

IEA-EBC Annex 5

Air Infiltration and Ventilation Centre

AIVC

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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.

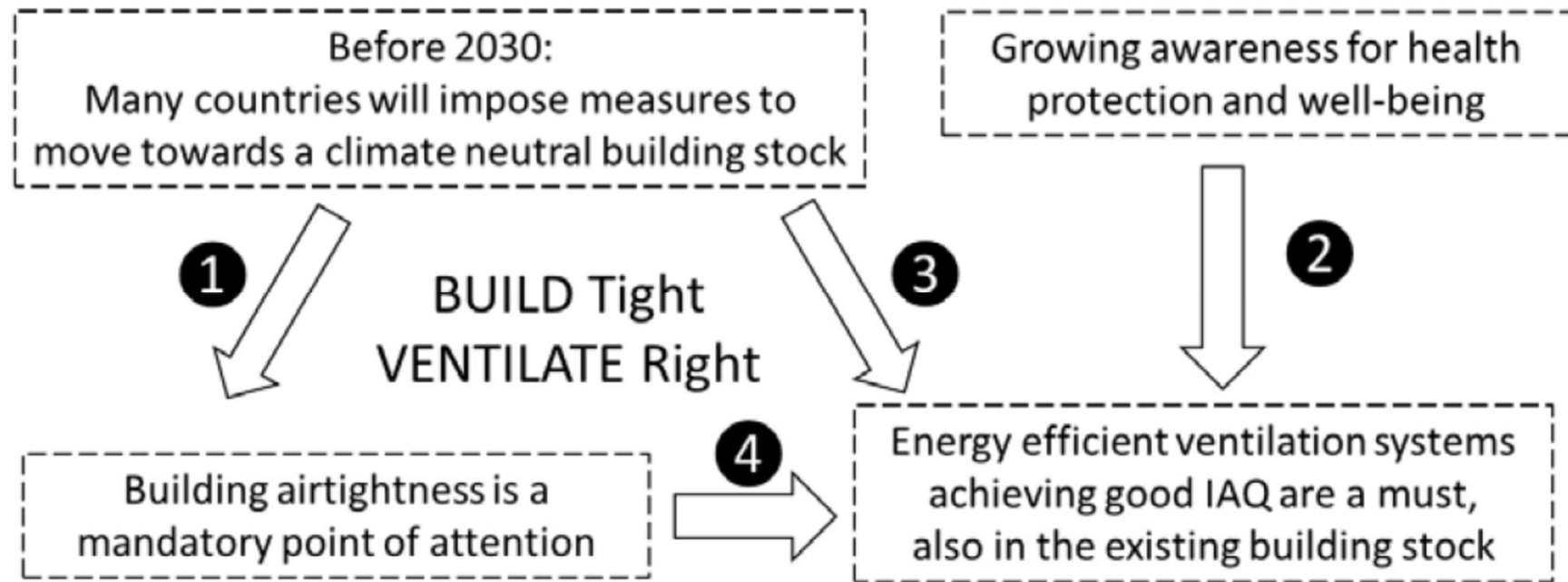


AIVC Technical Note 69
40 years to build tight and ventilate right:
History of the AIVC
February 2022



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.





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Events

The AIVC holds a conference each year in September/October, a workshop in March/April and several webinars, covering a wide range of topics in the field of infiltration and ventilation in buildings. The conferences and workshops take place in one of the AIVC participating countries. Since 1980, the AIVC annual conferences have been an international meeting point for presenting and discussing major developments and results regarding infiltration and ventilation in buildings.

Click on the links below to know more.



Conferences



Workshops



Webinars

- **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.





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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 Ventilation, special issue ‘Ventilation challenges in a changing world’



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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



