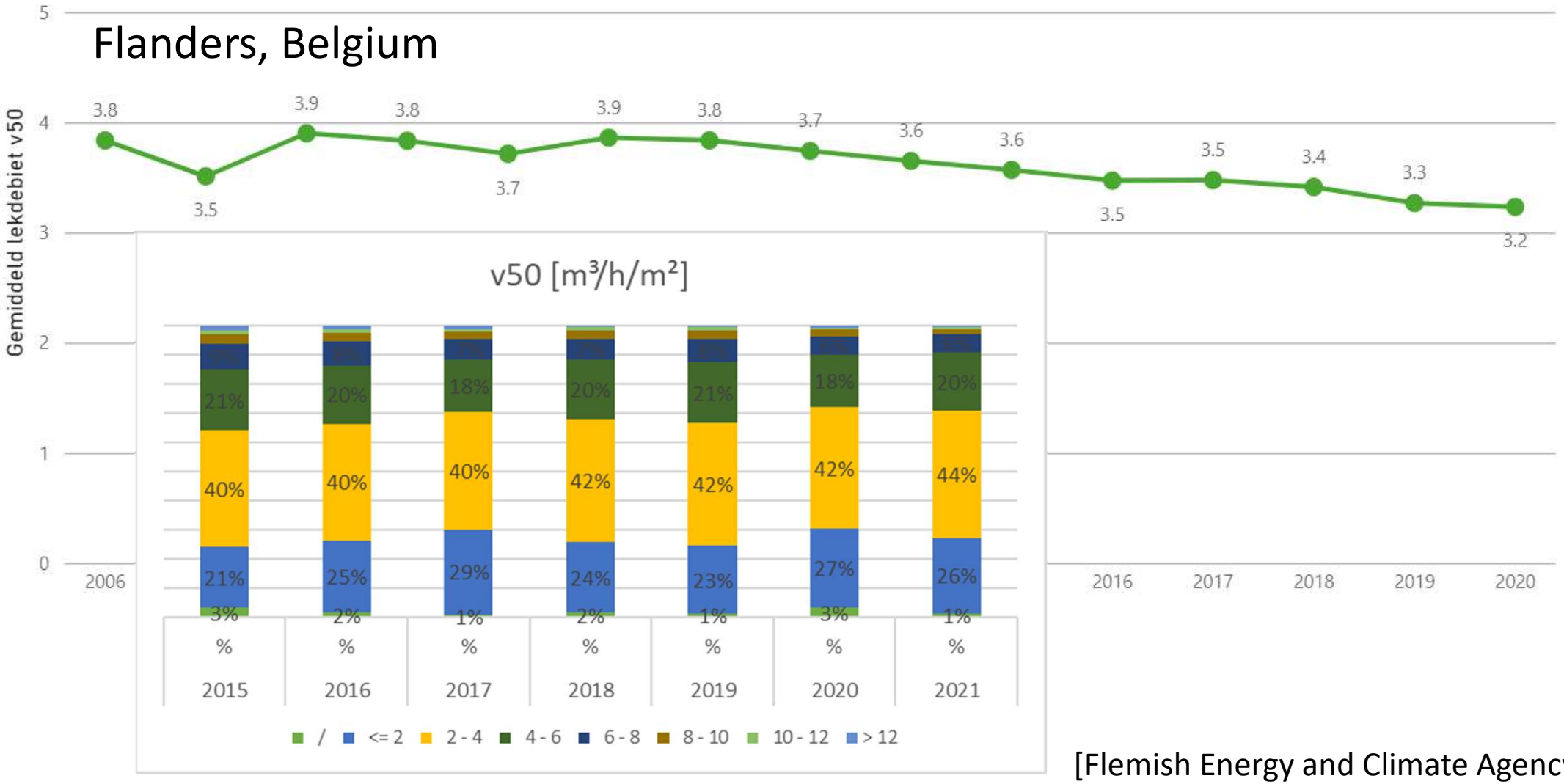


Evolution of share of residential EPB declarations with air tightness test



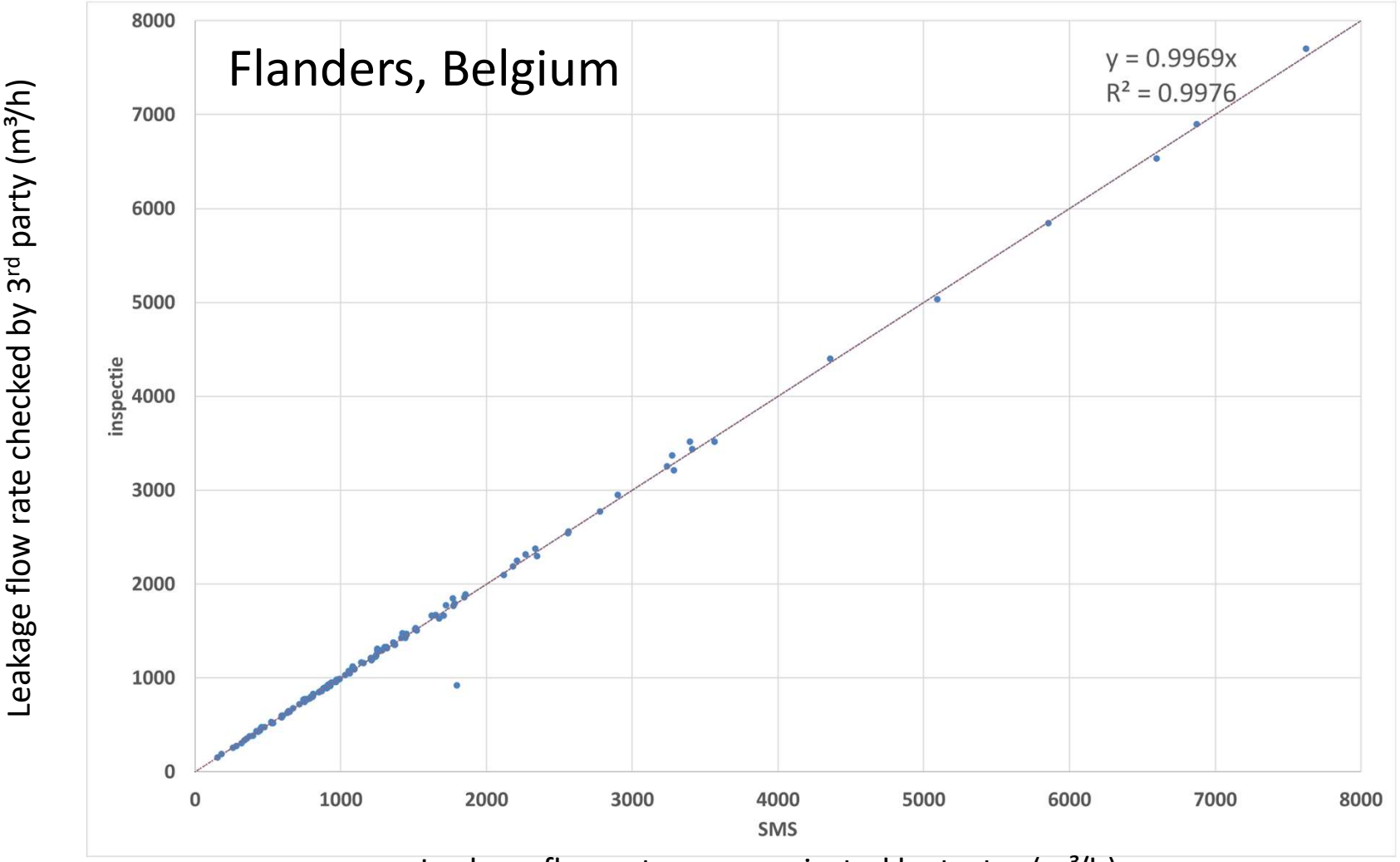
[Flemish Energy and Climate Agency]

Average air permeability (m³/h/m²): leakage flow rate @50 Pa divided by heat loss area



[Flemish Energy and Climate Agency]

3rd party control of declared airtightness results



Leakage flow rate checked by 3rd party (m³/h)

Leakage flow rate communicated by tester (m³/h)

[BCCA]

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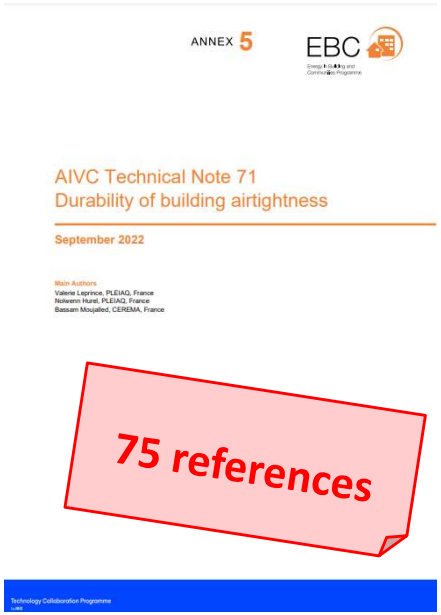

