NATIONAL ENERGY EFFICIENCY CONFERENCE
COMMERCIAL BUILDING STANDARDS

16 NOV 2016

CHRIS NUNN
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AIRTIGHTNESS IN AUSTRALIA?

> Airtightness is a great unknown in Australia

> Our buildings are considered “leaky”
  - 2 to 4 times leakier than Europe & Nth America (Luther, 2007)

> There is unrealised potential to improve energy efficiency and comfort through air tightness

> The forgotten piece of the energy efficiency puzzle

Reference: Luther, M. B., 2007, Realising Air Leakage in Australian Housing, Built Environment Design Professions Ltd and Royal Australian Institute of Architects, TEC 24 pp.1-11, November 2007.

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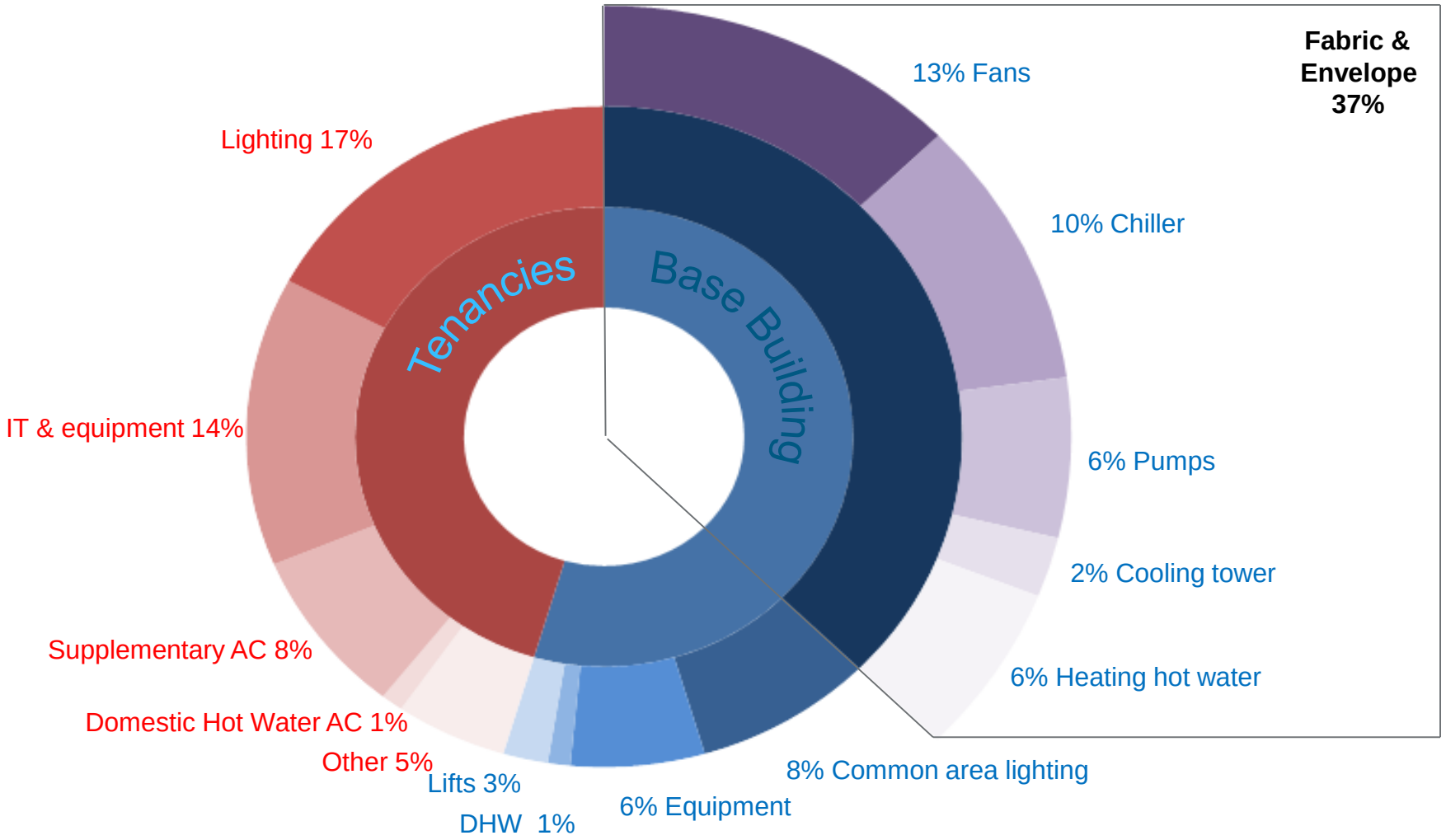

Australian Government National Strategy on Energy Efficiency, Baseline Energy Consumption and Greenhouse Gas Emissions In Commercial Buildings in Australia Report, Nov 2012

Department of Industry, Heating, Ventilation & Air-Conditioning High Efficiency Systems Strategy Fact Sheet, Sept 2013