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

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Context : AIVC VIPs



Building airtightness

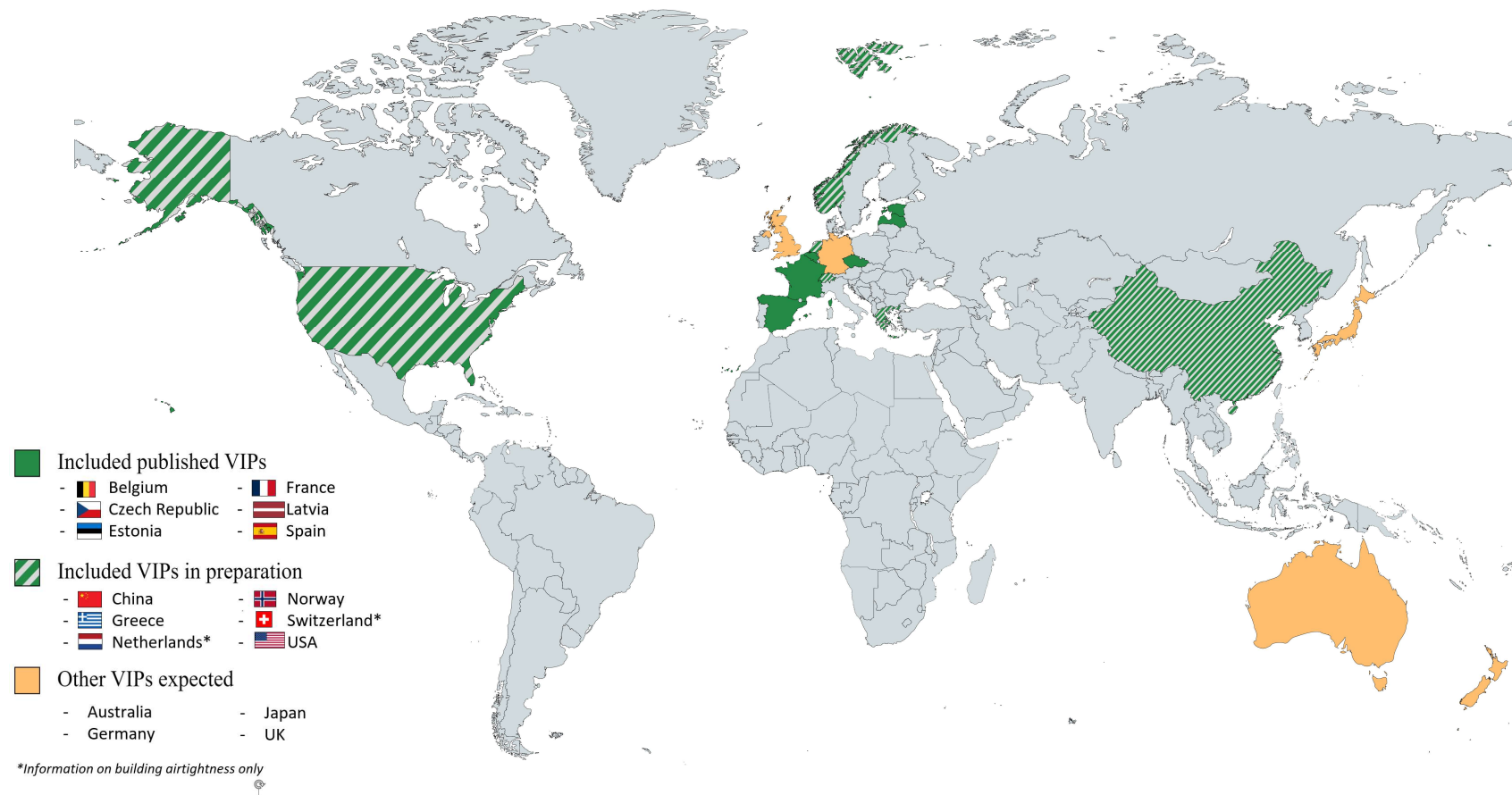


Ductwork airtightness

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


- ## Ventilation Information Paper n° 45.1
- July 2002
- © INVE EGO
Operating and
Maintenance Dept.
Boulevard de la Woluwe 62
1200 Brussels - Belgium
inve@skynet.be
International Energy Agency's
Expertise in Buildings and Communities
-
- An Institution and Ventilation Centre
- ## Trends in building airtightness in Estonia
- Tarmo Kovermaa, Tallinn University of Technology, Estonia
Jaanika Hallik, Tallinn University of Technology,
Estonia
Ahti Mäkelä,
- Tallinn University of Technology, Estonia
- ### 1 Introduction on the building market in Estonia
- Estonia is a country of 1,304 administrative counties according to the Estonian Building Registry. According to the number of private houses of houses since the year 2000 (including buildings under construction) there are now before 2000 (including buildings under construction) 155,150, their total floor space amounting to 19,000,000 m². The number of apartment buildings of houses there were taken into use before 2000 (including buildings under construction) 22,000, their total floor space amounting to 20,370,000 m². The Building Registry includes 375,000 one-unit residential buildings that go on as new and have been taken into use before 2000 (including those built during reconstruction). As illustrated in Figure 1, there are non-residential buildings with climate control (offices, educational and research (university) buildings, of residential buildings, agricultural buildings, pumping buildings, industrial buildings, power plants, etc.). There are around 12,000 such buildings as of the end of 2000, all of which have a total floor area of about 10 million m². According to the studies carried out by the Estonian Institute of Statistics, based on the overall energy consumption of 2001, 47% of population and housing centres of 2001, 47% of population and housing centres of 2001, 47% of population and housing centres of 2001, 47%
- In recent years, almost 10,000 building permits annually (see Figure 2). The difference between the number of the buildings and new permits is the number of existing building permit has been taken into consideration and the permit has not yet always been applied for.
- | Year | Number of buildings | Building permits issued |
|------|---------------------|-------------------------|
| 1990 | ~1000 | ~1000 |
| 1991 | ~1000 | ~1000 |
| 1992 | ~1000 | ~1000 |
| 1993 | ~1000 | ~1000 |
| 1994 | ~1000 | ~1000 |
| 1995 | ~1000 | ~1000 |
| 1996 | ~1000 | ~1000 |
| 1997 | ~1000 | ~1000 |
| 1998 | ~1000 | ~1000 |
| 1999 | ~1000 | ~1000 |
| 2000 | ~1000 | ~1000 |
| 2001 | ~1000 | ~1000 |
- Figure 2: Number of all buildings types and building permits issued in Estonia

