A Sustainable Career for Architects, Engineers and Designers

The State of Compliance for housing design in Australia. A summary of the issues confronting the BCA and 2nd Generation NatHERS and how professionals can make a difference in the innovation process.

Trevor Lee
Energy Partners
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www.**exemplary**.com.au

Seminar Format

Questions after each Section

- **Introduction to the Regulations**
- **Envelope Requirements**
- **Fenestration** (including roof glazing)
- **From 5 Stars to 6 Stars**
- **Services: lighting, hot water, HVAC**
- **Mandatory Disclosure**

Assistance with Creating this Presentation

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Peter Lyons, PhD (Peter Lyons & Associates, Canberra, ACT, +61 408 808 556)

Seminar Format

Questions after each Section

- Introduction to the Regulations
- Envelope Requirements
- Fenestration (including roof glazing)
- From 5 Stars to 6 Stars
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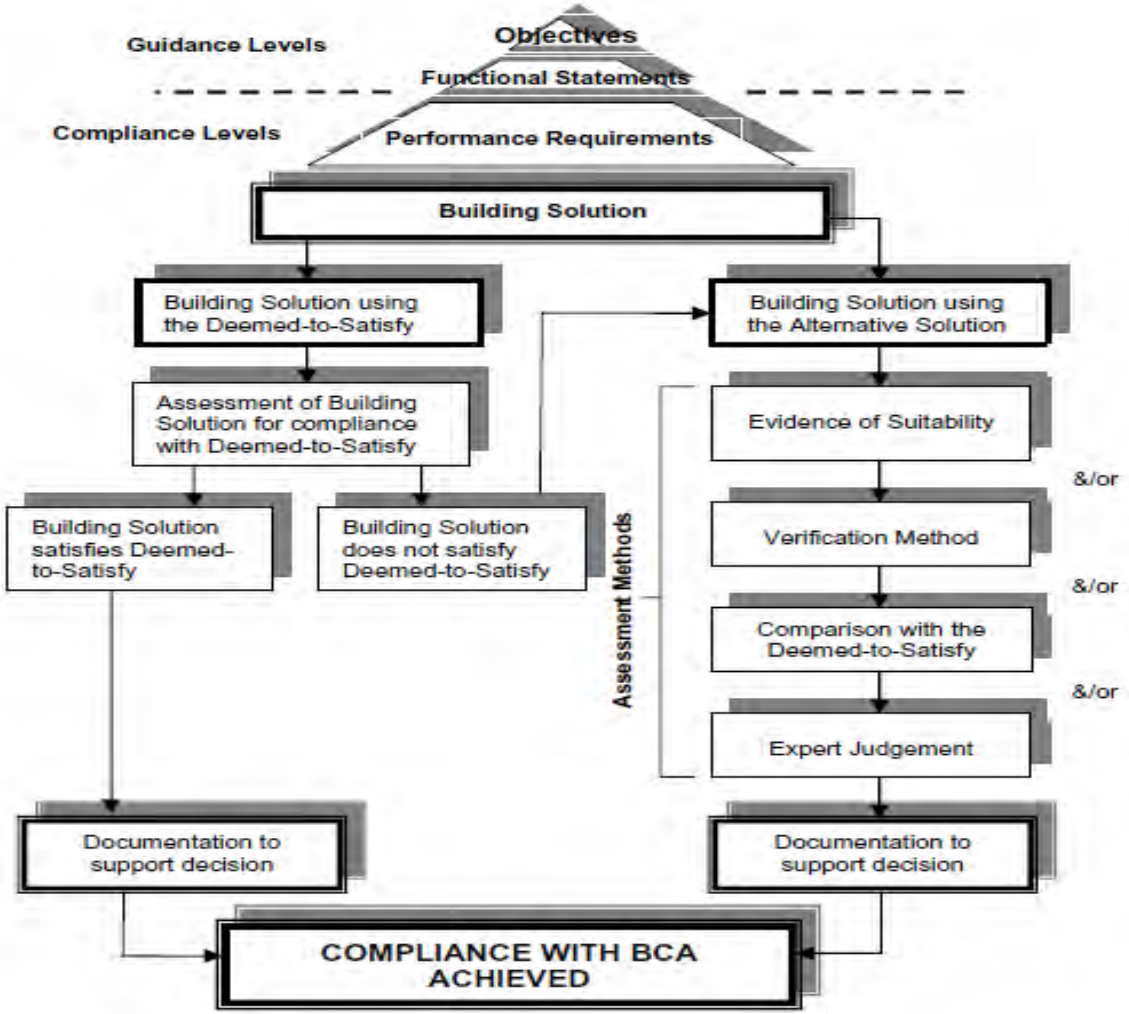
Figure 3.3 – Performance based compliance framework



2010 Energy Efficiency - General Information Update

On 30 April 2009, the Council of Australian Governments (COAG) announced that it would request the Australian Building Codes Board (ABCB) to increase the energy efficiency provisions in the 2010 edition of the Building Code of Australia (BCA).

In brief, COAG requested the ABCB to increase the energy efficiency provisions so that the 2010 BCA requires:

(i) a 6-star energy rating, or equivalent, for new residential buildings; ***and***

(ii) a significant increase in the energy efficiency requirements for all new commercial buildings.

Volume One, Section J
Volume Two, Section 3.12

Q: When does it apply?

A: All the time!

- **All projects must have a report done at the equivalent of BA or Building Certificate stage**
- **Some classes have an exemption for certain parts of Section J / 3.12**
- **Definition of envelope plays an important role**

ENVELOPE

- for purposes of Section J, means the parts of a building's *fabric* that separate a *conditioned space* or *habitable room* from –

the exterior of the building; or

a non-conditioned space including -

(i) the floor of a rooftop plant room, lift-machine room or the like; and.....

CONDITIONED SPACE

- means a space within a building where the environment is likely, by the intended use of the space, to be controlled by *air-conditioning*, but does not include -

a non-habitable room of Class 2 building or Class 4 part of a building in which a heater with a capacity of not more than 1.2 kW or 4.3 MJ/hour provides the air-conditioning

- Regulations will require more **efficient** building envelopes

- Deemed-to-Satisfy (DTS) will generally create more **costly** buildings than SIMULATION solutions (using 2nd Generation NatHERS tools)

- Glazing and window frames are only one component of a building – but increasingly important

Thermal Calculation Method (Software)