Durability of building airtightness

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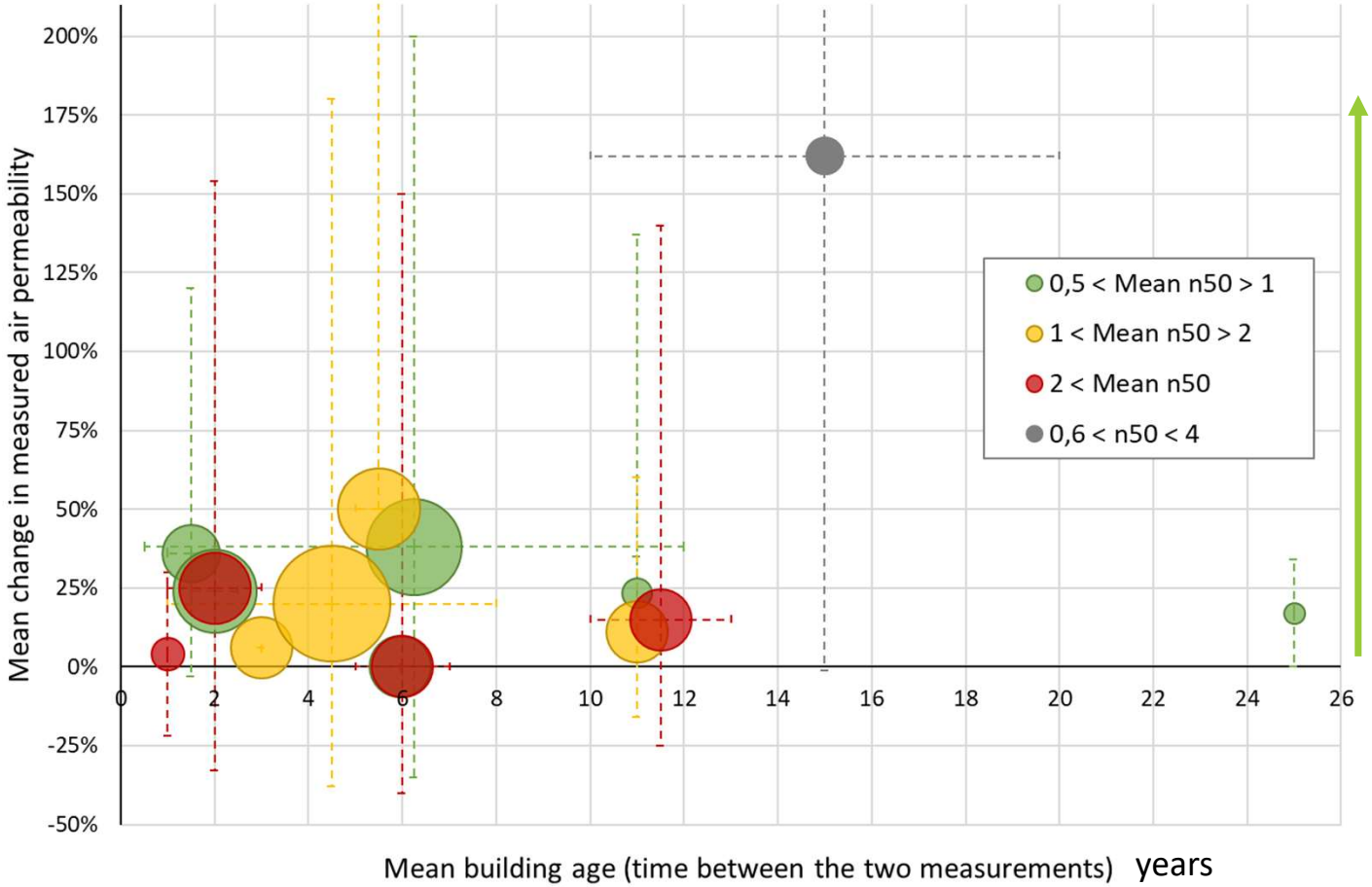
Review of on-site studies testing buildings airtightness durability



Airtightness tends to **deteriorate after completion**

→ The **mean change in air permeability is positive for all studies**. The average of all mean changes weighted by the sample size gives an increase of **24%**.