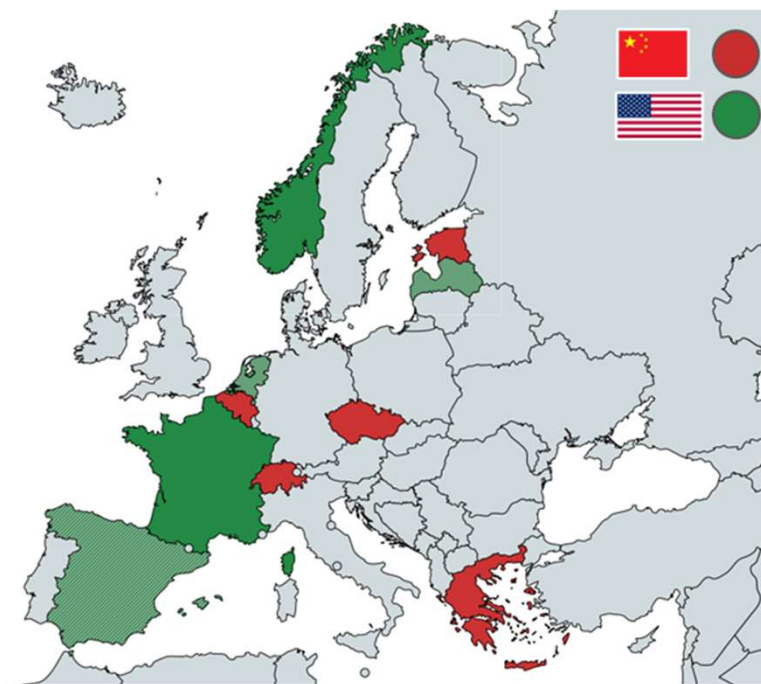
Countries included in this overview (12)





Mandatory envelope airtightness requirements

Mandatory requirements?					
NO	YES				
	Country	Mandatory for:	Values		Mandatory justification ?
			Indic. (unit)	Max. values	
	FR	Residential buildings	$q_{4PaSurf}$ ($m^3/(h.m^2)$)	<ul style="list-style-type: none"> 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} ($m^3/(h.m^2)$)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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})	<ul style="list-style-type: none"> 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})	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 3 nationally 5 in few locations with very mild climates 	YES, by test (sampling allowed for multi-family)



Requirements mainly in residential buildings

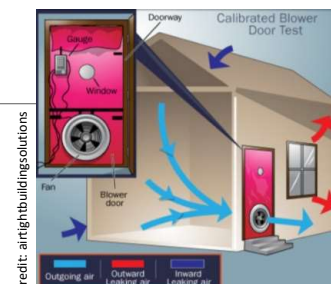
Why air tightness requirements (and testing)?

- 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

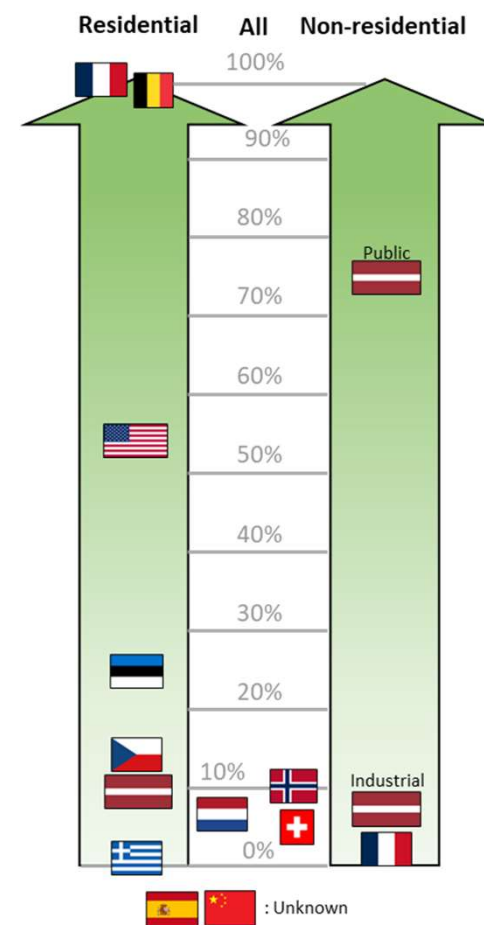
Country	National qualification for testers				National guidelines		
	Existing?	Mandatory?	Name	Number or %	Existing?	Name (year)	Specificities
BE	YES (Fl.)	YES ?	By BCCA and SKH	150 – 190 (Fl.)	YES	STS-P 71-3 (2014), mandatory only in Fl.	Tests in p ⁺ and p ⁻ (or correction if not possible)
CN	NO	-	-	-	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 New Green Savings (NGS) guidelines	Method for testing multi-family build. 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)	