Class 1, 2 and 10a buildings

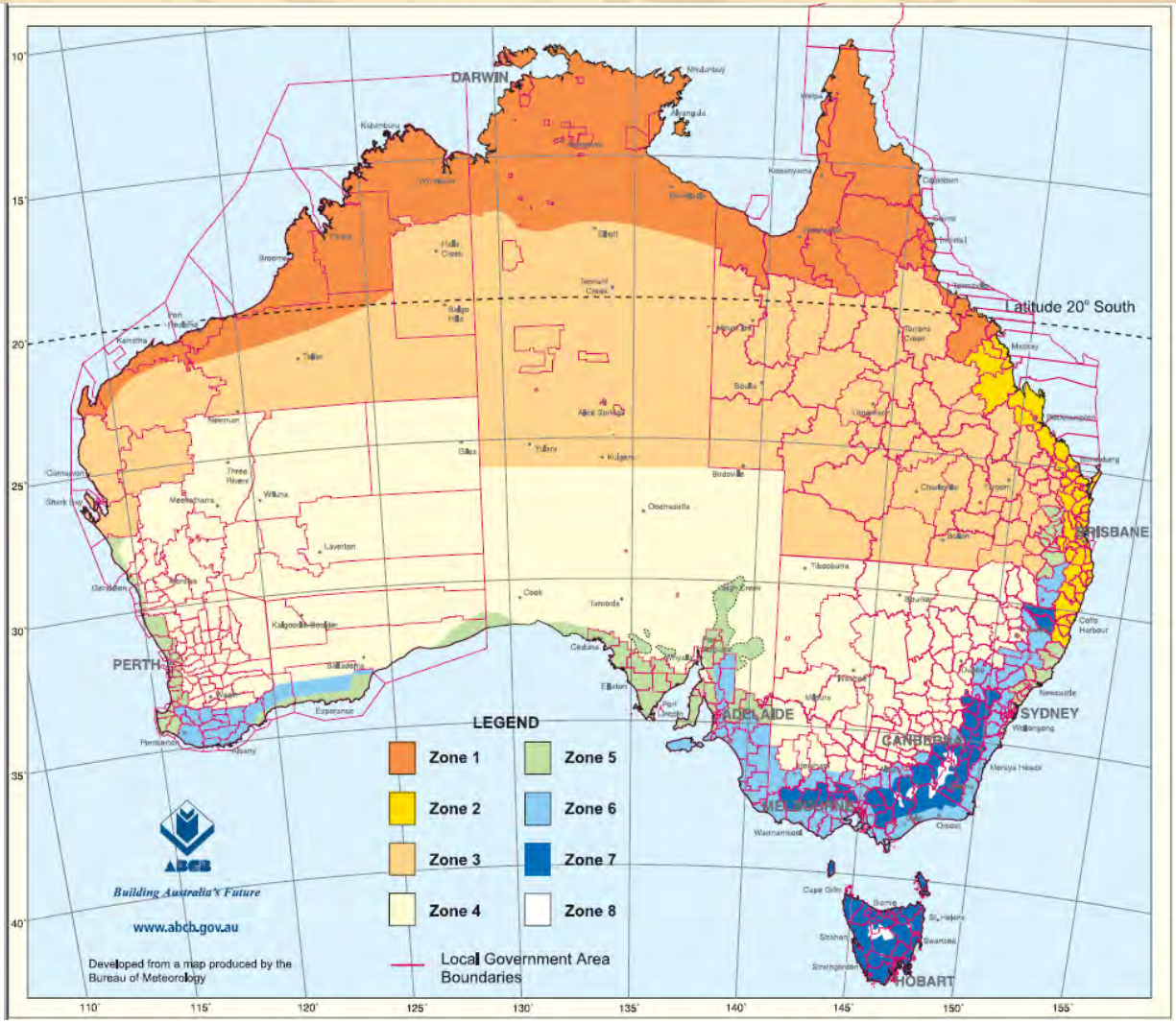
- BERS Pro
- FirstRate5

which both depend on the engine in -

- AccuRate

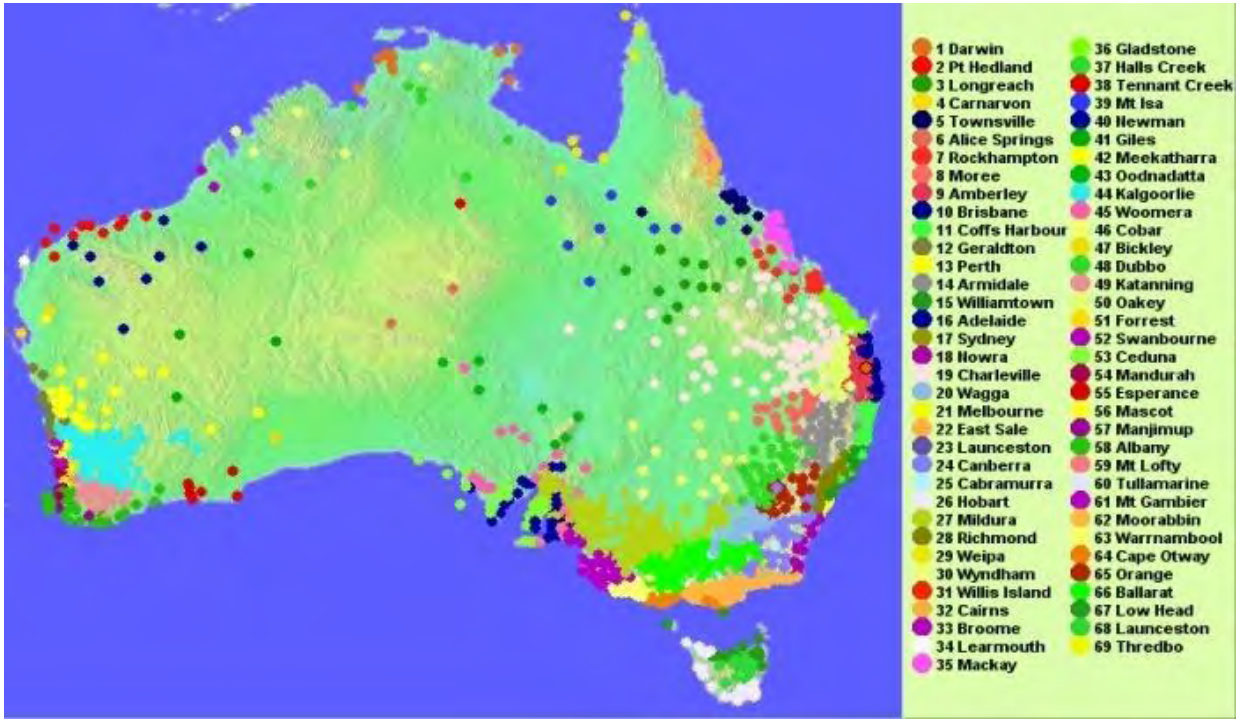
Canberra, Australia www.fenestralia.com
David Howard Partners Energy Alstonville, Australia www.partnersenergy.com.au

BCA Climate Zones: 8 of them, tropical to alpine



Climate data

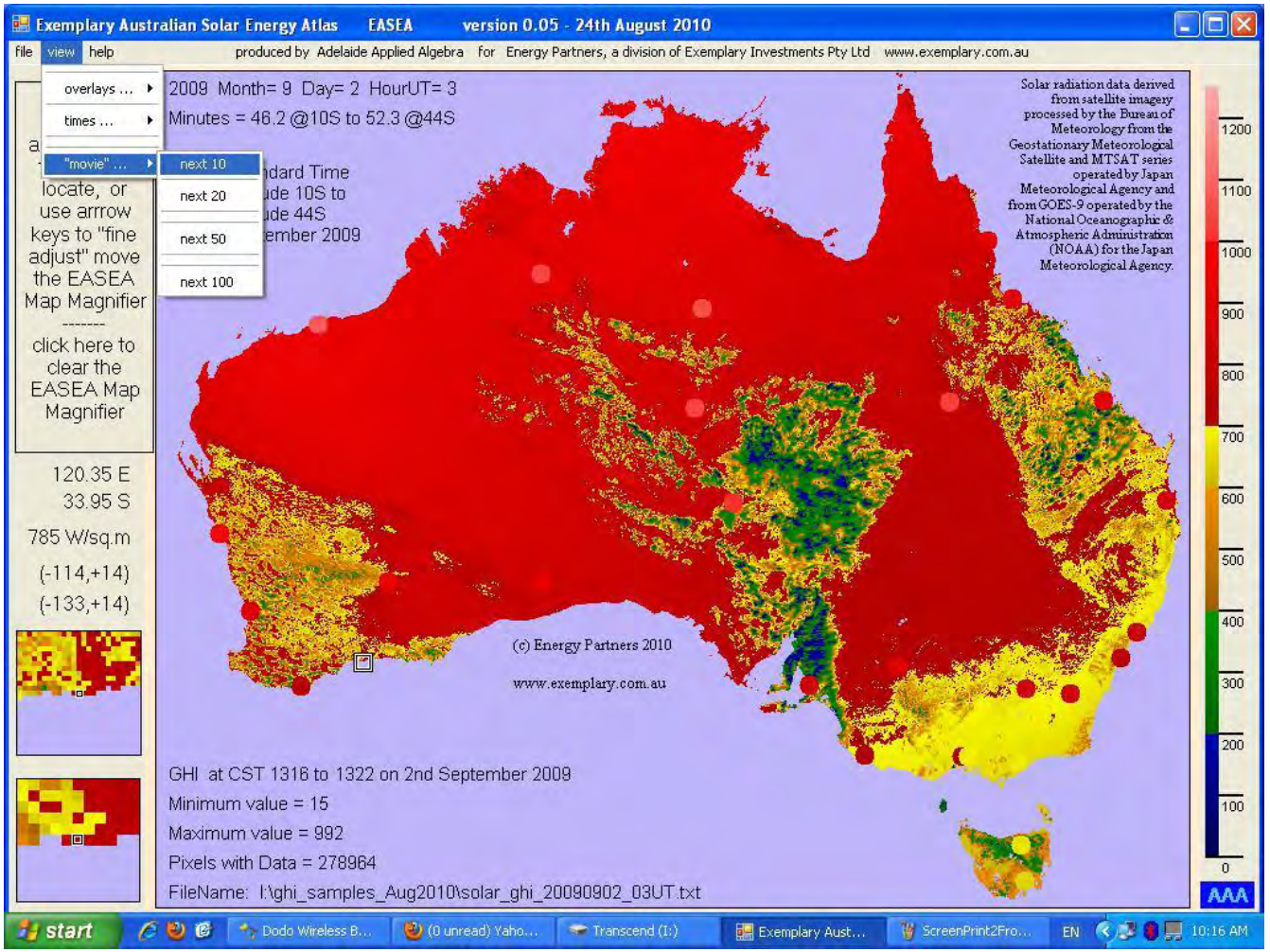
- DB Temperature
- Absolute Humidity
- Beam Radiation
- Diffuse Radiation
- Wind Speed
- Wind Direction
- Cloud Cover



Data at hourly intervals for one year;
Each postcode assigned 1 (2 or 3) of 69 (soon 80) climate files

Climate data – now almost anywhere

- DB Temperature
- Absolute Humidity
- **Beam Radiation**
- **Diffuse Radiation**
- Wind Speed
- Wind Direction
- Cloud Cover



Seminar Format

Questions after each Section

- Introduction to the Regulations
- **Envelope Requirements**
- Fenestration (including roof glazing)
- From 5 Stars to 6 Stars
- Services: lighting, hot water, HVAC
- Mandatory Disclosure

A high-performance building envelope cuts operational energy use

- The best high-performance buildings are a new generation of ***Zero-Energy Buildings*** which produce no greenhouse gas (GHG) emissions in their operation

- **ClimateWorks** (**www.climateworksaustralia.com**, 2010) estimates that Australia's commercial buildings can contribute three-quarters of the total, potential building-related GHG reductions between now and 2020. This translates into 16 million tonnes (Mt) of emissions saved – and at a nett savings to society – not a cost.

- **Beyond Zero Emissions (www.beyondzeroemissions.org**, 2010**)**
  "A concentrated effort to flatten the Victorian winter gas usage peak would yield major gains in flattening the Australian energy demand profile over the year. The flattening would be achieved primarily by thermal insulation of Victorian commercial buildings and households. This can reduce heating loads by a factor of 2-4."