FMA Operational Guide to Sustainable Facilities Management, 2010

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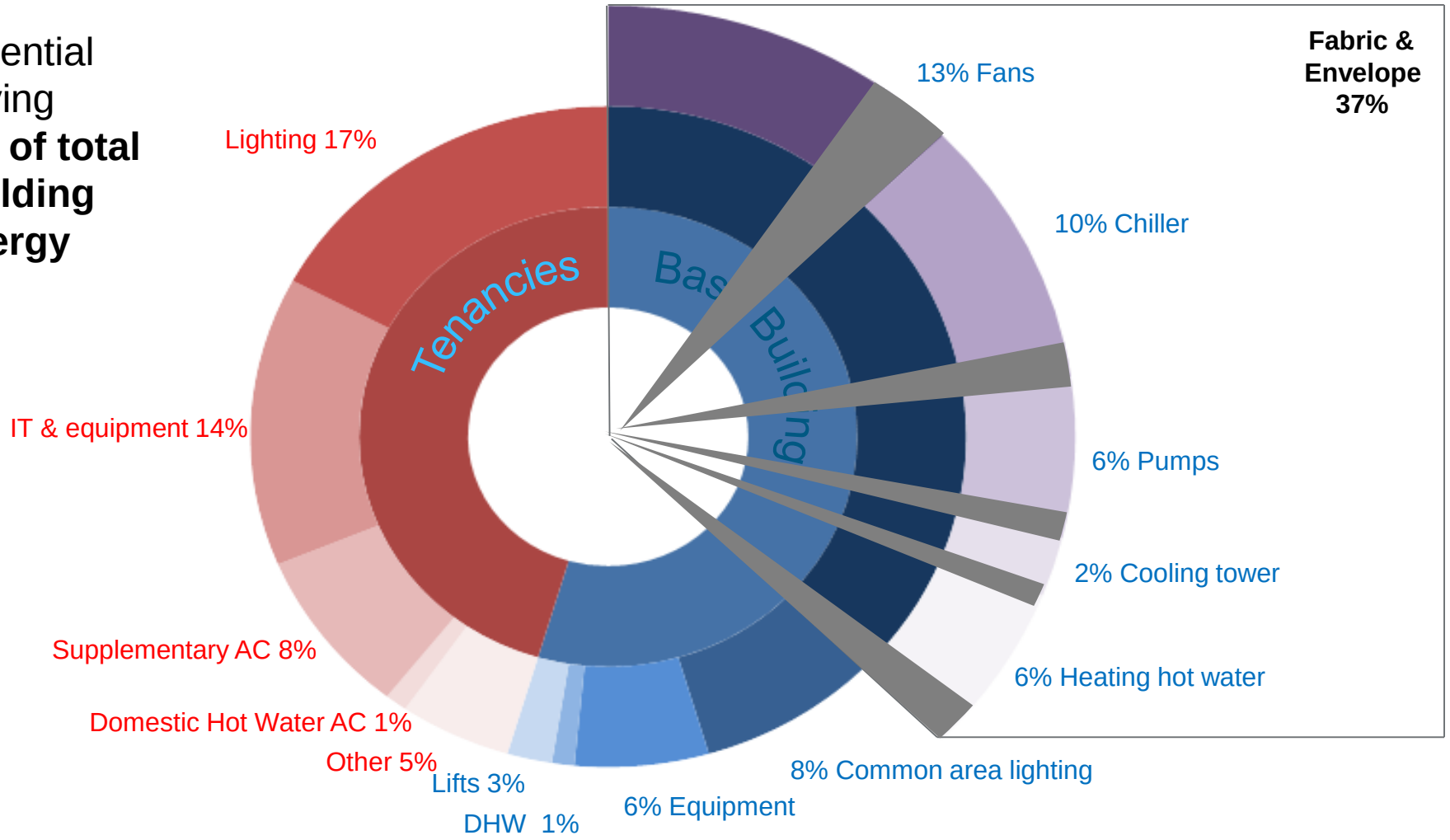
Potential saving **5% of total building energy**