Building airtightness tests performed

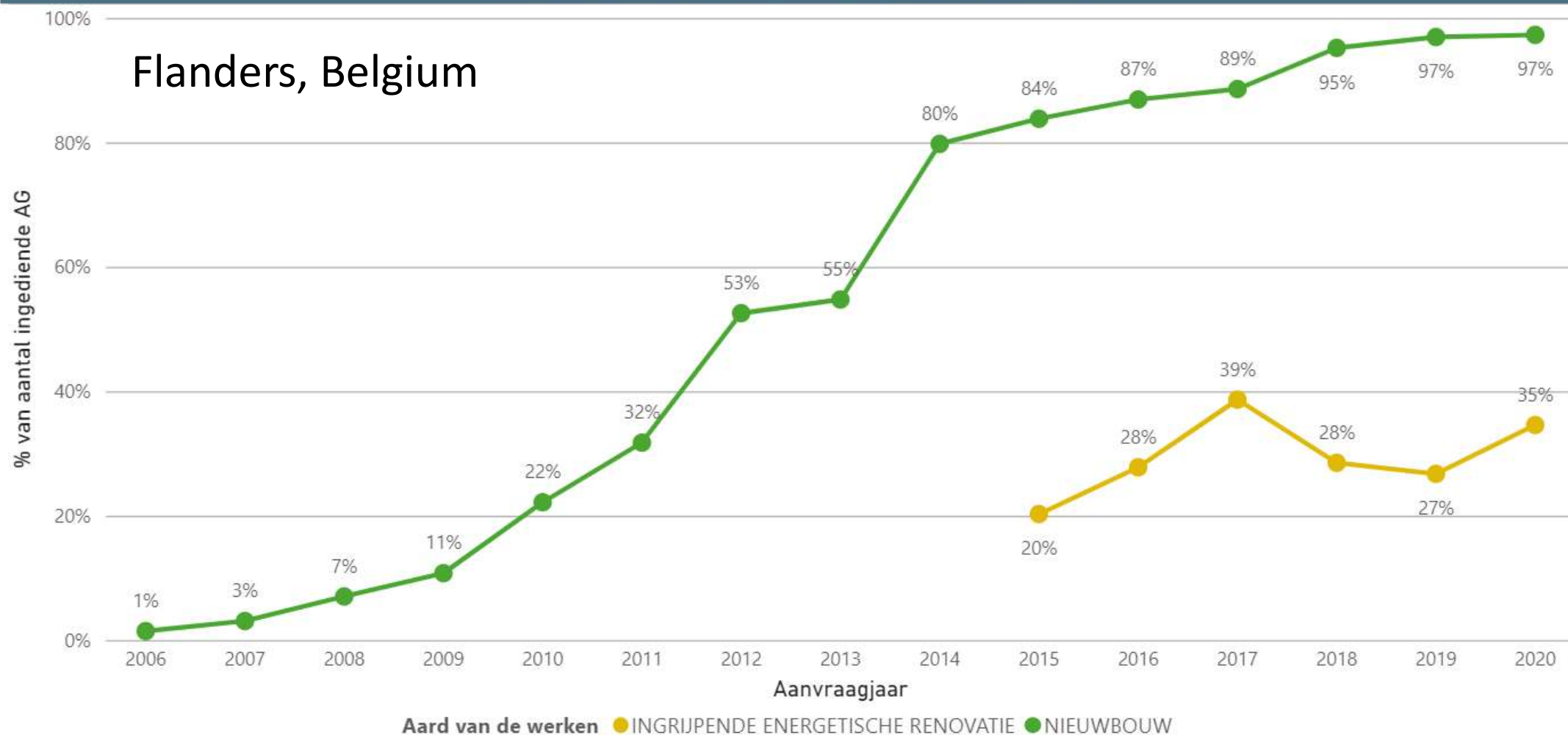
Country	Residential buildings	Non-residential buildings	Public database		
			Existing?	In charge:	% of tests
BE 	New: alm. 100%	-	YES	Flanders: VEKA	100%
	deep retrofit: ~ 25%			quality frameworks like BCCA	All from this QF
CN 	unknown	-	NO	-	-
CZ 	<15%	-	YES	A.BD_CZ	~ 3%
EE 	~ 25%	-	NO	-	-
FR 	100%	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

