



# Building and ductwork airtightness: a key challenge for NZEBs

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INIVE

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HVAC Technology in Energy Retrofitting  
Timisoara, Romania

19-20 April 2012



# Outline

- Context
- Trends and rationale behind TightVent
- Development of airtightness requirements
- Reliable testing and reporting
- Quality management in the building process
- Perspectives

# Context

- The EPBD has lead most EU countries to include building airtightness in their regulation, although they did not have to, cf. ASIEPI project,

[www.asiepi.eu](http://www.asiepi.eu)



- The EPBD recast (2010/31/UE, 19/05/10)

Building and ductwork  
airtightness becomes a key  
question

*Article 9*

**Nearly zero-energy buildings**

1. Member States shall ensure that:

(a) by 31 December 2020, all new buildings are nearly zero-energy buildings; and

(b) after 31 December 2018, new buildings owned by public authorities are nearly zero-energy buildings.

+ measures for existing stock

# A growing concern



## A new airtightness network was founded in the Czech Republic



## Procedia Engineering

Volume 21, 2011, Pages 98–105

2011 International Conference on Green Buildings and Sustainable Cities



## Protocols for Measuring the Airtightness of Multi-Dwelling Units in Southern Europe

Jesica Fernández-Agüera, Juan José Sendra, Samuel Domínguez

University Institute of Architecture and Building Science, Avda. Reina Mercedes n°2, Sevilla 41012, Spain

Available online 13 December 2011.

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ISSUE 9, VOL 5 OUT NOW

### Dwelling airtightness in Ireland: where we are, and where we're going

Posted by: Gavin O'Sé in weatherize, ventilation, upgrade, sustainable, sealing, retrofit, renovation, remodel, proof, passive house, Part L, green, Energy, eco, draught, construction, building standards, Building Regulations, building, BER, airtightness, airtight, air quality on Feb 3, 2011

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Bygg Byggevarer Eiendom Næringsliv Kalender BA-torget Prosjekter

Arbeidstelt  
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STILLINGSYSTEMER

Leca

SCHÖCK

PROTAN

## Hold bygget tett!

I samarbeid med Boligprodusentene, Lavenergiprogrammet, NRI, Byggmesterforbundet og NELFO lanserer Enova nå kampanjen "Hold Tett".

STILLINGSANNONSER (13)

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A - Z

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### Airtightness

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BSRIA provides nationwide airtightness testing, consultancy, design reviews and support services on all buildings, both dwellings and non-dwellings. We have regionally based engineers in England, Wales and Scotland to provide a cost-effective, local service. BSRIA also tests buildings in Northern Ireland and the Republic of Ireland in partnership with Anderson Mechanical Services.

Airtightness  
Testing dwellings  
Testing non-dwellings  
Blower door sales  
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Guidance to download  
Roof inspections

## Regulatory requirements for ductwork leakage in Portugal: reasons behind and lessons learnt

- Based on presentation at the 2011 AIVC-TightVent conference by Eduardo Maldonado, University of Porto, Portugal

Ductwork airtightness is often considered to be an issue in cold or mild climates only in Europe, although there has been a significant amount of work in hot climates in particular in the US that demonstrates the great energy savings potential by reducing duct leakage.

One interesting exception is Portugal where mandatory requirements have been included in the regulation since 2006, as part of the implementation of the EU directive

procedure similar to that described in the AMA requirements in Sweden.