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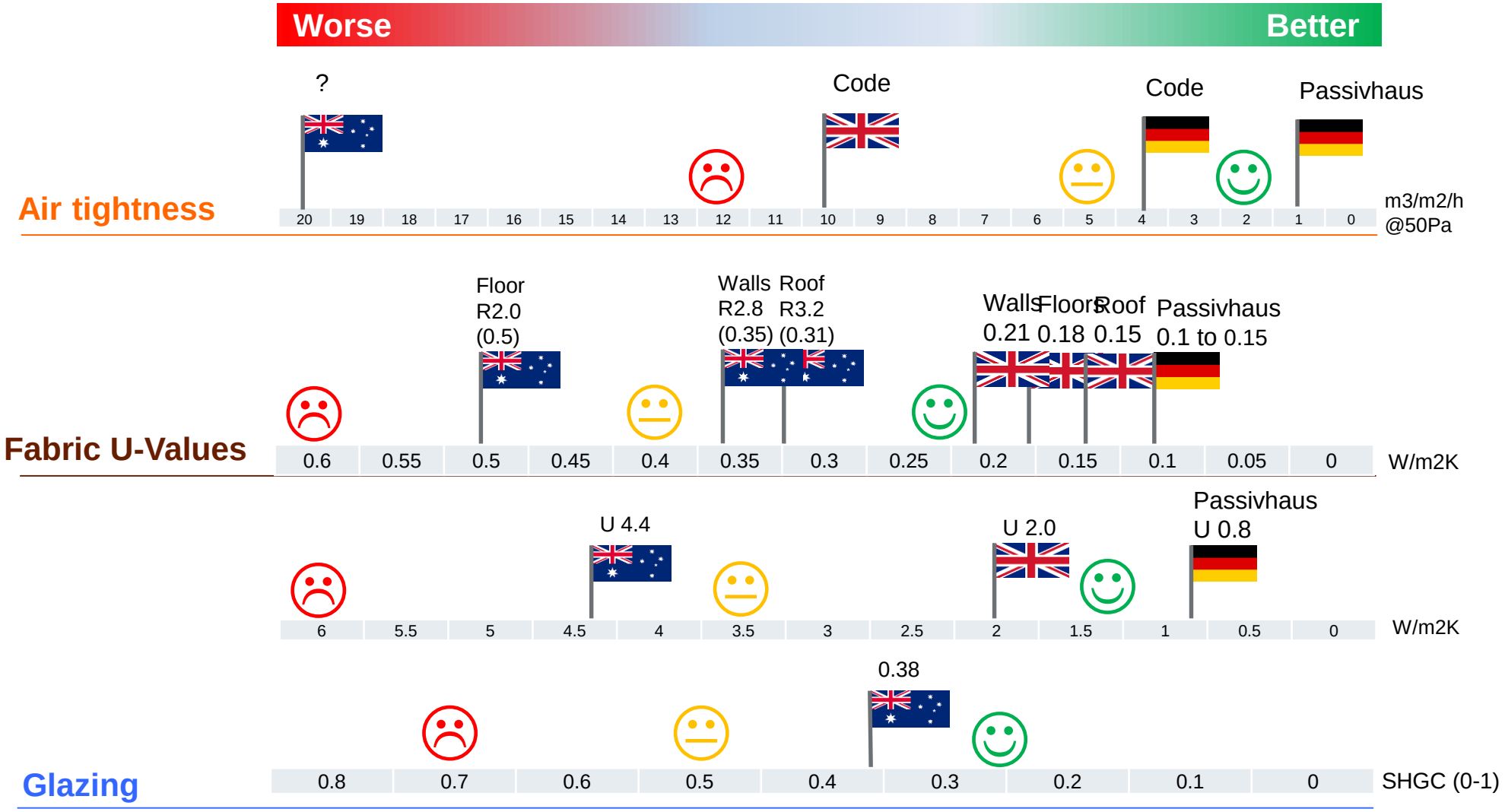

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SECTION J ENERGY EFFICIENCY (2015 EDITION)

PART J3 BUILDING SEALING

> *J3.4 Windows and doors*
  - *Seals to restrict air infiltration on*
    - *doors*
    - *openable windows*
    - *entrance must have an air curtain, self-closing door, or revolving door*

> *J3.5 Exhaust systems must have a self-closing damper*

> *J3.6 Construction of roofs, walls and floors*
  - *Roofs, ceilings, walls, floors and any opening must be constructed to minimise air leakage;*
  - *enclosed by internal lining systems that are close fitting at ceiling, wall and floor junctions; or*
  - *sealed by caulking, skirting, architraves, cornices or the like.*

#FAIL

- No requirement to verify a building's air tightness
- No numerical air tightness criteria
- This is like saying: must have insulation, but not specifying an R-value, and not checking if any insulation has been installed.

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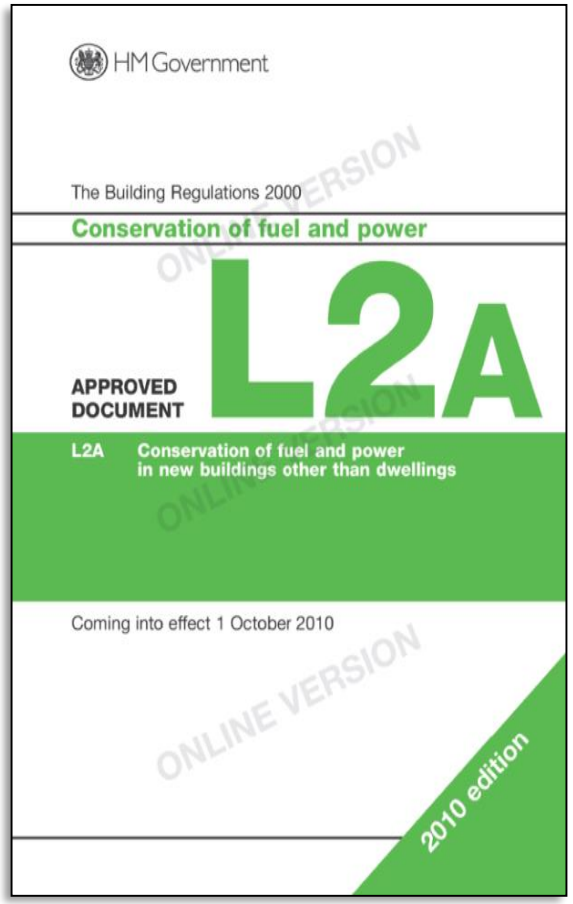
UK BUILDING CODE – PART L