Building Fabric 09/10 Comparison

Climate Zone 7		BCA 2009	BCA 2010
Structure		**Total R value**	**Total R value**
	Solar Absorptance		
Ceiling/Roof	Light (< 0.4)	4.3	4.1
	Mid (0.4 - 0.6)	4.3	4.6
	Dark (> 0.6)	4.3	5.1
	Wall Density		
	< 220 kg/m^2	2.4	2.8
External Walls	> 220 kg/m^2	incorporates insulation >R1.0	External glazing C_u reduces by 15% and wall incorporates insulation >R1.0 **OR** External glazing C_u reduces by 20% and wall incorporates insulation >R0.5 **OR** incorporates insulation >R1.5
Suspended Floor			
	Enclosed	1.5	2.75
	Unenclosed	2.5	
	Slab with inslab heating or cooling	Edge Insulation R1.0	Edge Insulation R1.0
Concrete Slab on Ground		No underslab insulation required	No underslab insulation required
	Slab with inslab heating or cooling	Edge Insulation R1.0	Edge Insulation R1.0

Building Fabric – Roofs

Table 3.12.1.1a ROOF AND CEILING—MINIMUM TOTAL R-VALUE

Climate zone	1	2		3	4 and 5	6 and 7	8
		Altitude less than 300 m	Altitude 300 m or more				
Direction of heat flow	Downwards		Downwards and upwards		Upwards		
Minimum Total R-Value for a roof with an upper surface solar absorptance value of not more than 0.4	4.1		4.1		**4.1**		6.3
... of more than 0.4 but not more than 0.6	4.6		4.6		**4.6**		6.3
... of more than 0.6	5.1		5.1		**5.1**		6.3
Note: Altitude means the height above the Australian Height Datum at the location where the building is to be constructed.							

Typical Absorptance Values

Colour	Value
Slate (dark grey)	0.9
Red, green	0.75
Yellow, buff	0.6
Zinc aluminium — dull	0.55
Galvanised steel — dull	0.55
Light grey	0.45
Off white	0.35
Light cream	0.3

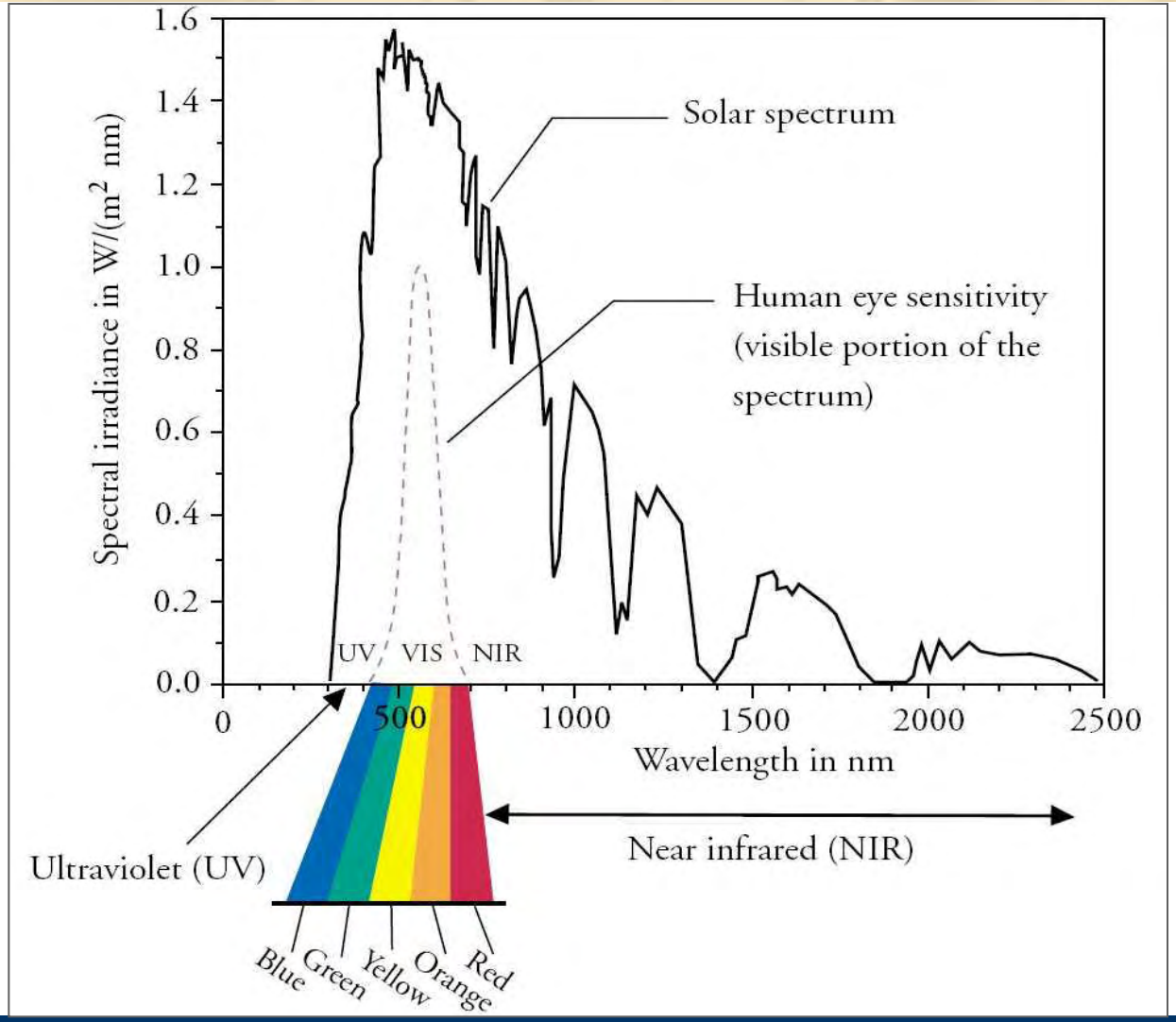
For Residential ADJUSTMENT OF MINIMUM R-VALUE FOR LOSS OF CEILING INSULATION, Refer to Commercial Building Fabric Table J1.3 (a) .

Seminar Format

Questions after each Section

- Introduction to the Regulations
- Envelope Requirements
- **Fenestration** (including roof glazing)
- (and just a little on simulation as a compliance tool)
- From 5 Stars to 6 Stars
- Services: lighting, hot water, HVAC
- Mandatory Disclosure

The solar spectrum *(McCluney & Jindra, 2001)*



1 nanometre (1nm)

= 10^{-9}m

= 1 billionth of a metre

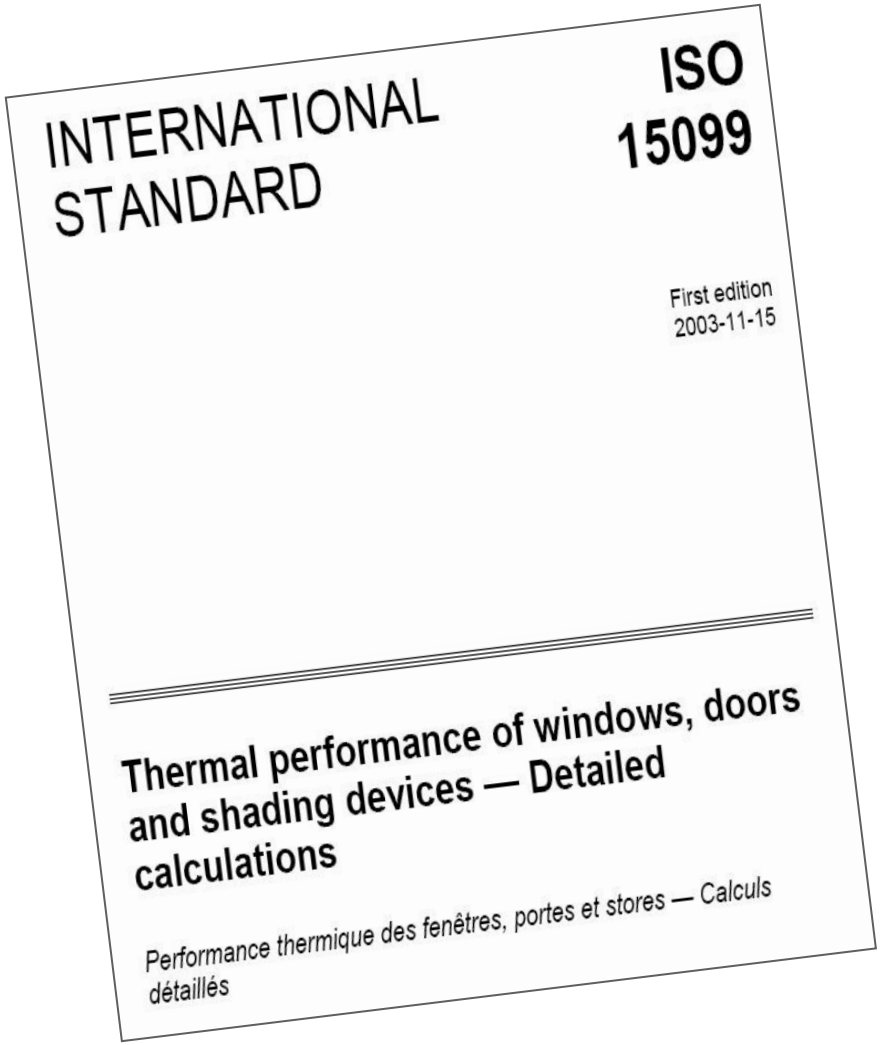
1 micron (1µm)

= 10^{-6}m

= 1 millionth of a metre

= 1000 nm

Worldwide international standard for fenestration energy and visible transmittance calculations


INTERNATIONAL STANDARD

ISO 15099

First edition
2003-11-15

Thermal performance of windows, doors and shading devices — Detailed calculations

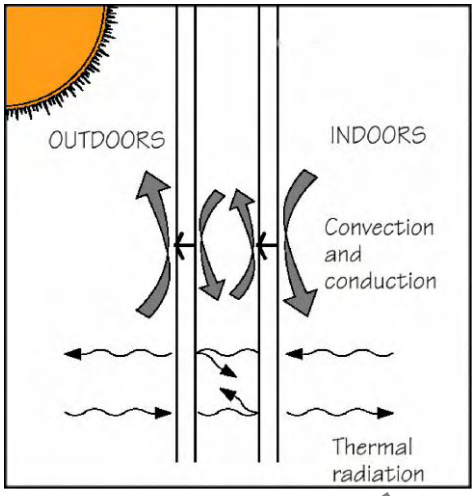
Performance thermique des fenêtres, portes et stores — Calculs détaillés