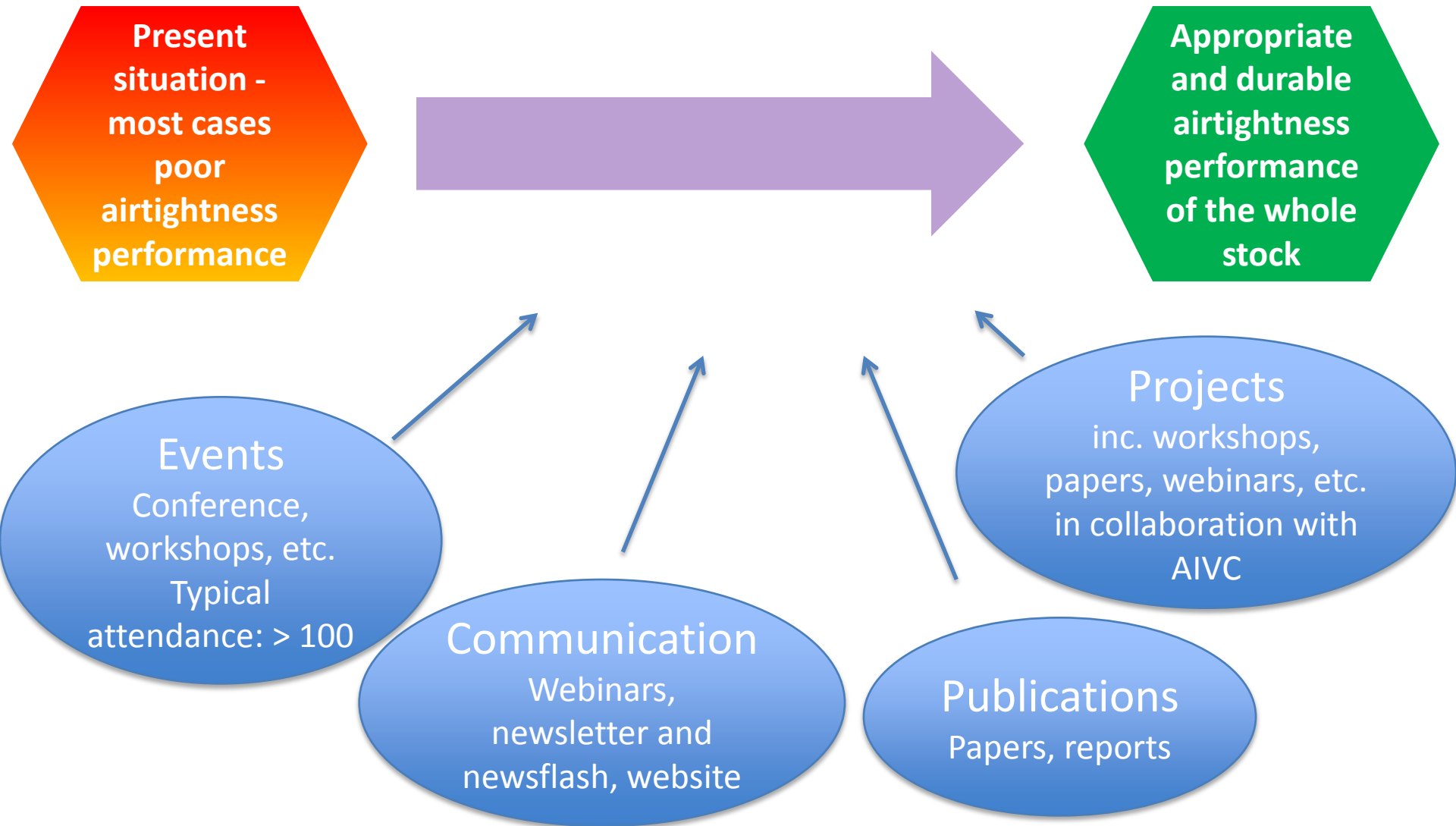
It is too early to say if the new regulations have been successful: the data regarding the actual performance of the few buildings constructed with the new requirements has not been analyzed yet.

However, there is proof that the market adapted to the regulations. The share of pre-fabricated round ductwork with quality seals between ductwork components increased significantly (from less than 5% in 2006 to 30% in 2010). For rectangular ducts, the