> Pressure testing requirements introduced gradually

- 2002: pressure testing mandatory for >1,000 m^2
- 2006: pressure testing mandatory for >500 m^2
- Since 2010:
  - Pressure testing mandatory and
  - any building with a floor area over 1,000m^2 air permeability must be less than: **10 m3/hr.m2 @ 50 Pa.**



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EUROPE: MINIMUM STANDARDS

> Sweden	**2.2** $m^3/(h.m^2)$@50Pa	
> Denmark	**2.5** $m^3/(h.m^2)$@50Pa	
> Norway	**2.5** $m^3/(h.m^2)$@50Pa	
> Finland	**4** $m^3/(h.m^2)$@50Pa	
> Germany	**4** $m^3/(h.m^2)$@50Pa	
> Italy	**10** $m^3/(h.m^2)$@50Pa	
> UK	**10** $m^3/(h.m^2)$@50Pa	

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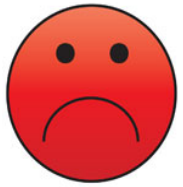
BEST PRACTISE: WHAT IS ‘GOOD’ V ‘BAD’ AIRTIGHTNESS

> **10** m3/(h.m2) @50Pa  Minimum standard

5 m3/(h.m2) @50Pa  Ok

< **2** m3/(h.m2) @50Pa  Good

Reference: ATTMA (UK) Technical Standard L2: Measuring Air Permeability of Building Envelopes (Non-Dwellings), Oct 2010

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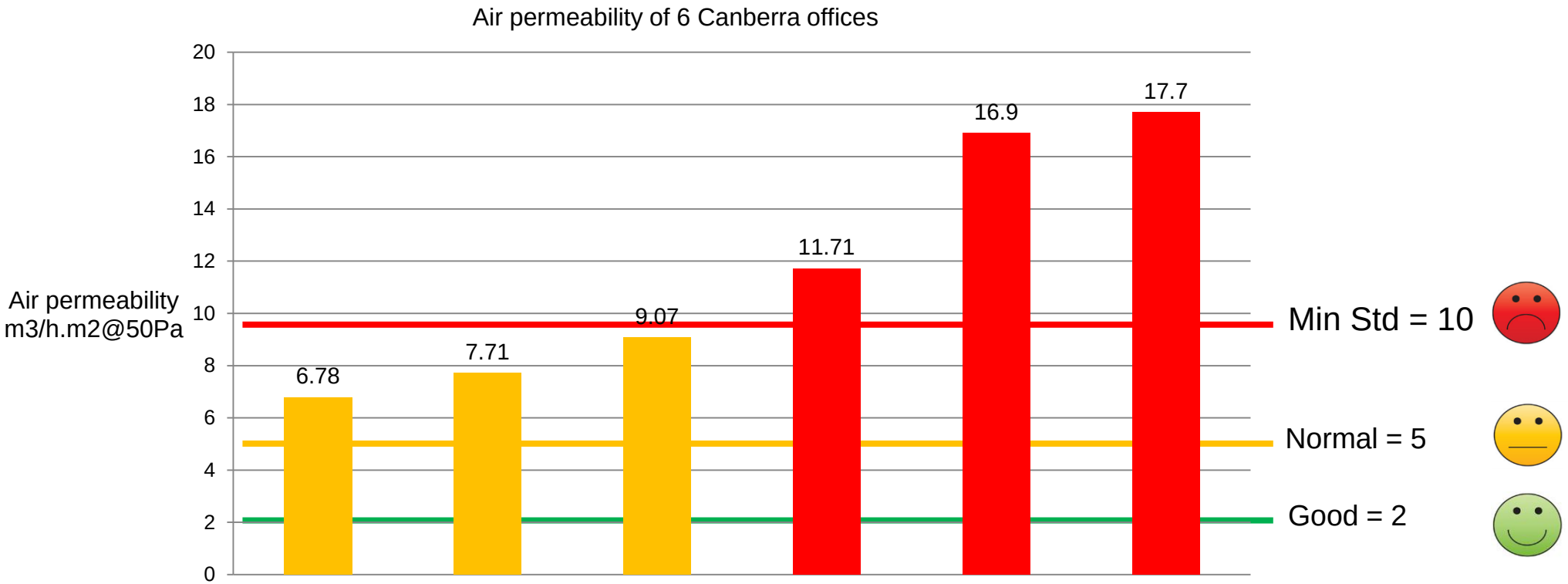
EGAN, 2012 (AU), AIRAH



Reference: Egan, A.M, 2012, "Air tightness of Australian Office Buildings: Reality versus typical assumptions used in energy performance simulation" AIRAH Ecolibrium March 2012, p28.