Evolutie aandeel aangiften wonen met luchtdichtheidstest

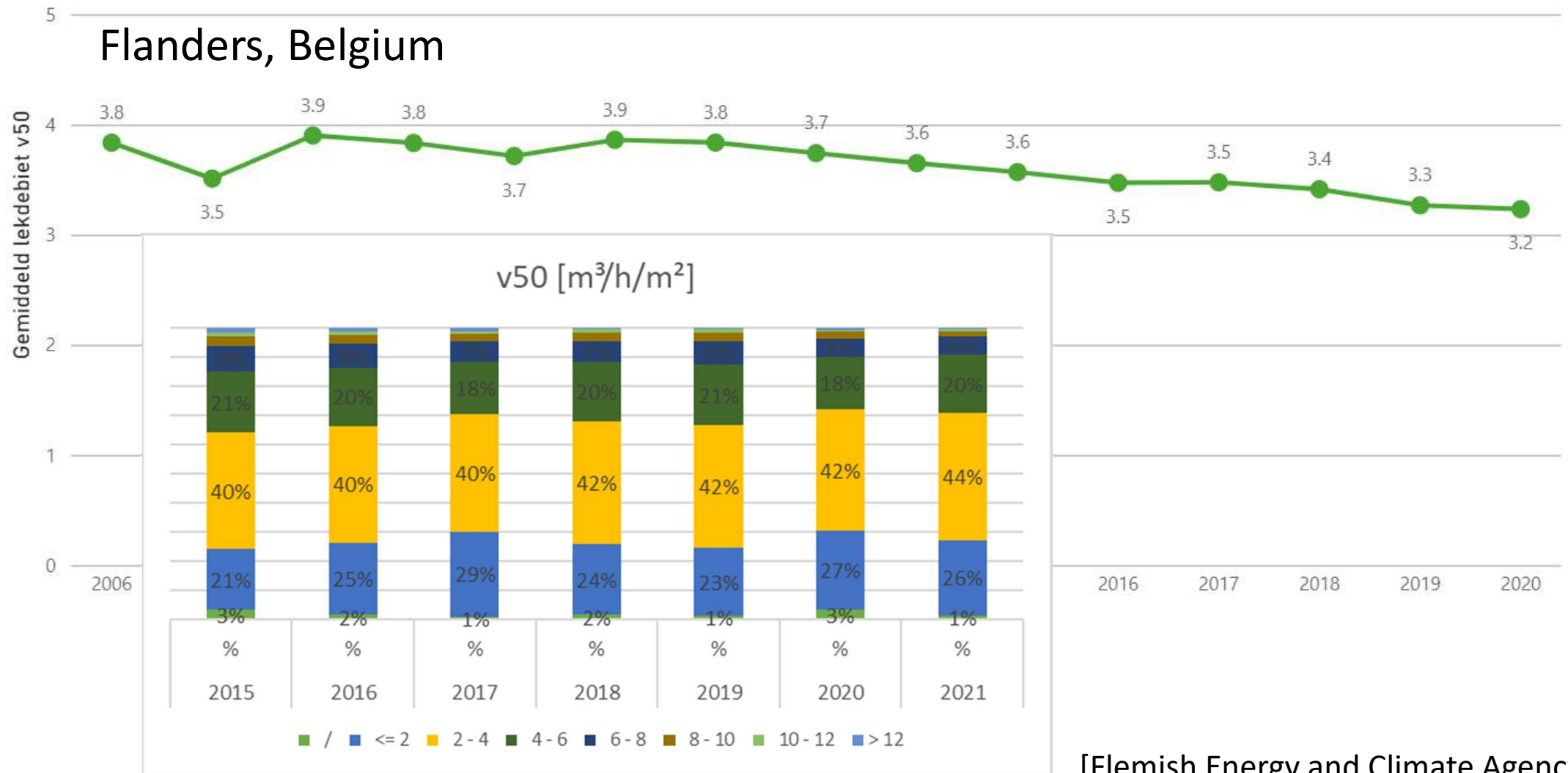
Flanders, Belgium



[Flemish Energy and Climate Agency]

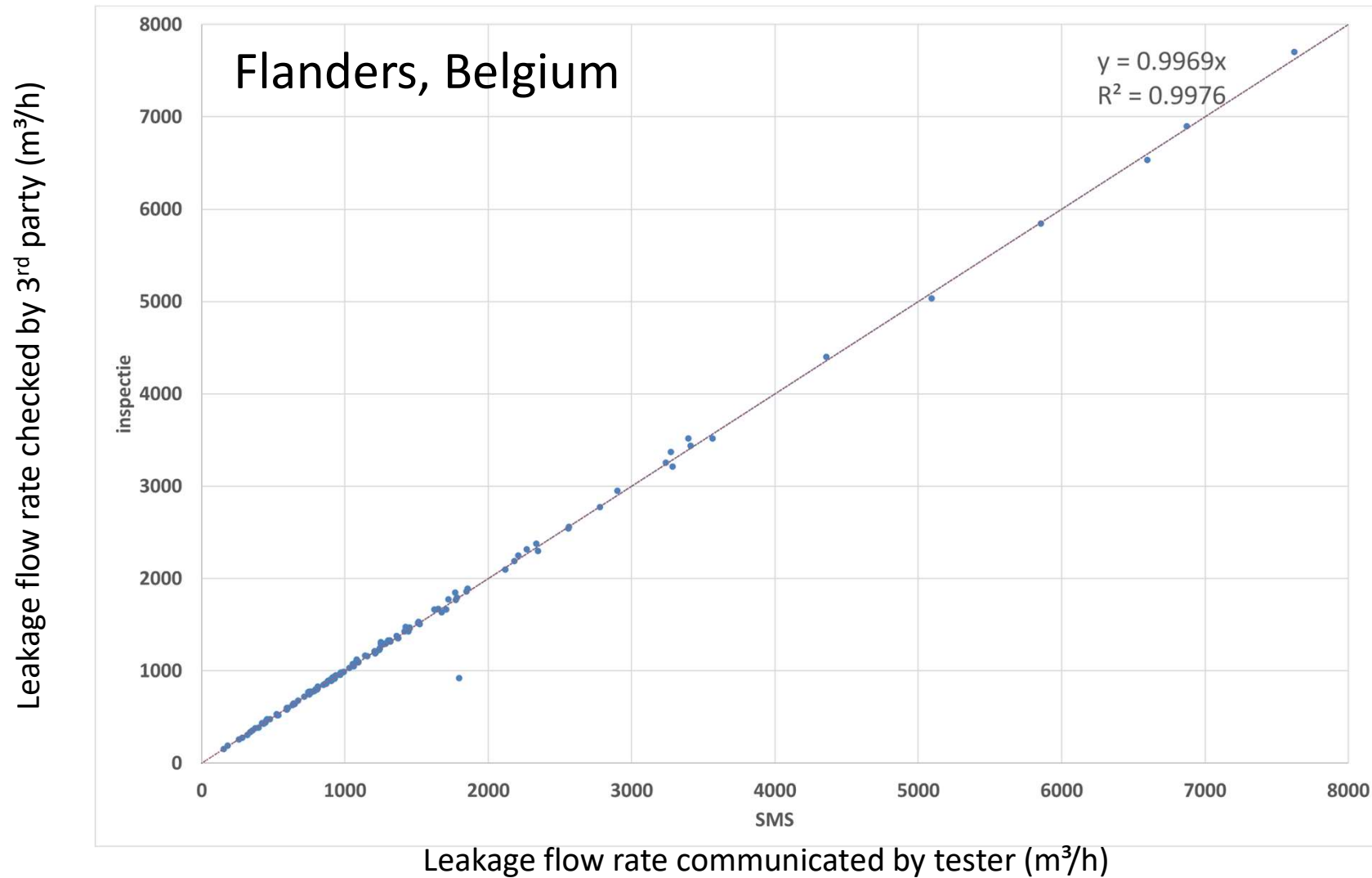
Average air permeability ($\text{m}^3/\text{h}/\text{m}^2$): leakage flow rate @50 Pa divided by heat loss area

Flanders, Belgium



[Flemish Energy and Climate Agency]