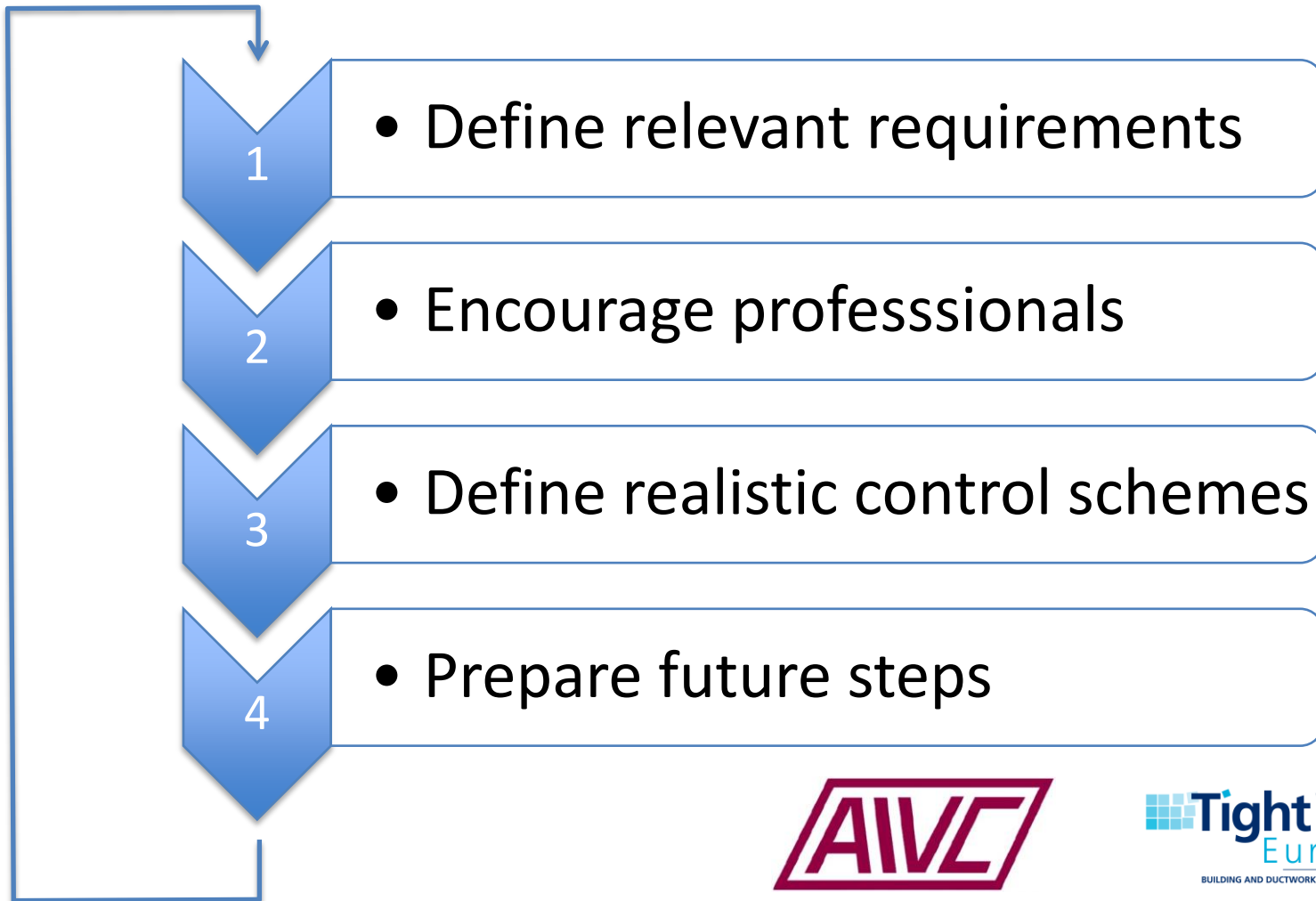
# Preconceived ideas

- Building and ductwork air leakage levels are well-known
- You must impose very strict requirements, whatever the building usage, climate, etc.
- This is not a concern for mild climates
- It's easy, professionals can rapidly integrate these issues
- Testing is easy and can be rapidly integrated in a regulatory control scheme
- We know well the stakes and barriers, no need for research, to develop new methods and products