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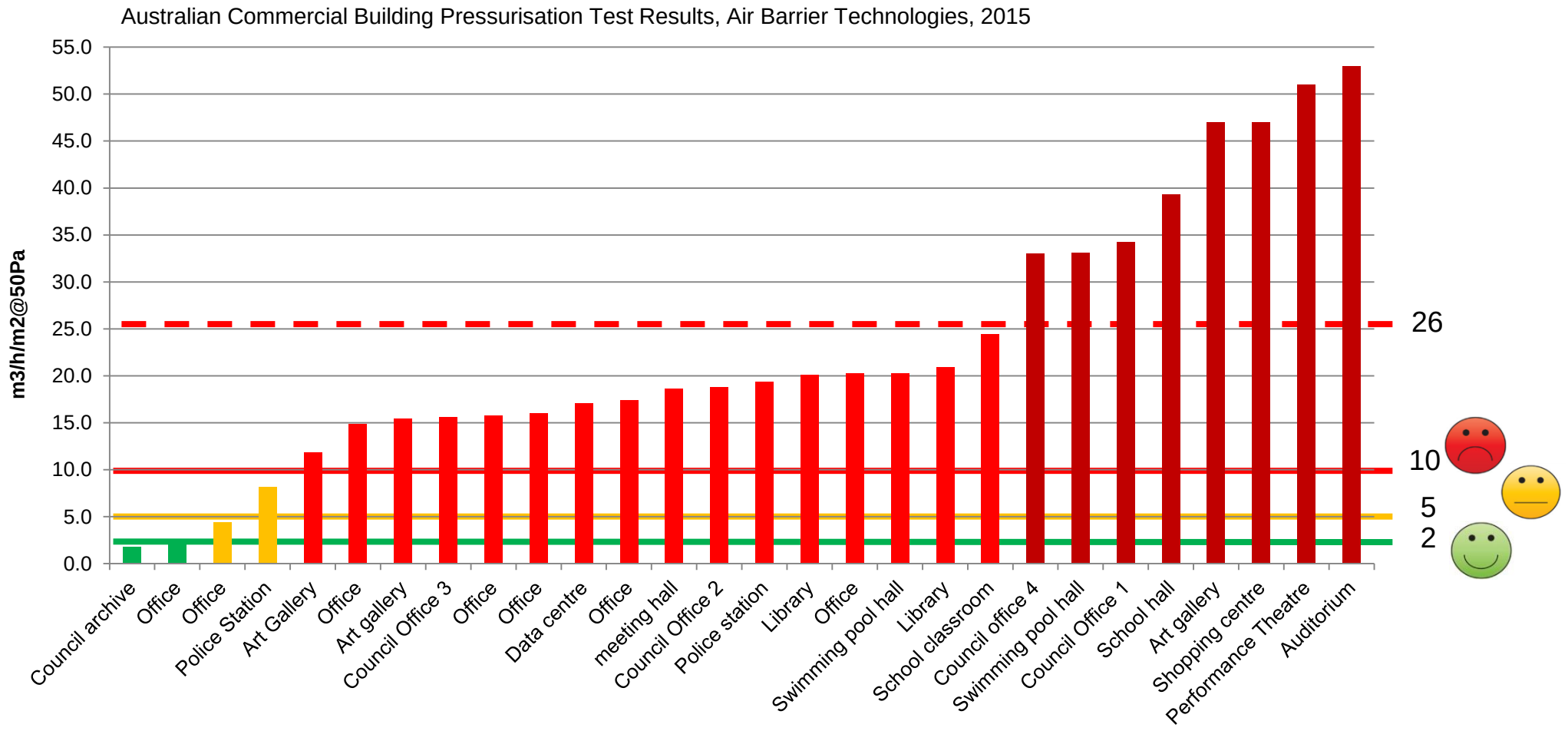
28 buildings: average was 26 m3/h.m2@50Pa
24 >10 = bad
4 <10 = UK Code
3 < 5 = 'Normal'
2 < 2 = 'Best practice'



Source: Mike Rogers, Air Barrier Technologies

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TESTING AIR TIGHTNESS

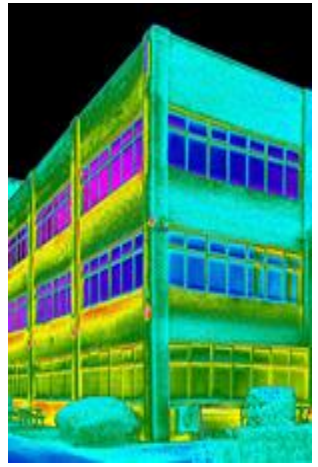
1. Determine leakage rate
   - Blower door test

2. Identify air leakage sites
   - Infrared scanner
   - Smoke tracer pen

3. Take remedial measures

4. Re-test leakage rate




Infrared images courtesy of http://ired.co.uk/

ACTUAL AUSTRALIAN COMMERCIAL BUILDING PERFORMANCE

> Average before **35** m3/h/m2@50Pa (range 16 to 53)

> Average after works **11** m3/h/m2@50Pa (range 5 to 19)

> Average improvement **~70%** tighter (range 38% to 82% tighter)

Source: Mike Rogers, Air Barrier Technologies

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ENERGY SAVING POTENTIAL

> Australian range **5%** to **15%**

> International range **2%** to **45%**

OTHER BENEFITS

Capital equipment savings

Improved control

Minimise condensation

Improve comfort

Air quality

Noise

Quality of construction

Egan, 2012; Emmerich, 2005; Shaw and Reardon, 1995; US Army Corps of Engineers, 2012