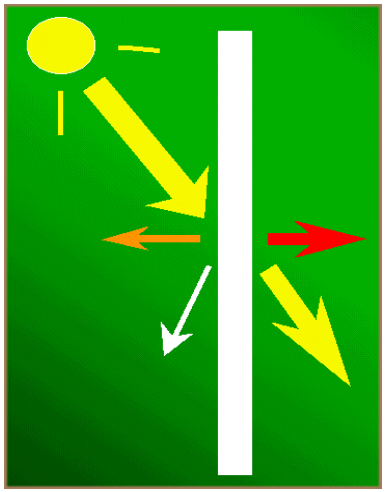
Complete procedure with algorithms

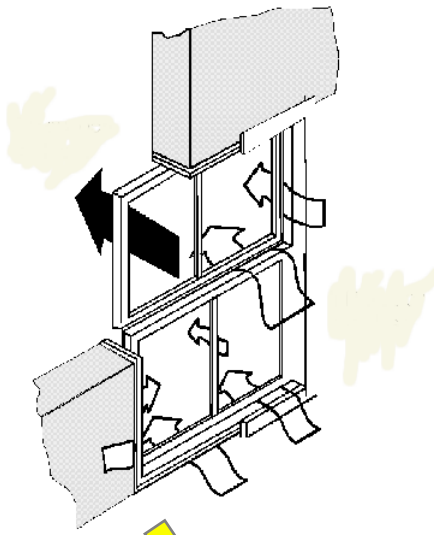
enables

simulation-based energy rating of windows, glazed doors and skylights

Complete window heat-balance equation



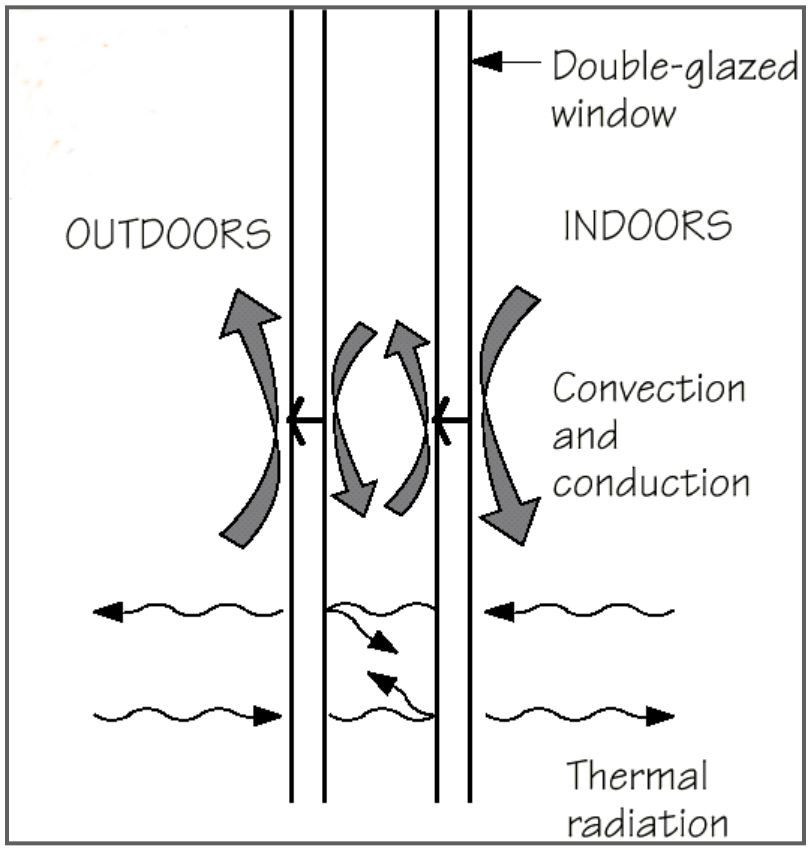




Net heat flow = temperature term + solar term + air-leakage term

Q *[watts]* = $UA.\Delta T$ + $I_s.A.g$ + AL

U-value (thermal transmittance, U-factor)



Lawrence Berkeley National Laboratory, 2000

U-value

= measure of heat flow from warm side to cold side / (area x temp difference)

= watts / (square metres x Kelvin)

= $W/m^2.K$

where

1 Kelvin (1K) = temp diff of 1°C

and

0 Kelvin = - 273.15°C

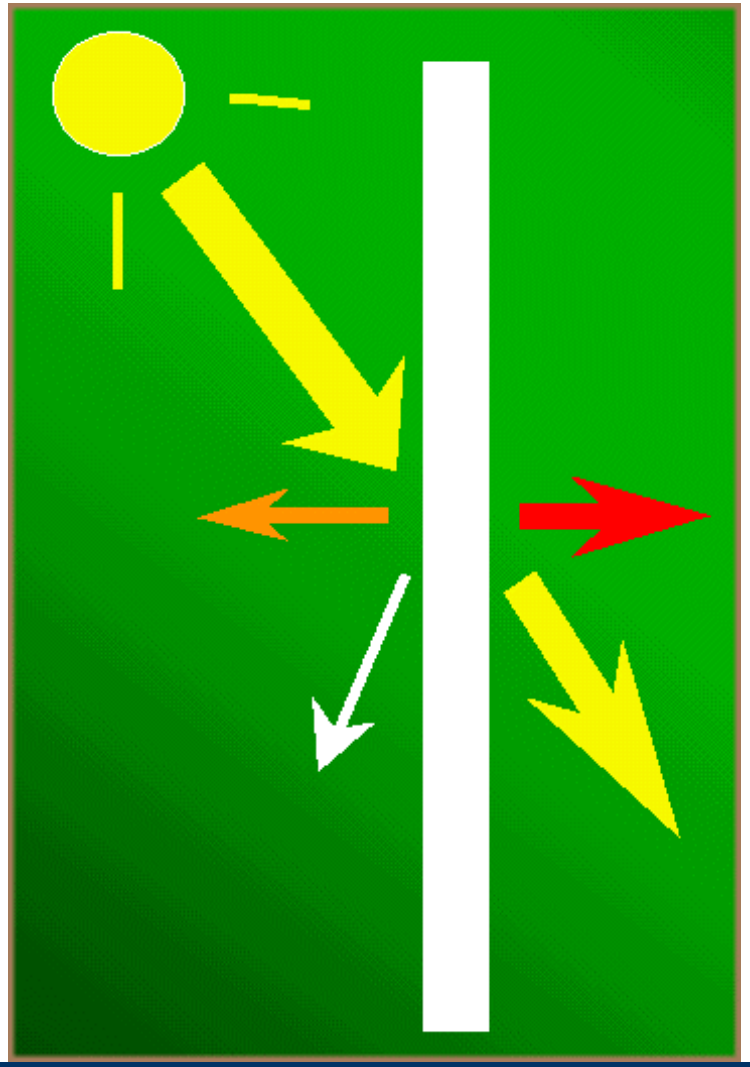
= absolute zero

E.g:

Single-glazed aluminium window: U = 7.5

Double-glazed low-e argon, timber frame: U = 1.8

SHGC (solar heat gain coefficient)



SHGC

$= T_s + n*A_s$

a.k.a. total solar transmittance

a.k.a. solar factor

a.k.a. g-value

Fraction absorbed then re-radiated and convected = $n*A_s$

+

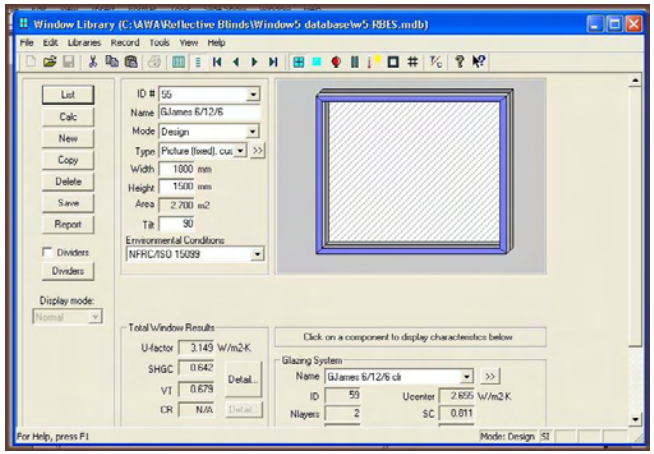
Fraction transmitted directly = T_s

Single-glazed aluminium window:	0.7
Double-glazed spectrally selective low-e argon, timber frame:	0.2

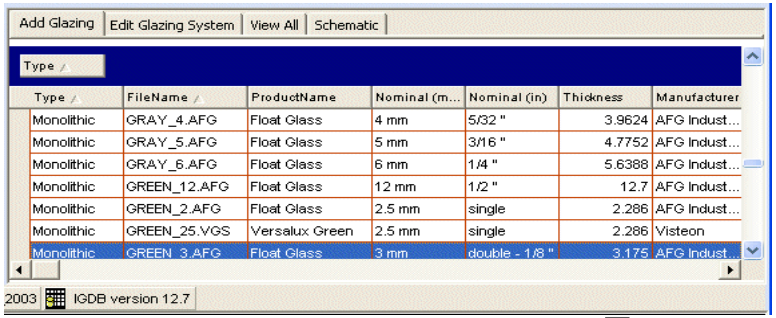
WINDOW – THERM – OPTICS suite of software from Lawrence Berkeley National Laboratory

windows.lbl.gov/software

WINDOW 5 now….WINDOW 6 from 2010



W5 & W6: International Glazing Database (IGDB)