3rd party control of declared airtightness results



[BCCA]

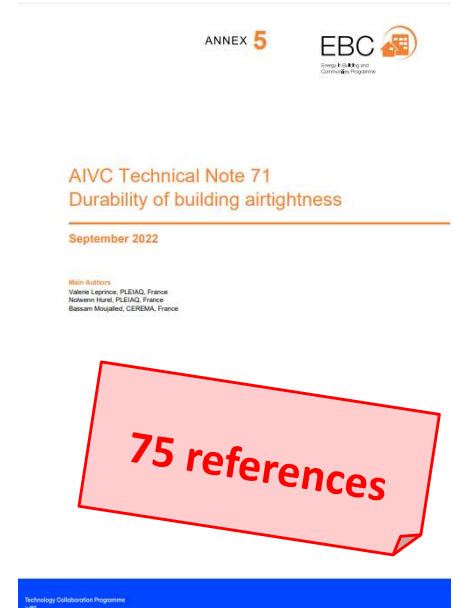
Durability of building airtightness

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BUILDINGS”

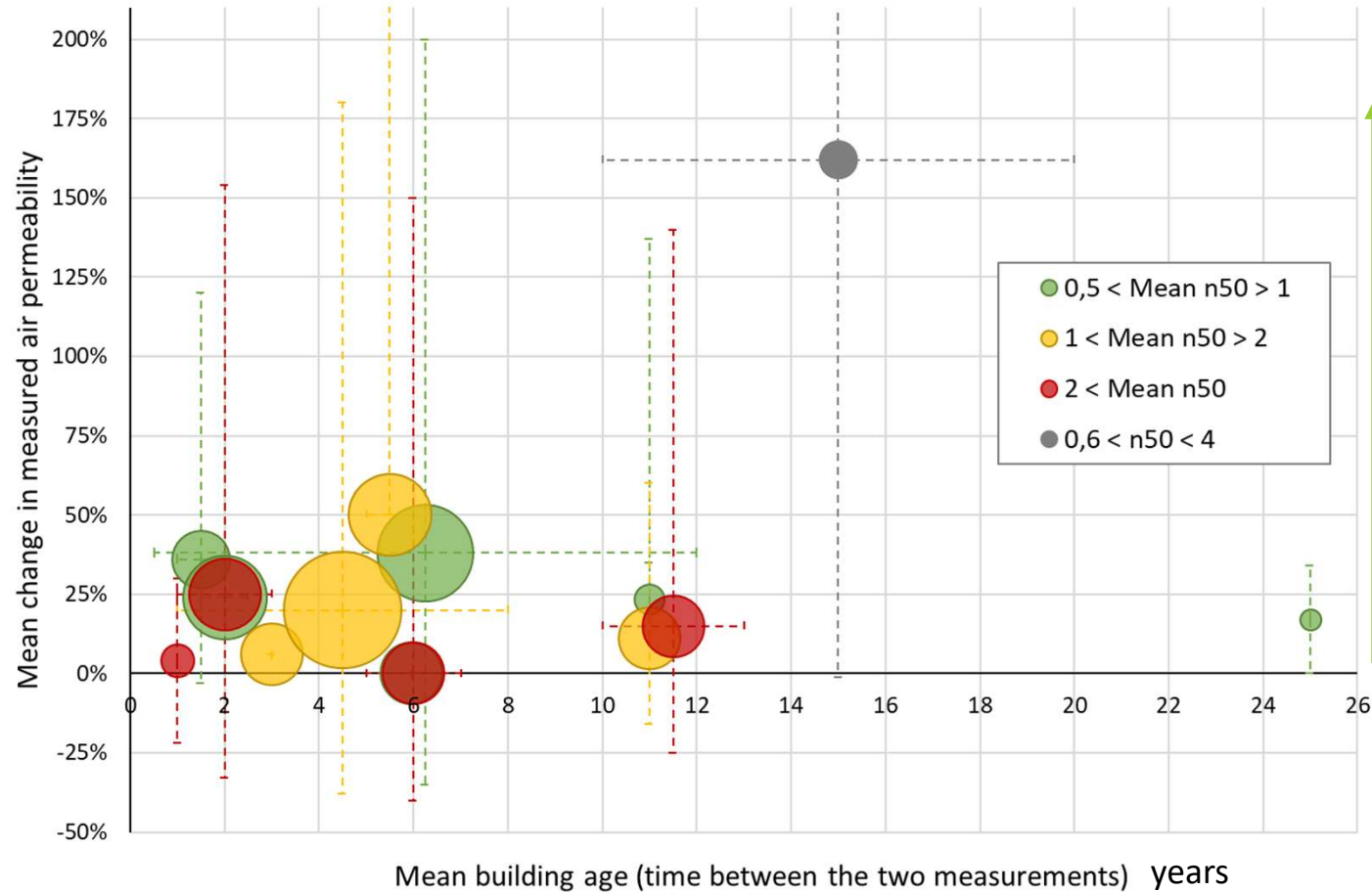
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Review of on-site studies testing buildings airtightness durability



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%**.

An aerial night view of a city skyline, likely Chicago, with numerous skyscrapers illuminated. A large blue rectangular overlay covers the left side of the image, containing the title and speaker information.