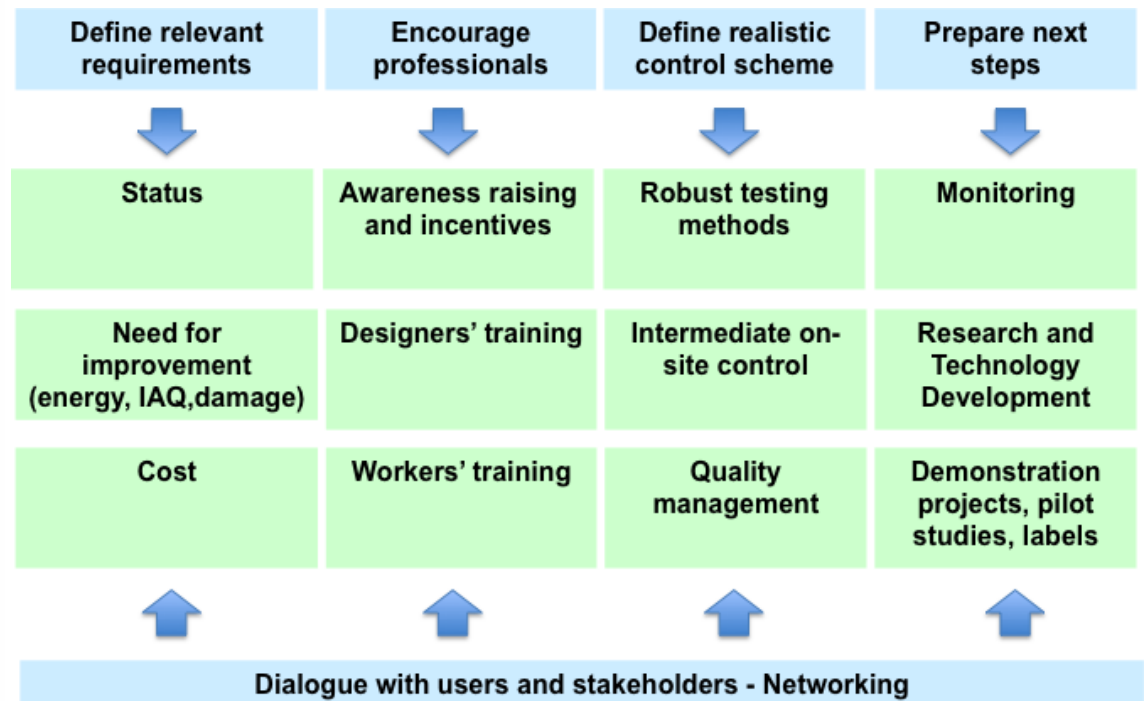
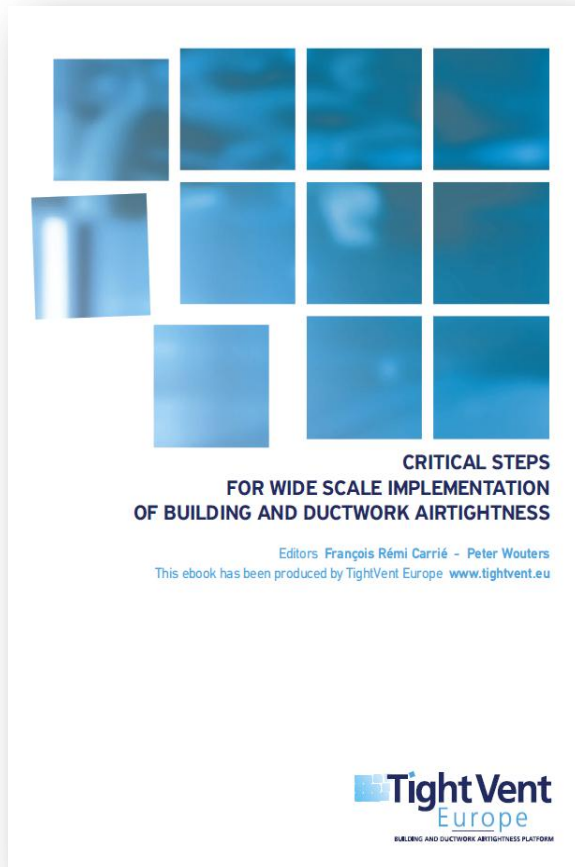
# TightVent overview



# Towards a global approach



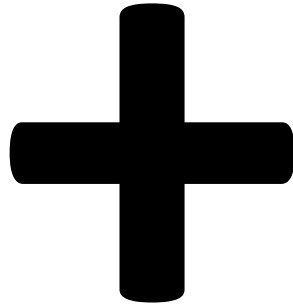
# Towards a global approach







Resolution: 800 x 600 px  
Free Photoshop PSD file download  
[www.psdgraphics.com](http://www.psdgraphics.com)



# AIVC-TightVent projects

Development and applications of building air leakage databases

- Fundamental starting point to identify progress needed (step 1)
- Essential tool to monitor the application of practices and to evaluate policies (step 4)

Philosophy for setting airtightness requirements

- Understand the pros and cons of possible approaches and issues to address, inc. in terms of IAQ and building damage (step 1)

How tight and insulated ducts should be?

- Underline the impact and possible progress, with prior identification of possible approaches, issues to address, including in terms of IAQ and building damage (step 1)

Measurement quality

- Disseminate good practice
- Increase the accuracy of the measurement, critical point in case of disputes for non compliance to a specific requirement or to a financial aid

Approches « qualité » pour améliorer les pratiques

- Disseminate good practice
- Raise awareness about the potential of voluntary schemes with self-control and/or third party control and about the benefits for builders and contractors as well as end users.