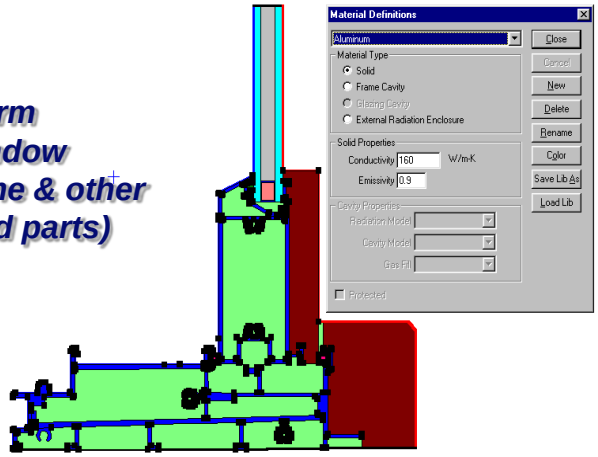


Type	FileName	ProductName	Nominal (m...	Nominal (in)	Thickness	Manufacturer
Monolithic	GRAY_4.AFG	Float Glass	4 mm	5/32 "	3.9624	AFG Indust...
Monolithic	GRAY_5.AFG	Float Glass	5 mm	3/16 "	4.7752	AFG Indust...
Monolithic	GRAY_6.AFG	Float Glass	6 mm	1/4 "	5.6388	AFG Indust...
Monolithic	GREEN_12.AFG	Float Glass	12 mm	1/2 "	12.7	AFG Indust...
Monolithic	GREEN_2.AFG	Float Glass	2.5 mm	single	2.286	AFG Indust...
Monolithic	GREEN_25.VGS	Versalux Green	2.5 mm	single	2.286	Visteon
Monolithic	GREEN_3.AFG	Float Glass	3 mm	double - 1/8 "	3.175	AFG Indust...

W6: Complex Glazings Database (CGDB)

Diffuse glazings, fritted glass, diffusing interlayers, shading layers, etc…

Therm (window frame & other solid parts)



Optics 5

European EN vs. NFRC / AFRC ratings

Why are there different numbers for same product?

- U-value and g-value (SHGC) depend partly on indoor and outdoor air movement
- When it is windy, more heat flows through the glass and is carried away by the wind. (U-value is based on assumpton that outdoors colder than indoors)
- More wind → higher U-value
- BUT more wind → lower SHGC. Why? Because the heated glass is cooled more effectively
- Main difference between EN and NFRC/AFRC reference conditions is that NFRC is windier. ***But it is still the same window!***
- Clearly, performance comparisons must be based on same set of conditions
- No selective quoting! [E.g. EN for U-value (looks lower; NFRC for SHGC (sometimes looks lower)]
- **Building Code of Australia requires NFRC/AFRC-based numbers**

WINDOW 6 & THERM 6

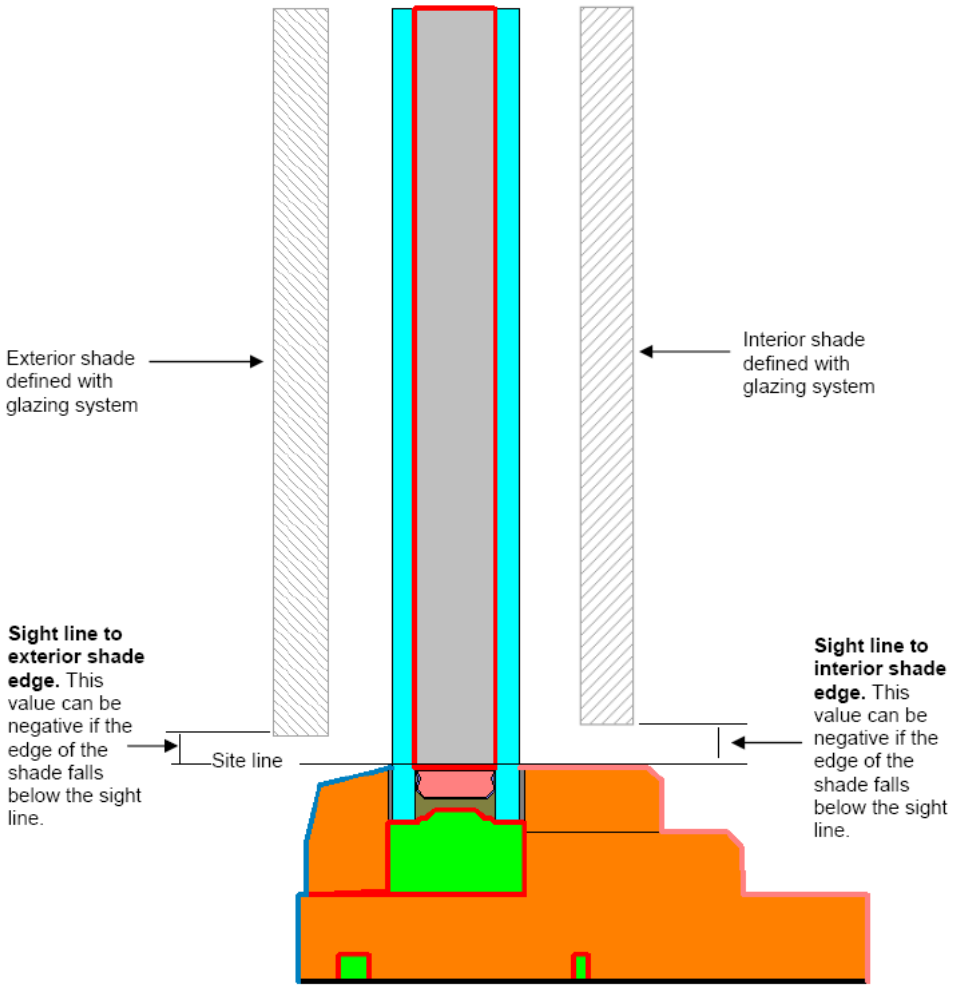
Bringing it all together : glazing, blind, frame

- → Whole-system performance data
- → US Department of Energy has invested over US$10 million in WINDOW 4, 5, 6 since 1990
- → Includes $2M to add shading layers and diffuse glazings to new WINDOW 6
- → All window technologies are important (no playing favourites)