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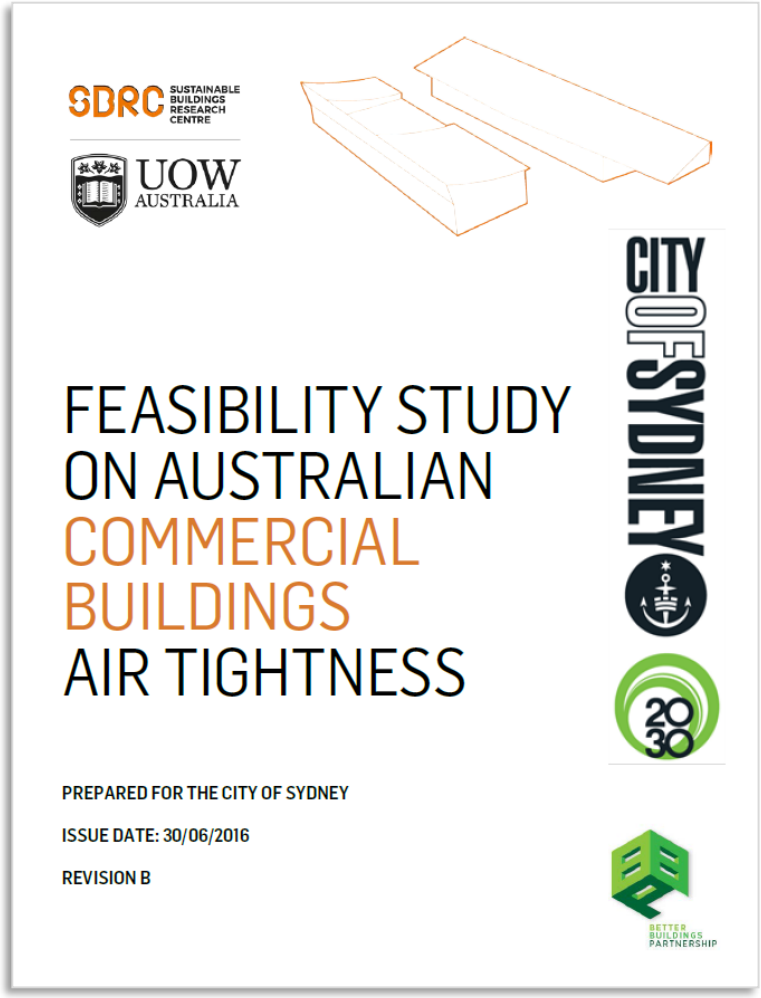
CITY OF SYDNEY & SBRC RESEARCH

Commercial building air tightness

> The limited data available shows that many Australian commercial buildings would not comply with international minimum standards, and are far from best practice levels

> No regulations or specific provisions for air tightness exist in the BCA



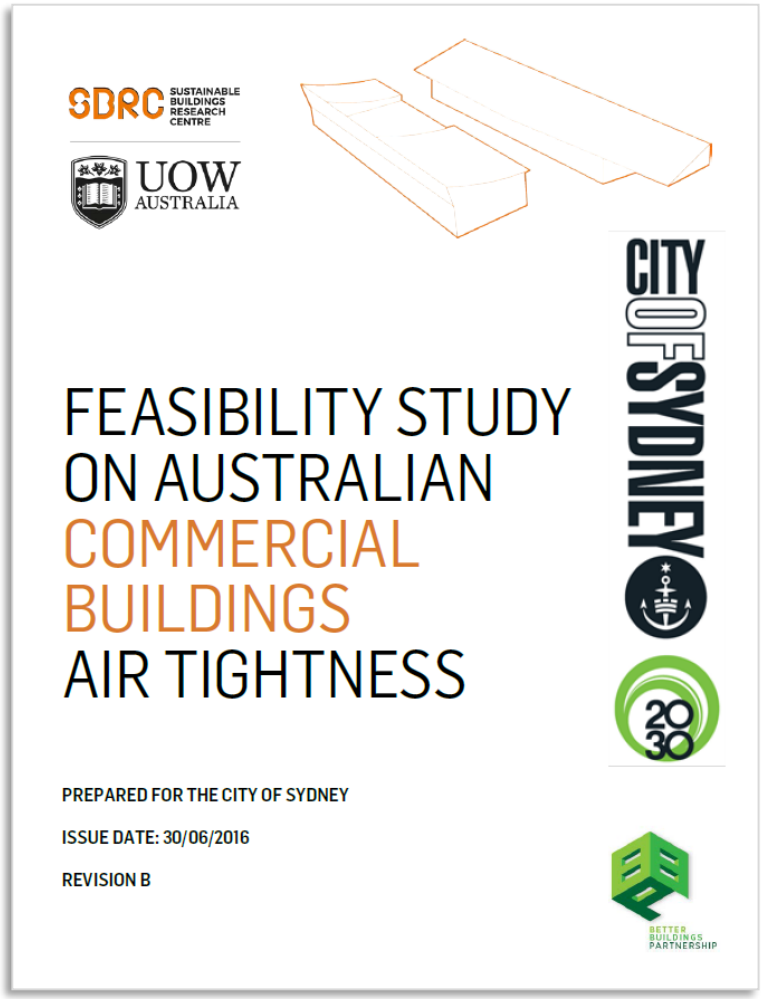
CITY OF SYDNEY & SBRC RESEARCH

Commercial building air tightness

> **5.5** m3/(h.m2)@50Pa recommended for most Australian climate zones

Table 3 Suggested air permeability requirements for the seven Australian climate zones from the BCA matched with equivalent overseas location (ASHRAE 90.1, 2007; Horne et al., 2005).