Durability of building airtightness

- Better understand the evolution of airtightness in time, progress needed, and consequences in terms of verifications and inspections.



**International workshop**

**Achieving relevant and durable airtightness levels:  
status, options and progress needed**

**Brussels, Belgium, 28-29 March 2012**



# Development of requirements

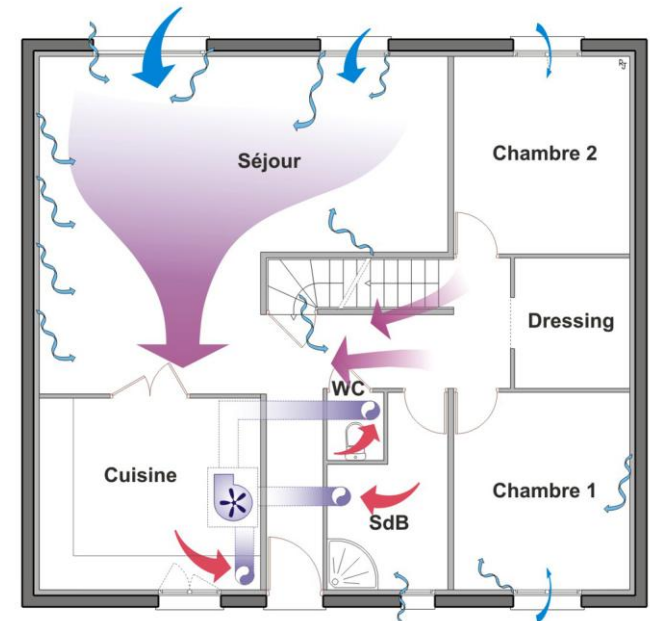
- Purpose of the requirements
  - **Type A:** To limit of the air leakage because of energy impacts
    - This position is often further backed up with IAQ and building damage issues
    - Ensure proper ventilation airflow rates
    - Underlying philosophy: **Build Tight, Ventilation Right!**
  - **Type B:** To overcome IAQ concerns raised by very low air tightness levels
    - *This position is often backed up with cost issues*
    - *Stems from problems:*
      - *in renovated buildings with no ventiation system (whether natural, hybrid or mechanical)*
      - *with unvented combustion appliances inside the conditioned space*
    - Underlying philosophy: **How tight is too tight?**

# Type B requirements

- Legitimate concerns regarding:
  - tightening of existing buildings => provisions for proper air renewal and treatment of liquid water penetrations (e.g., by capillarity);
  - provisions for air supply for unvented combustion appliances inside the conditioned space;
  - provisions for air renewal in case of ventilation system fault.

# Type B requirement

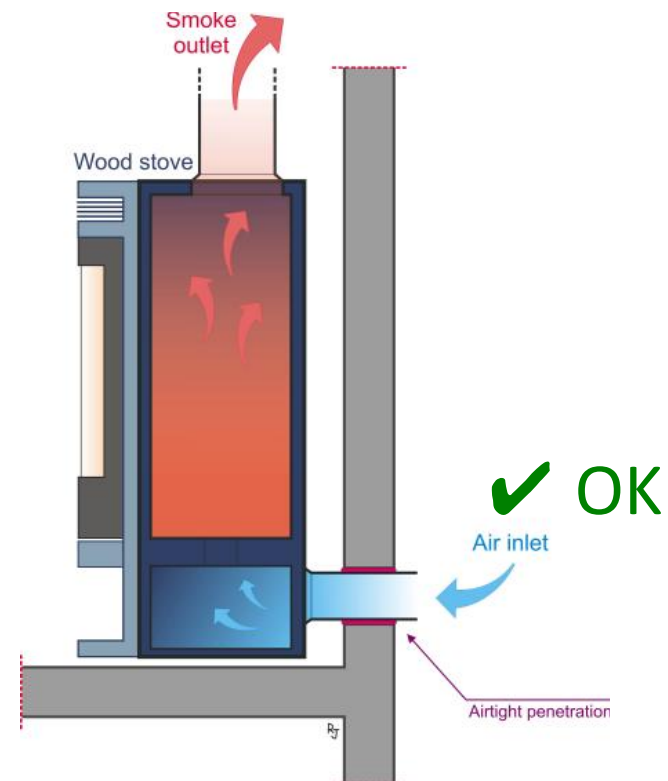
- Is that the right answer?
- Shortcomings:
  - Very difficult (if not impossible) to target a minimum leakage level.
    - *“Make it just bad enough”*;
  - Although the overall renewal may be sufficient, rooms may be short-circuited, yielding IAQ problems locally.