Robin Mitchell,

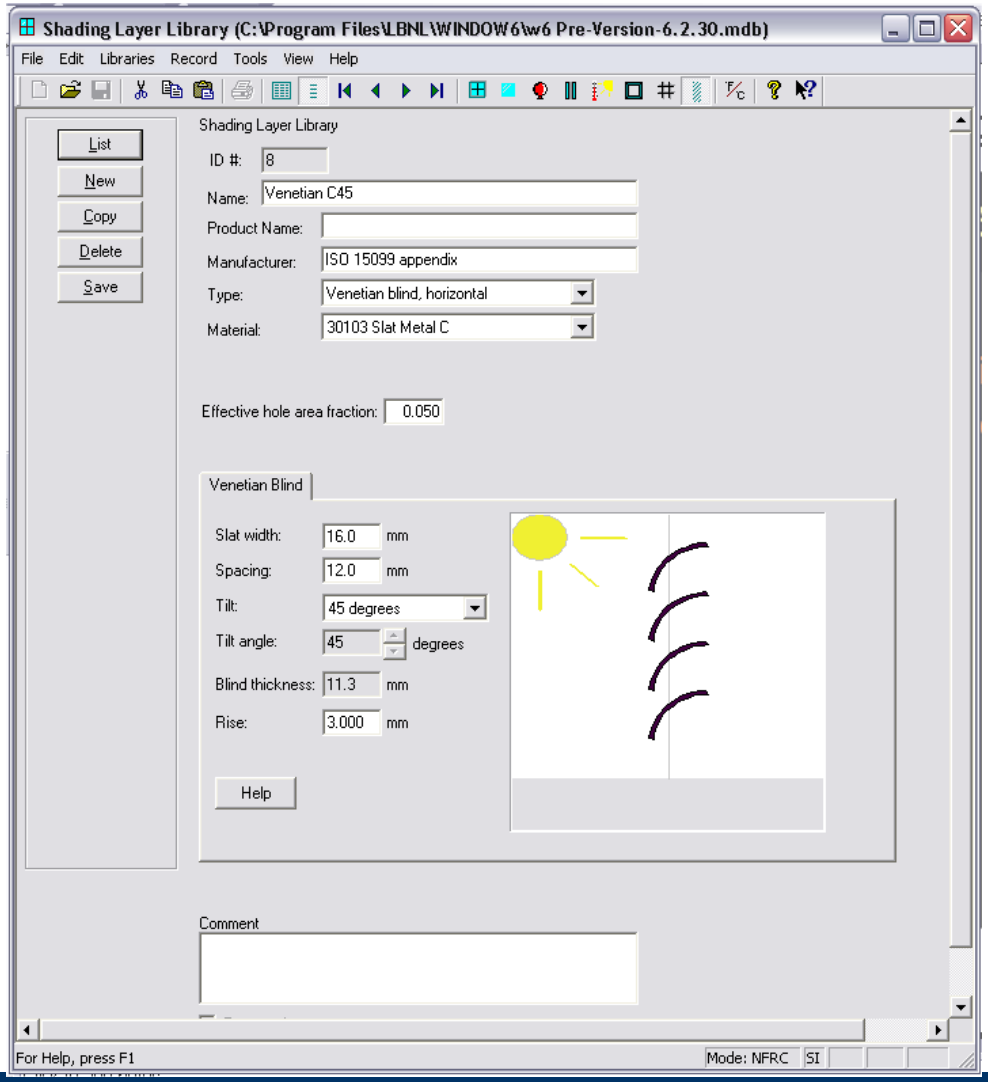
Lawrence Berkeley National Laboratory

Windows and Daylighting Group, 2009

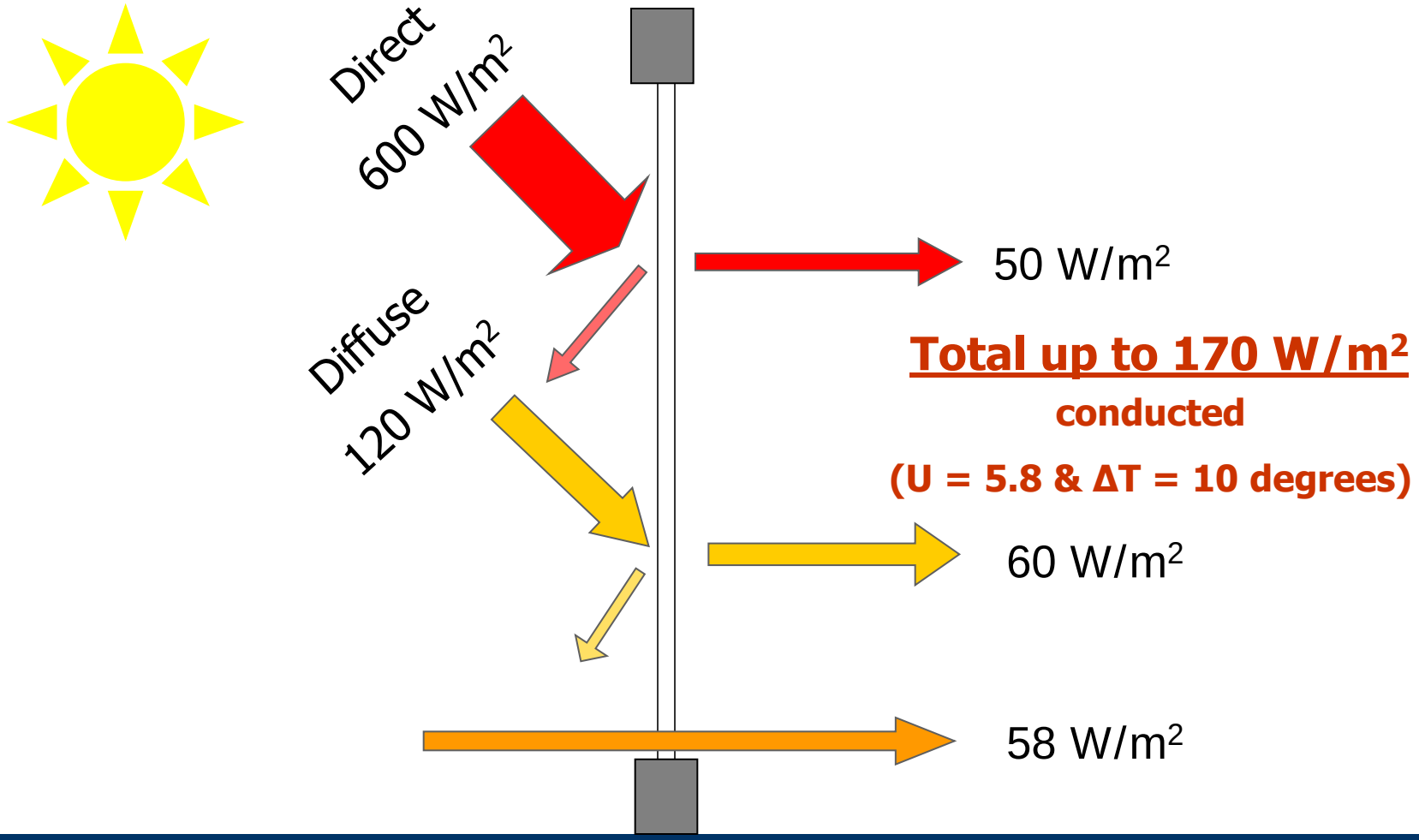


WINDOW 6 – THERM 6 Validation Research Project

- Extensive project: 26 window/attachment combinations
- U-value and SHGC tests (ATI Lab)
- Comparison U-value and SHGC simulations (W6/T6) (Carli, Inc.)
- Agreement so far generally very good



Conducted plus radiant summer heat gains through **north-facing** 3mm clear glass at noon

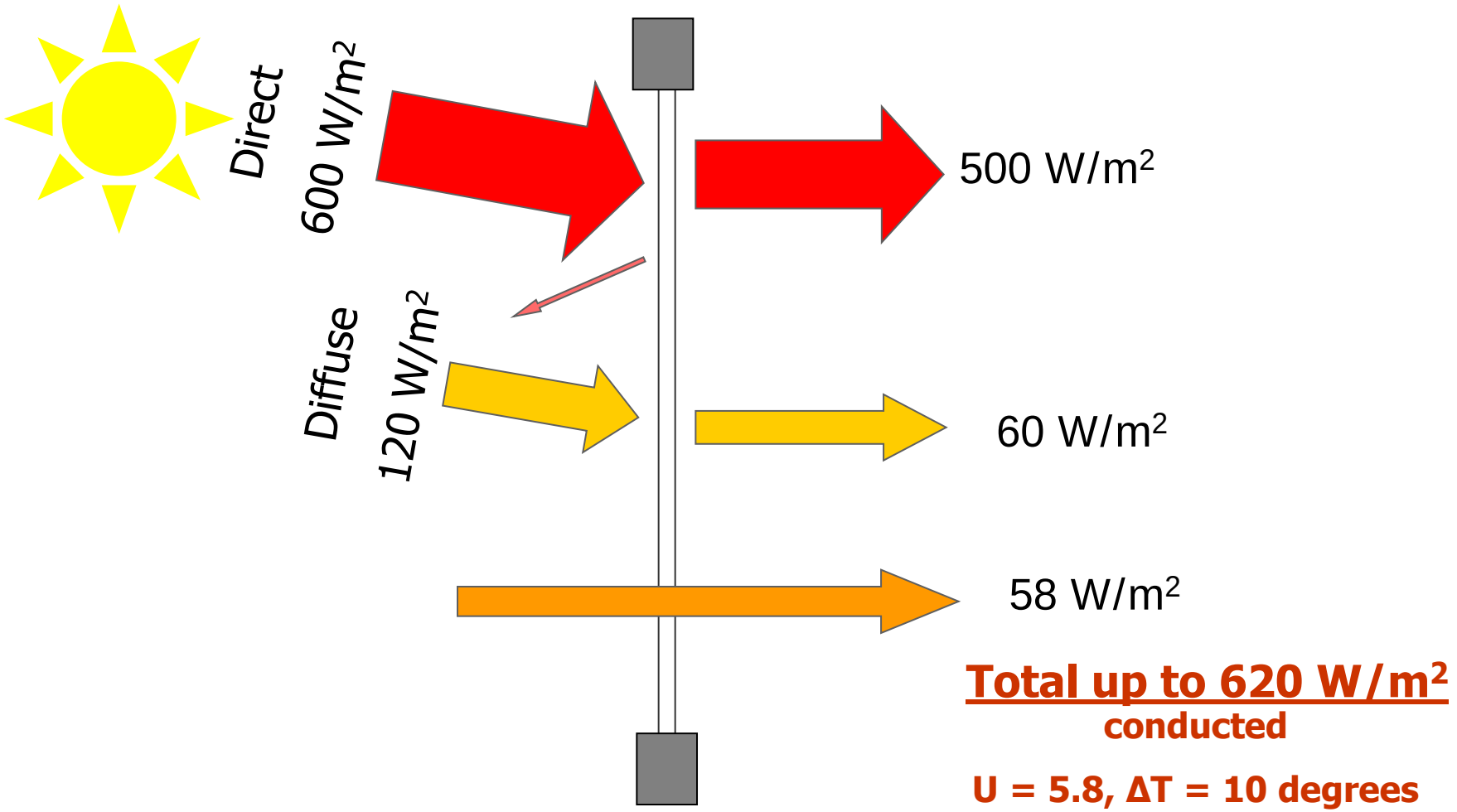


Total up to 170 W/m²

conducted

(U = 5.8 & ΔT = 10 degrees)

Summer heat gains through **east or west-**facing glass at 7am or 5pm



Total up to 620 W/m²
conducted

U = 5.8, ΔT = 10 degrees

SKYLIGHTS – rectangular, shafted, tubular

BCA Glazing Calculator 2010: what's new? ?????

- The *Glazing Calculator* software continues as a more rapid and user-friendly alternative to the manual glazing tables in Part J2 and 3.12.2.2 (11 pages!).

- For 2010 this free, downloadable software tool has been revised to be consistent with new stringencies and clauses described above. Glazing Calculators are available for Volume One and Volume Two, in Excel 2003 and Excel 2007 versions.

- Note that the Glazing Calculator does *not* actually calculate fenestration energy performance. Rather it requires users to input whole-system U-values and SHGCs into a spreadsheet to determine if the proposed building's annual energy performance is BCA compliant. Such whole-product window, door and skylight energy ratings must come from AFRC ratings, NFRC ratings or soon, in the case of skylights, WERS for Skylights.