Australia climate zone (ABCB, 2015) (example city)	Overseas equivalent climate location	Air permeability requirements (Good Practice) $m^3/(h \cdot m^2)$ @ 50 Pa	Air permeability suggestions by sustainability ratings (Best Practice) $m^3/(h \cdot m^2)$ @ 50 Pa
Climate zone 1 (Darwin)	Orlando, Florida	5.5 – (Florida Building Code, 2014)	2.7 (mid-rise apartments) (LEED, 2016)
Climate zone 2 (Brisbane)	Austin, Texas	5.5 - Adapted from IECC (2012)	
Climate zone 3 (Longreach)	Charlotte, North Carolina	5.5 (North, Energy, Code, Ncecc, & Chapter, 2012)	
Climate zone 4 (Dubbo)	Phoenix, Arizona	5.5 Adapted from IECC (2012)	
Climate zone 5 (Sydney)	Bakersfield, California	5.5 - Adapted from IECC (2012)	
Climate zone 6 (Melbourne)	San Francisco Bay, California	5.5-(California Energy Commission, 2012)	
Climate zone 7 (Hobart)	Vancouver British Columbia	5.5 Adapted from IECC (2012)	Airtightness: 0.6 h^{-1} (Multi residential units with commercial units) (McLeod, Jaggs, Cheeseman, Tilford, & Mead, 2014)
Climate zone 8 (Thredbo)	Boston, Massachusetts and Berlin (ASHRAE 90.1, 2007)	3.9 (mechanical ventilation) 7.8 (natural ventilation) (Erhorn-Kluttig, Erhorn, & Lahmidi, 2009)	



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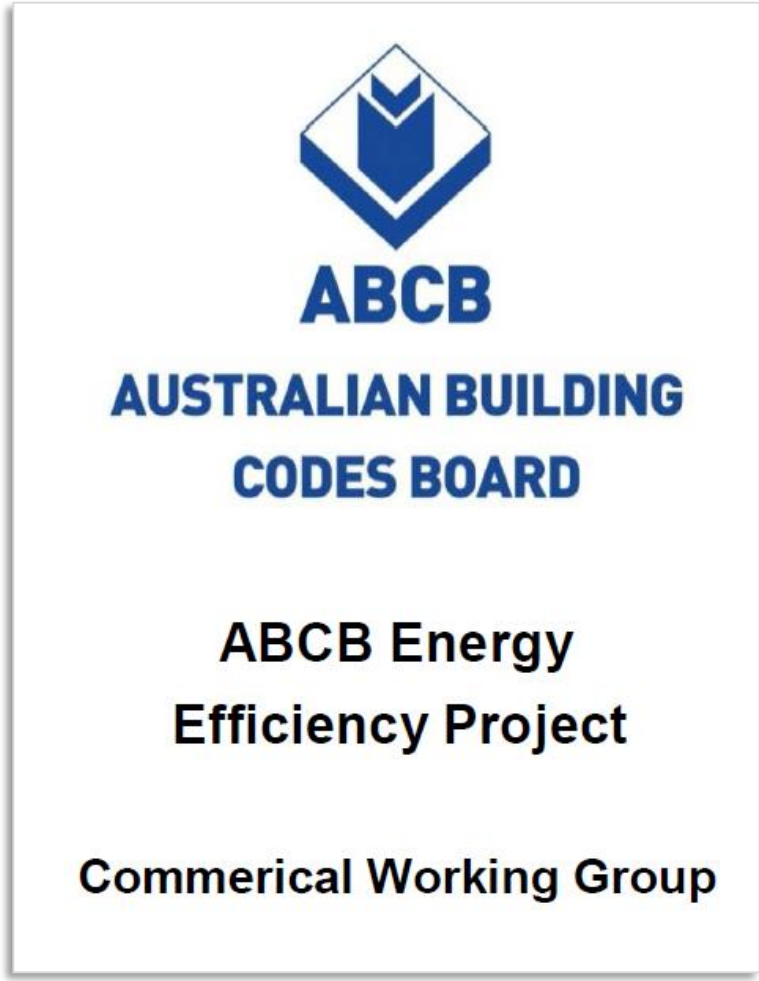
ASBEC NCC WORKING GROUP