Airtightness Testing of Large Buildings

Iain Walker
Scientist
Building Technology & Urban Systems Division



BUILDING TECHNOLOGY & URBAN SYSTEMS DIVISION
Energy Technologies Area

homes.lbl.gov

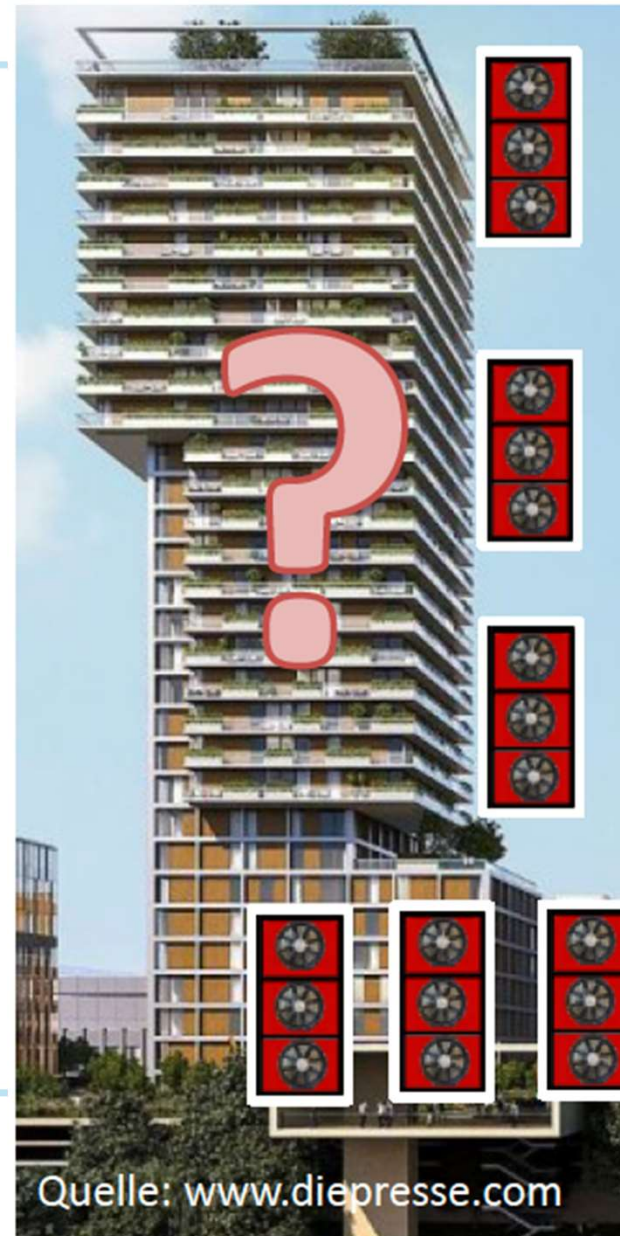
Non-residential/ Large Building Testing Issues