Airtightness Testing of Large Buildings

Iain Walker
Scientist
Building Technology & Urban Systems Division

Non-residential/ Large Building Testing Issues

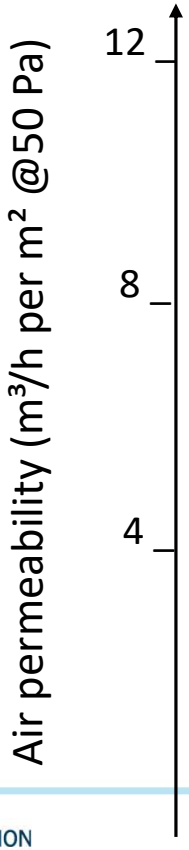
- Pressure uniformity
- Building preparation
- Moving enough air
- What about occupants? Can we only test when empty?
- Operation of other air moving systems and general building control
- Need data automation: multiple air flow and pressure location measurements need to be combined

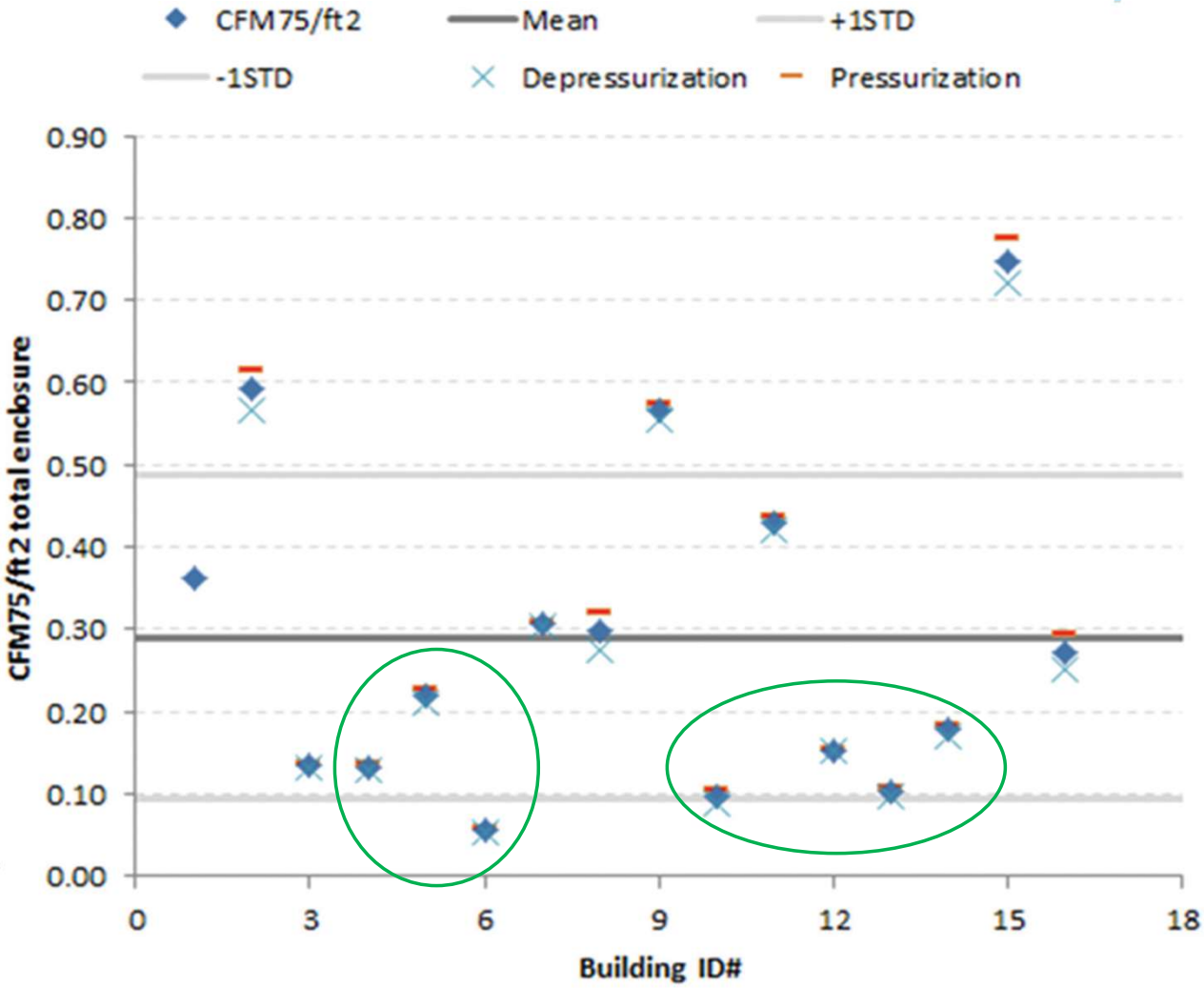
Where to install fans?