Thermal Calculation Method (Software)

Class 1, 2 and 10a buildings

- BERS Pro 4.1
- FirstRate5

which both depend on the engine in -

- AccuRate

AccuRate house energy rating report

Large	
View from street	
Ground	
Upper	

Tony Isaacs, 2007 and SWA 2009-2010

 Energy Partners

AccuRate V1.1.4.1 NFRC Glazing version

Nationwide House Energy Rating Scheme

Project Details

Project Name: SWA 2009
File Name:
Postcode: 5000 **Climate Zone:** 16
Design Option: North
Description: Large House, 2-storey, 241.3 m2, U=6.34, SHGC=0.29
NFRC version of AR
R2.0RFL walls, R5.0 ceiling, E-facing

Client Details

Client Name:
Phone: **Fax:** **Email:**
Postal Address:
Site Address:
Council submitted to (if known by assessor):

Assessor Details

Assessor Name: Peter Lyons **Assessor No.**
Phone: 0408 808 556 **Fax:** (02) 6103 9033 **Email:** peter.lyons@fenestralia.com
Assessment Date: 11/05/2009 **Time:** 10:01
Project Code:
Assessor Signature:

CALCULATED ENERGY REQUIREMENTS* (RESEARCH VERSION: RESULTS NOT FOR RATING)

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
46.9	53.9	2.5	103.3	MJ/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

AREA-ADJUSTED ENERGY REQUIREMENTS (RESEARCH VERSION: RESULTS NOT FOR RATING)

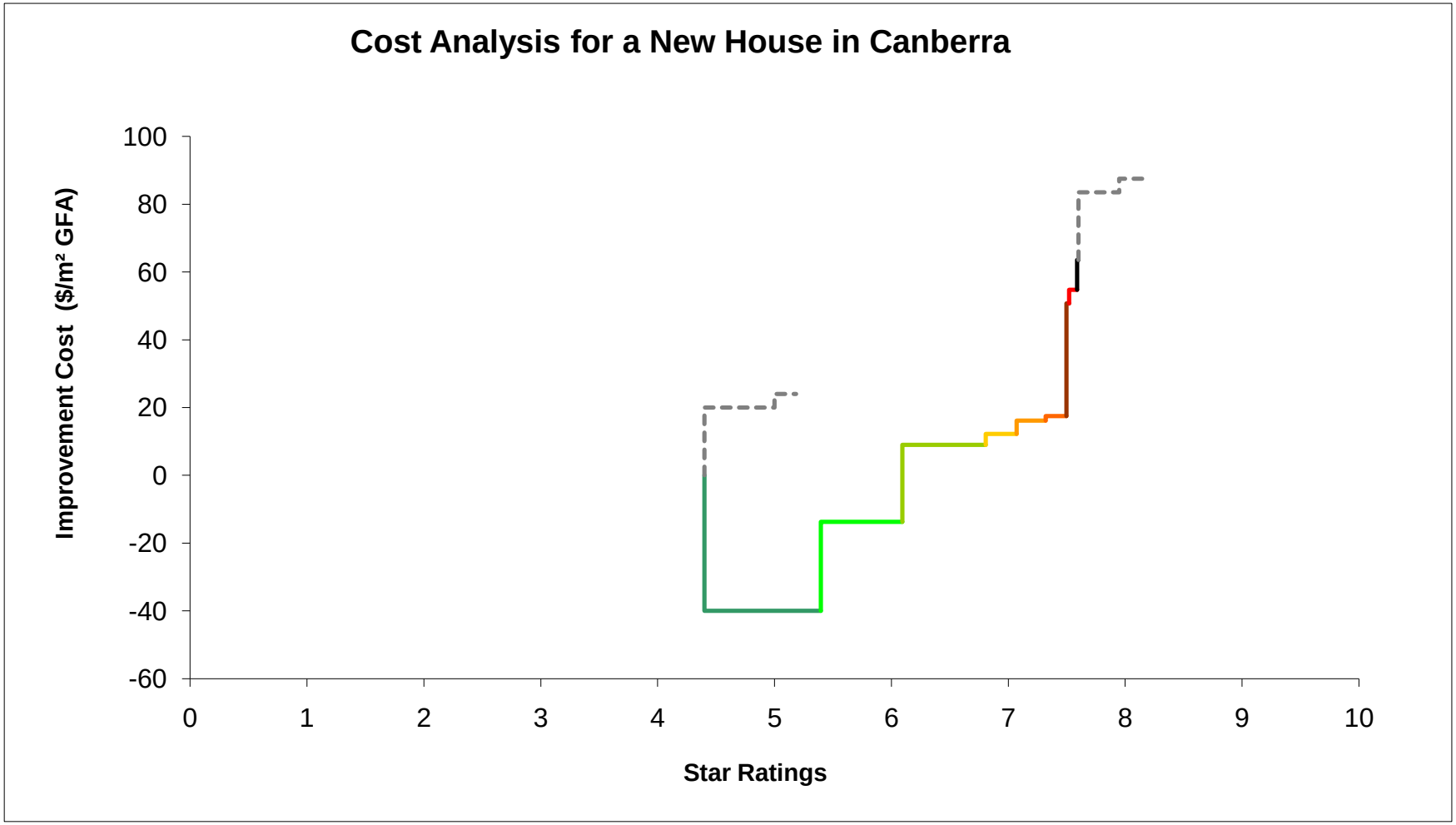
Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
50.3	57.8	2.7	110.7	MJ/m².annum
Conditioned floor area		237.3 m²		

Star Rating (RESEARCH VERSION: RESULTS NOT FOR RATING)

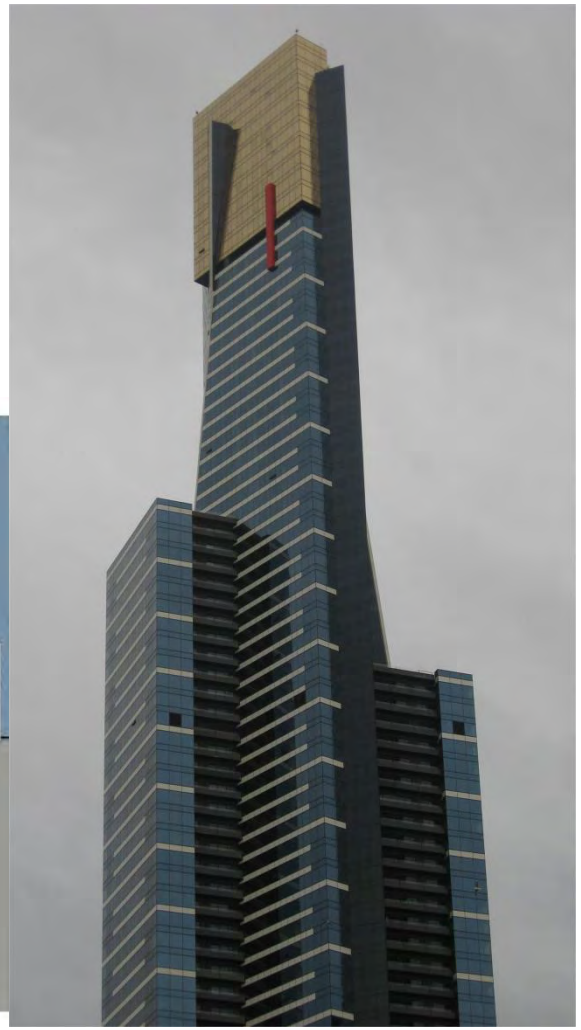
★★★★★ **5.4 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
480	325	227	165	125	96	70	46	22	3


Cost Analysis for a New House in Canberra
Improvement Cost ($/m² GFA)
100
80
60
40
20
0
-20
-40
-60
0
1
2
3
4
5
6
7
8
9
10
Star Ratings

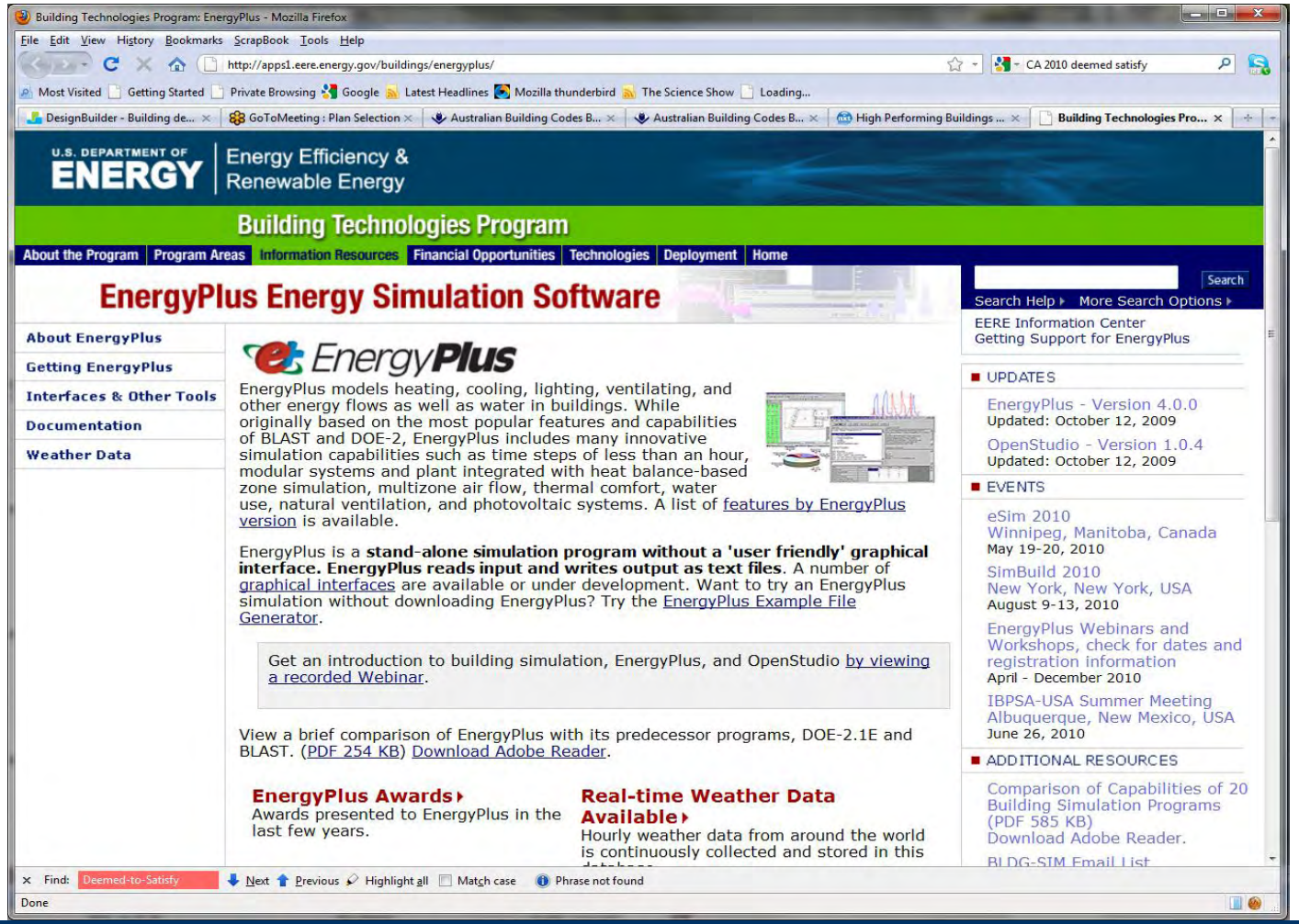

Paul Wakefing



EnergyPlus, for commercial and residential buildings

US$6 million a year funding; free to acquire; upgrades every April & October

www.energyplus.gov **Residential (Class 1 - 4 & 10), Commercial (Classes 2 - 9)**