- 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 m³/h



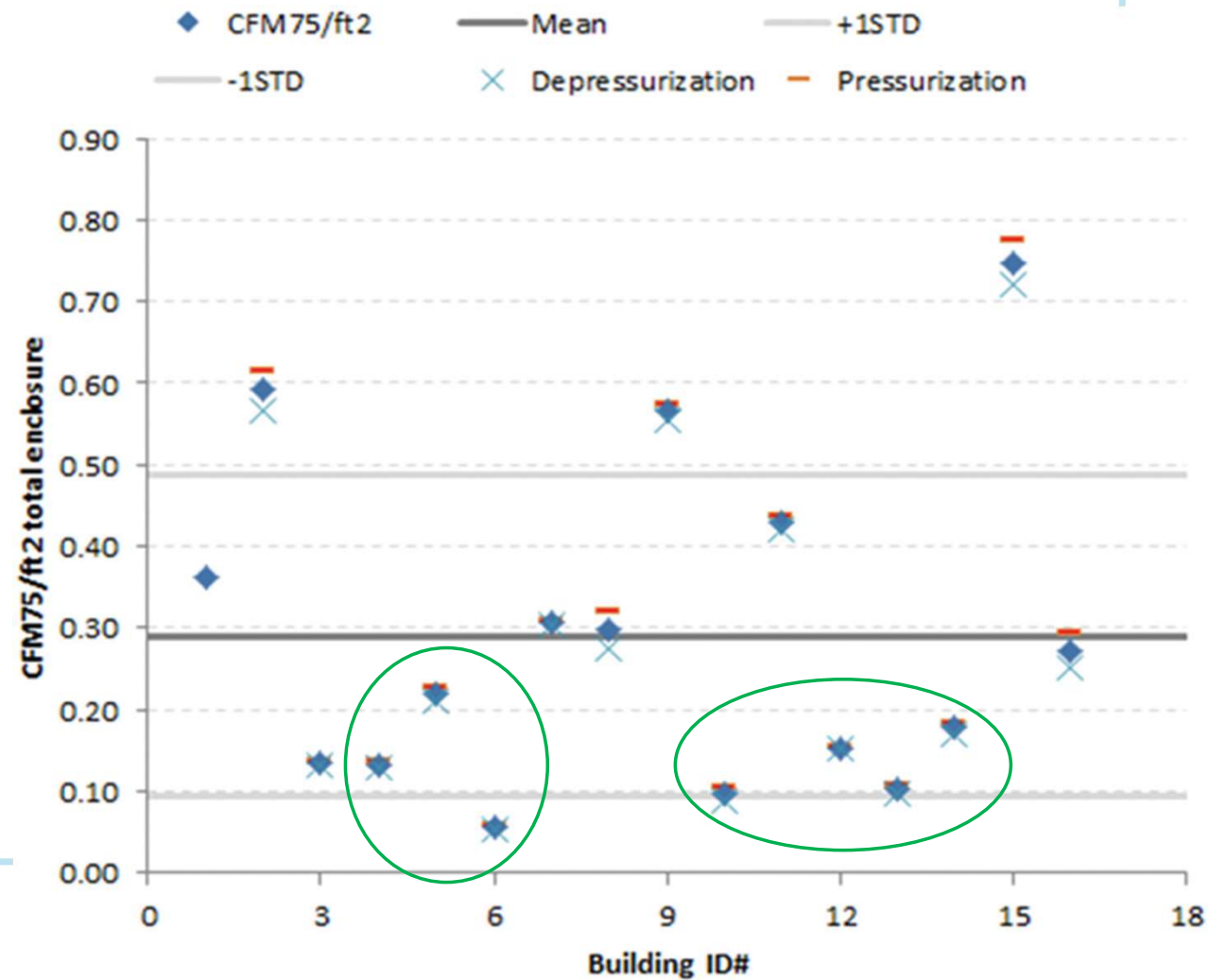
Quelle: www.diepresse.com



Lots of building to building variability

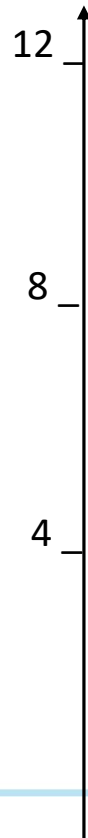
Air permeability ($\text{m}^3/\text{h per m}^2$ @50 Pa)

[Brennan et al. 2013]

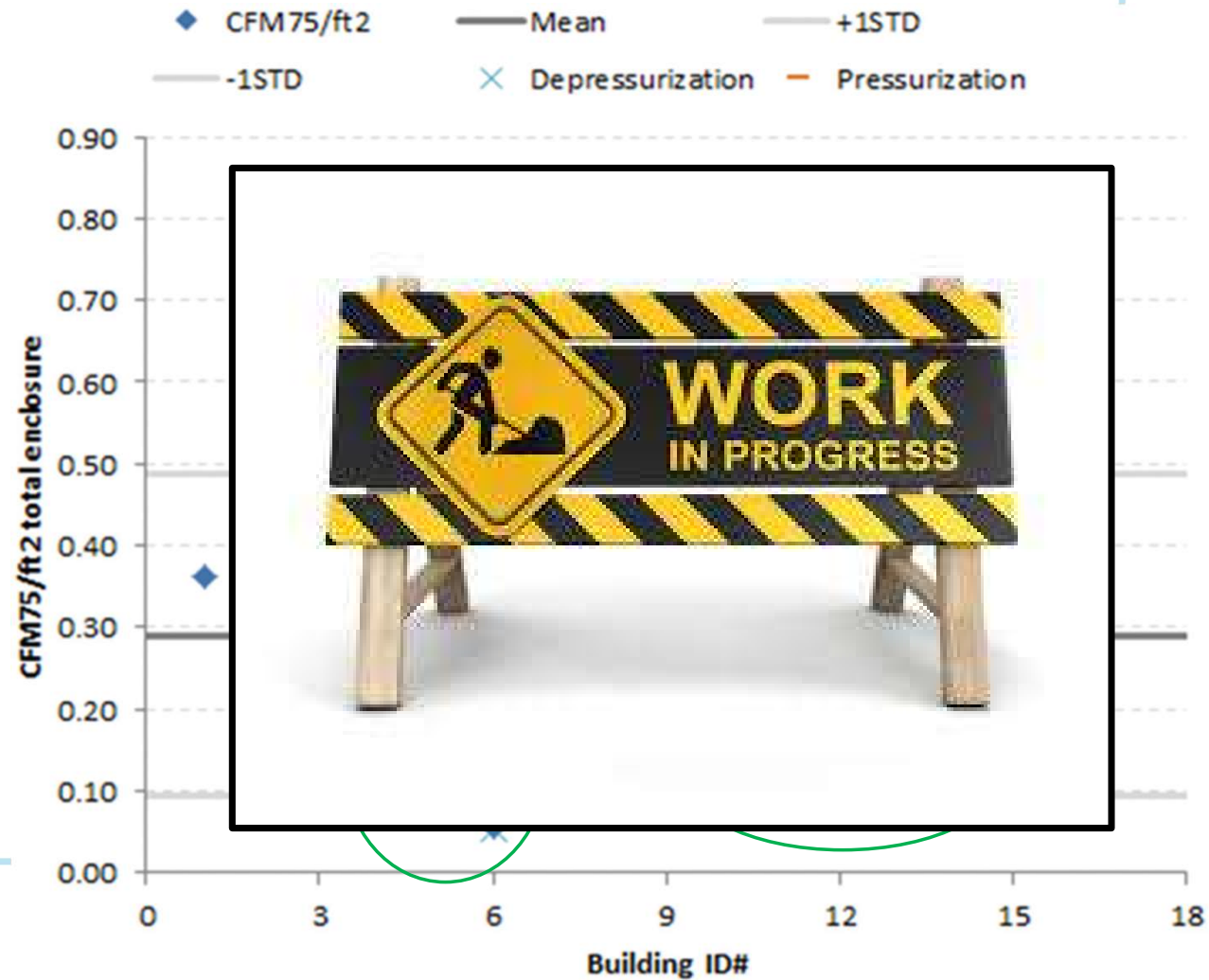


Lots of building to building variability

Air permeability (m^3/h per m^2 @50 Pa)



[Brennan et al. 2013]





Thank you for your attention!

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