Estimate that 18 fans will be needed
120,000 m^3/h

Lots of building to building variability

[Brennan et al. 2013]





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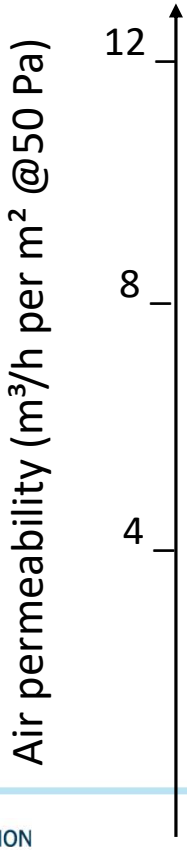
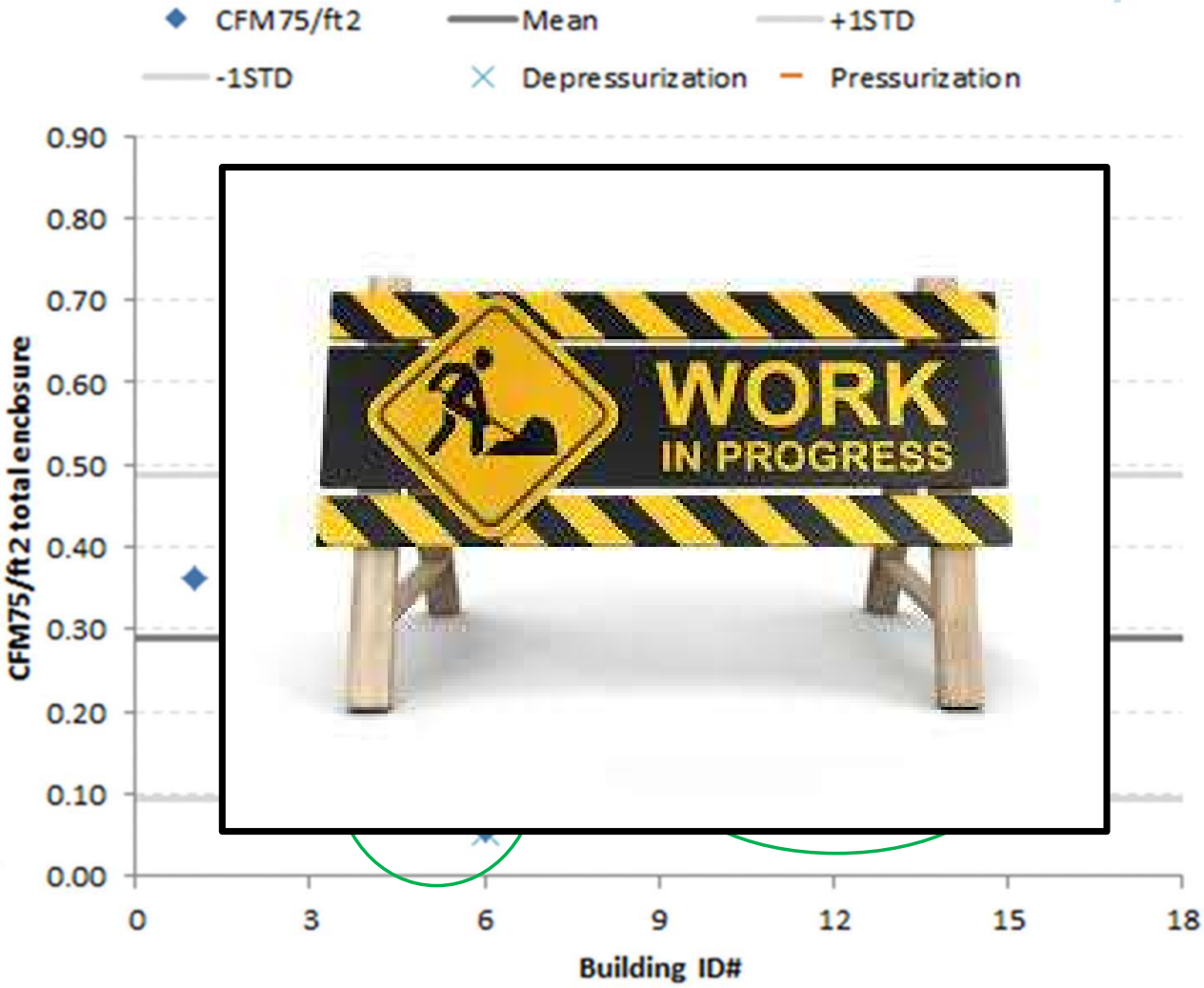
[Brennan et al. 2013]





Thank you for your attention!

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Air Infiltration and Ventilation Centre **AIVC, INIVE** vzw