Source: CETE de Lyon

# Type B requirements

- The case of unvented appliances
  - A real and severe problem
  - Alternative developed in France:
    - Impose a minimum opening size to provide air to the appliance
    - How to deal with the temptation of user to seal the opening?
  - => *Phasing out these types of appliances?*



Wood stove with specific air inlet  
**outside** the conditioned space  
Source: CETE de Lyon

# Type A requirements



Calculation

Default value,  
with credit

Minimum  
Requirement

Testing scheme

Strict

Intermediate

Loose

Strict

Intermediate

Loose



# Type A requirements

Testing scheme	Frequency	Examples
Strict	Systematic testing and strict control of reporting procedure	Mostly voluntary schemes: Passivhaus, Minergie-P, Guaranteed Performance Homes, etc.
Intermediate	Airtightness levels must be justified. It always involves some testing but not systematically	Regulatory schemes in e.g. France and the UK
Loose	Tests rarely performed	

# Requirements

- Fact:
  - Market transformation on-going with **clear messages and testing**
    - France, UK, USACE, Guaranteed Performance Homes
- Should be taken into account if you want a market transformation to occur
- Legitimate concerns must be addressed
  - Combustion appliances
  - Renovation
  - What happens in case of disputes?
  - Etc.

Check the building performance on site!

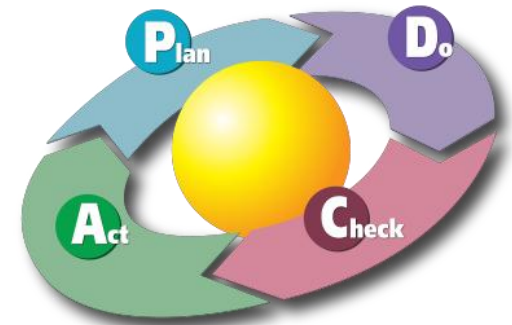


# Testing and reporting

- This philosophy implies that tests are reliable
- Qualification schemes for testers are necessary
- Such developments in
  - Europe
    - Finland (< 100 certified testers, [www.rateko.fi](http://www.rateko.fi))
    - France (> 320 qualified testers, objective is 3 000, [www.qualibat.fr](http://www.qualibat.fr))
    - Germany ([http://www.flib.eu/certifications\\_cc.html](http://www.flib.eu/certifications_cc.html))
    - UK (several hundreds, [http://www.bindt.org/Air Tightness Testing & Measurement/Air Tightness Testing Requirements.html](http://www.bindt.org/Air_Tightness_Testing_&_Measurement/Air_Tightness_Testing_Requirements.html) )
    - Others?
  - Japan (over 3 000 registered testers)

# Testing and reporting

- Facts:
  - The schemes are proven to be useful to:
    - Improve the quality of the measurements
    - Push building professionals to evaluate their procedures for making airtight buildings
    - A first step in **quality management**
  - General positive feedback although they can be improved
- ... a strong basis for new initiatives...