Process

> Working group meetings to discuss potential changes to the NCC for 2019

Proposals for change to NCC 2019

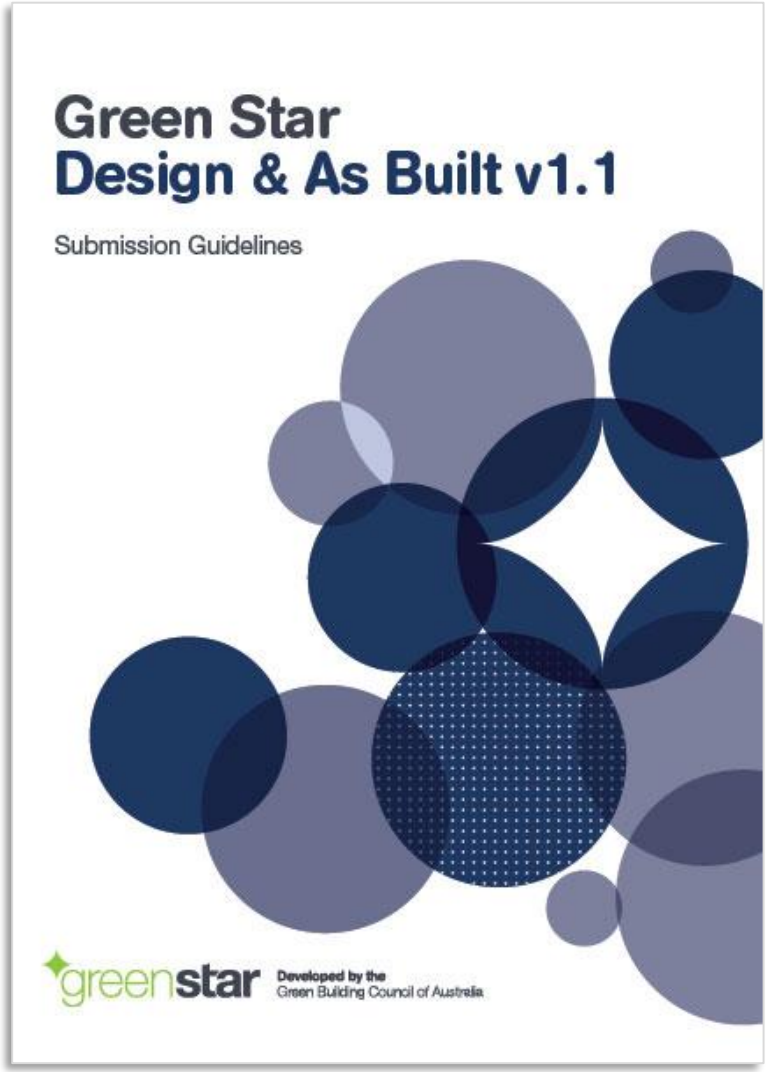
> Key activities relevant to commercial buildings
  - Sealing:
    - Blower door testing method: proposal for change being developed by AIRAH
    - Airtightness criteria: prescriptive sealing provisions being developed by AIRAH
  - Thermal breaks: investigating improvement options
  - NABERS: evaluating using NABERS commitment agreement process for NCC compliance
  - Green Star Energy modelling: evaluating use of energy model for NCC compliance
  - Software: revised protocol for software tools used for JV3 compliance
> Developing a forward trajectory toward low & zero carbon buildings



GBCA GREEN STAR AIR TIGHTNESS CREDITS

> GBCA Air Tightness **Innovation credit** references international standards (ATTMA & CIBSE TM23)
  - Good **5** m3/(h.m2)@50Pa
  - Best **2** m3/(h.m2)@50Pa

> GBCA proposed Air Tightness **Commissioning credit**
- Blower door testing as part of envelope commissioning
- Performance:
  - Minimum **20** m3/(h.m2)@50Pa
  - Good **5** m3/(h.m2)@50Pa
  - Best **2** m3/(h.m2)@50Pa



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AUSTRALIAN PASSIVE HOUSE ASSOCIATION

PASSIVHAUS

International standard

> Focused on balancing energy efficiency and indoor air quality: “Build tight, ventilate right”
> Delivers energy savings of up to 90% compared with typical existing buildings and over 75% compared with average new best-practice constructions.
> Passive buildings are also praised for their high level of comfort.
> What’s involved:
  - Air tight construction combined with
  - A mechanical ventilation system consistently supplying fresh air via a heat recovery unit
  - High quality (double) glazing
  - Well insulated exterior walls, roof and floor slab
> Increasingly being applied to commercial buildings

Monash University, Clayton Campus

Monash’s Building and Property Division, Clayton campus - Passive House Pioneers program http://passivehouseaustralia.org/monash-university-finalist-in-the-premiers-sustainability-awards/

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INSTITUTIONAL BUILDING OWNERS

Key issues

> Strong drivers for continual improvement: NABERS portfolio ratings & GRESB scores have pushed ongoing investment in energy efficiency
> Many owners are approaching limits of energy efficiency improvements in existing commercial office buildings (e.g. 5.5 Star NABERS), after which additional investment in mechanical services and controls upgrades may have diminishing returns
> Façade performance & air tightness may be a cost effective next step

Barriers

> ESD advice is focused on mechanical & electrical engineers & contractors (not architecture & builders)
> Lack of local data & case studies to make the business case for pressure testing & rectification works
> Limited number of blower door technicians & test units
> Lack of awareness of ‘tight building’ techniques among architects & building contractors

CONCLUSIONS

> **Room to improve**
- Most commercial buildings would probably not meet international best practice standards
- 70% improvements in air tightness are achievable through remediation work
- 5% to 15% energy savings are possible in Australia through tighter envelopes

> **Fabric first approach**
- Reduce reliance on services solutions to achieve energy efficiency goals
- Increase focus on fabric performance
- Set as-built air tightness performance criteria

> **Pressure test more buildings**
- Contacts:
  - Craig McLauchlan of UoW SBRC, City of Sydney Research Grant leader
  - Sean Maxwell, President, Air Infiltration and Ventilation Association of Australia
  - Mike Rodgers, Air Barrier Technologies