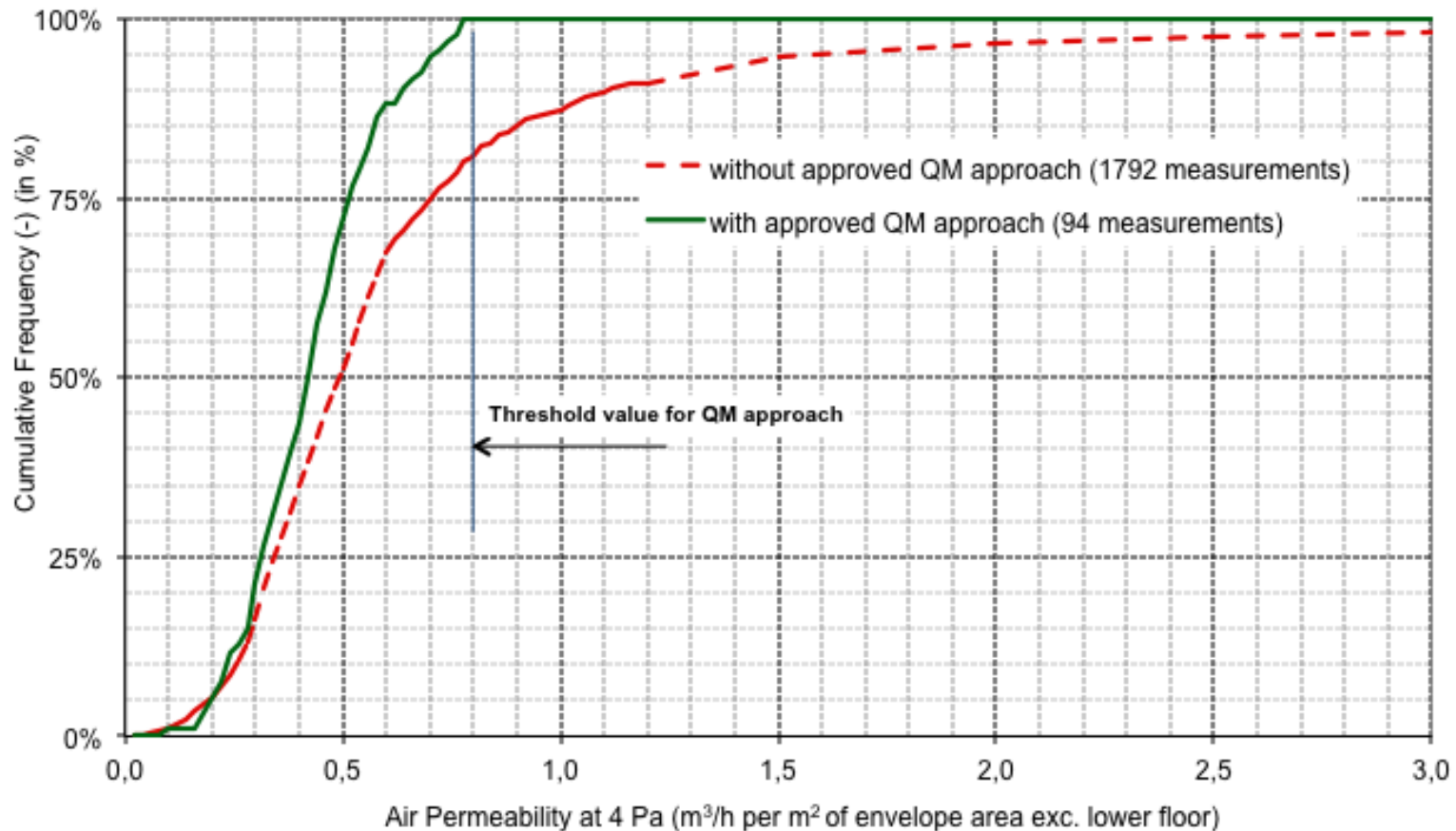
PDCA cycle (source: Wikipedia)

# Quality management in construction process

- Facts:
  - Obviously, methodology helps and has multiple benefits:
    - Encourage quality concerns among building professionals
    - Avoid remedial actions and re-testing
    - Contain costs and save on customer service
  - Satisfactory results with certification or regulatory frameworks in Japan and France

# Quality management in construction process

Distribution of measured airtightness of houses with and without implementation of an approved quality management approach (France)



# Durability

- A well-designed and implemented airtightness strategy is more likely to remain effective in time than last-minute remedial actions
- Immediate actions are possible
  - Users' guide
  - Start collecting data (cf. database)
- Research needed



Apparatus to test alternating loads on tapes: excerpt from paper presented by T. Ackermann



Test room for accelerated aging: excerpt from paper presented by M. Hansen



# Perspectives

AIVC-TightVent Conference – October 2012



33rd AIVC conference – 2nd TightVent conference

Optimising Ventilative Cooling and Airtightness for  
[Nearly] Zero-Energy Buildings, IAQ and Comfort

Copenhagen, Denmark, 10-11 October 2012

In cooperation with



**Abstracts before May 1!**



<http://www.tightvent.eu>  
<http://www.aivc.org>

# Acknowledgements



<http://www.tightvent.eu>

The TightVent Europe “Building and Ductwork Airtightness Platform” was launched on January 1, 2011. It aims at facilitating exchanges and progress on building and ductwork airtightness issues.

Founding partners



Platinum partners



Associate partners



<http://www.aivc.org>

The Air Infiltration and Ventilation Centre was inaugurated through the International Energy Agency and is funded by the following countries:

Belgium, Czech Republic, Denmark, France, Germany, Greece, Italy, Japan, Republic of Korea, Netherlands, New Zealand, Norway, Portugal, Sweden, and United States of America.