DesignBuilder:
User-friendly, 3D graphical front end for EnergyPlus

designbuilder.com.au

Residential (Class 1 - 4 & 10)

Commercial (Classes 2 – 9)

- **Training and support for DesignBuilder and EnergyPlus**
- **Supported and sponsored by Engineers Australia**

Some commercial building simulation tools – 2010

Much more info at: www.eere.energy.gov/buildings/tools_directory
but this site still not exhaustive

Non-residential and commercial buildings

• DOE-2 (*e.g.* eQUEST)	www.doe2.com	Free
• EnergyPlus	www.energyplus.gov	Free
• DesignBuilder	www.designbuilder.com.au	Commercial
• EFEN	www.designbuildersoftware.com	Comm.
• Energy Express (CSIRO)	www.hearne.com.au	Commercial
• ECOTECT	squ1.com	Commercial
• ESP-r	www.esru.strath.ac.uk/Programs/ESP-r.htm	Open source
• IES	www.iesve.com/content/	Commercial
• CAMEL, BEAVER	www.ozemail.com.au/~acadsbsg	Comm.
• TAS	http://212.23.11.237/default.htm	Comm.
• TRNSYS	sel.me.wisc.edu/trnsys	Comm.

…and many others

Seminar Format

Questions after each Section

- Introduction to the Regulations
- Envelope Requirements
- Fenestration (including roof glazing)
- From 5 Stars to 6 Stars
- Services: lighting, hot water, HVAC
- Mandatory Disclosure

Glazing Calculator 2009 – Aluminium Frame Single Glazing

GLAZING CALCULATOR FOR USE WITH PART 3.12.2, BCA VOLUME TWO (HOUSING)

HELP

Climate zone: 7

Building name/description: 5 Star Dewlling Canberra

Storey: 1

Floor Construct'n	Type A	Type B
Area of Floor	120m²	
Air Movement	S	

Glazing area ###### ..... (22% of area of floor Type A)

Note: Air Movement level must be separately verified

CONSTANTS	Type A	Type B
C_U / C_{SHGC}	1.4 / 0.26	

ALLOWANCES	
C_U x Area	168.0
C_{SHGC} x Area	31.2

Number of rows preferred in table below: 12 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION, SIZE and PERFORMANCE CHARACTERISTICS										SHADING		CALCULATION DATA			CALCULATED OUTCOMES - OK (if inputs are valid)			
Glazing element		Orientation		Size			Performance			P&H or device		Exposure		Size	Conductance - PASSED		Solar heat gain - PASSED	
ID	Description (optional)	Floor type A	Floor type B	Height (m)	Width (m)	Area (m²)	*Total U-Value* (NFRC)	*SHGC* (NFRC)		P (m)	H (m)	P/H	E factor	Area used (m²)	U x area	Element share of % of allowance used	SHGC x E x area	Element share of % of allowance used
1	BD1 W1	S		1.80	1.80	3.24	6.2	0.77					0.64	3.24	20.1	12% of 98%	1.6	8% of 62%
2	BD1 W12	E		1.00	1.50	1.50	6.2	0.77					1.21	1.50	9.3	6% of 98%	1.4	7% of 62%
3	WC1 W11	E		2.00	0.60	1.20	6.2	0.77					1.21	1.20	7.4	4% of 98%	1.1	6% of 62%
4	BD2 W4	W		1.20	1.80	2.16	6.2	0.77					1.19	2.16	13.4	8% of 98%	2.0	10% of 62%
5	BD3 W3	S		1.80	1.80	3.24	6.2	0.77					0.64	3.24	20.1	12% of 98%	1.6	8% of 62%
6	W5	N		1.00	1.20	1.20	6.2	0.77					0.96	1.20	7.4	4% of 98%	0.9	5% of 62%
7	W2	S		2.10	0.30	0.63	6.2	0.77					0.64	0.63	3.9	2% of 98%	0.3	2% of 62%
8	W6	W		1.80	0.90	1.62	6.2	0.77					1.19	1.62	10.0	6% of 98%	1.5	8% of 62%
9	W7	N		1.80	1.80	3.24	6.2	0.77					0.96	3.24	20.1	12% of 98%	2.4	12% of 62%
10	W8	N		2.10	1.80	3.78	6.2	0.77					0.96	3.78	23.4	14% of 98%	2.8	14% of 62%
11	W9	N		1.80	1.80	3.24	6.2	0.77					0.96	3.24	20.1	12% of 98%	2.4	12% of 62%
12	W10	E		1.80	0.90	1.62	6.2	0.77					1.21	1.62	10.0	6% of 98%	1.5	8% of 62%

If inputs (including air movement levels) are valid

Glazing Calculator 2010 – Standard Aluminium Frame Double Glazing

BCA VOLUME TWO GLAZING CALCULATOR (first issued with BCA 2010)

HELP

Building name/description: **5 Star Dewlling Canberra**

Climate zone: **7**

Storey: **1**

Air Movement: **Standard**

Floor Construction — Direct contact: **120m²** — Suspended:

Area of storey: **120m²**

Area of glazing 26.7m² (22% of area of storey)

Wall insulation concession (requires increased glazing stringency): *Table 3.12.1.3b Climate zone 7 Option (a)(i)*

Number of rows preferred in table below: **12** *(as currently displayed)*

	C_U	C_{SHGC}
CONSTANTS	5.486	0.189
CONSTANT REDUCED BY	*15%*	
ADJUSTED CONSTANT	4.663	
	C_U (only)	C_{SHGC} x Area
ALLOWANCES	**4.7**	**22.7**

GLAZING ELEMENTS, ORIENTATION, SIZE and PERFORMANCE CHARACTERISTICS							SHADING		CALCULATION DATA		CALCULATED OUTCOMES			
Glazing element		Orientation	Size			Performance	P&H or device		Exposure	Size	*Conductance - FAILED*		Solar heat gain - PASSED	
ID	Description (optional)	Facing sector	Height (m)	Width (m)	Area (m²)	Total U-Value (AFRC)	SHGC (AFRC)	P (m)	H (m)	P/H	Es	Area used (m²)	U x area / winter access	Element share of % of allowance used	SHGC x Es x area	Element share of % of allowance used
1	BD1 W1	S	1.80	1.80	3.24	4.6	0.69				0.64	3.24	0.66	12% of 116%	1.4	8% of 77%
2	BD1 W12	E	1.00	1.50	1.50	4.6	0.69				1.21	1.50	0.31	6% of 116%	1.3	7% of 77%
3	WC1 W11	E	2.00	0.60	1.20	4.6	0.69				1.21	1.20	0.24	4% of 116%	1.0	6% of 77%
4	BD2 W4	W	1.20	1.80	2.16	4.6	0.69				1.19	2.16	0.44	8% of 116%	1.8	10% of 77%
5	BD3 W3	S	1.80	1.80	3.24	4.6	0.69				0.64	3.24	0.66	12% of 116%	1.4	8% of 77%
6	W5	N	1.00	1.20	1.20	4.6	0.69				0.96	1.20	0.24	4% of 116%	0.8	5% of 77%
7	W2	S	2.10	0.30	0.63	4.6	0.69				0.64	0.63	0.13	2% of 116%	0.3	2% of 77%
8	W6	W	1.80	0.90	1.62	4.6	0.69				1.19	1.62	0.33	6% of 116%	1.3	8% of 77%
9	W7	N	1.80	1.80	3.24	4.6	0.69				0.96	3.24	0.66	12% of 116%	2.1	12% of 77%
10	W8	N	2.10	1.80	3.78	4.6	0.69				0.96	3.78	0.77	14% of 116%	2.5	14% of 77%
11	W9	N	1.80	1.80	3.24	4.6	0.69				0.96	3.24	0.66	12% of 116%	2.1	12% of 77%
12	W10	E	1.80	0.90	1.62	4.6	0.69				1.21	1.62	0.33	6% of 116%	1.4	8% of 77%

Glazing Calculator 2010 – Improved Aluminium Frame Double Glazing

BCA VOLUME TWO GLAZING CALCULATOR (first issued with BCA 2010)

HELP

Building name/description: **5 Star Dwelling Canberra**

Climate zone: **7**

	C_U	C_{SHGC}
CONSTANTS	5.486	0.189
CONSTANT REDUCED BY	*15%*	
ADJUSTED CONSTANT	4.663	
	C_U (only)	C_{SHGC} x Area
ALLOWANCES	**4.7**	**22.7**

Storey: **1**

Air Movement: **Standard**

Floor Construction: Direct contact **120m²**; Suspended

Area of storey: **120m²**

Area of glazing *26.7m² (22% of area of storey)*

Wall insulation concession (requires increased glazing stringency): ***Table 3.12.1.3b Climate zone 7 Option (a)(i)***

Number of rows preferred in table below: **12** *(as currently displayed)*

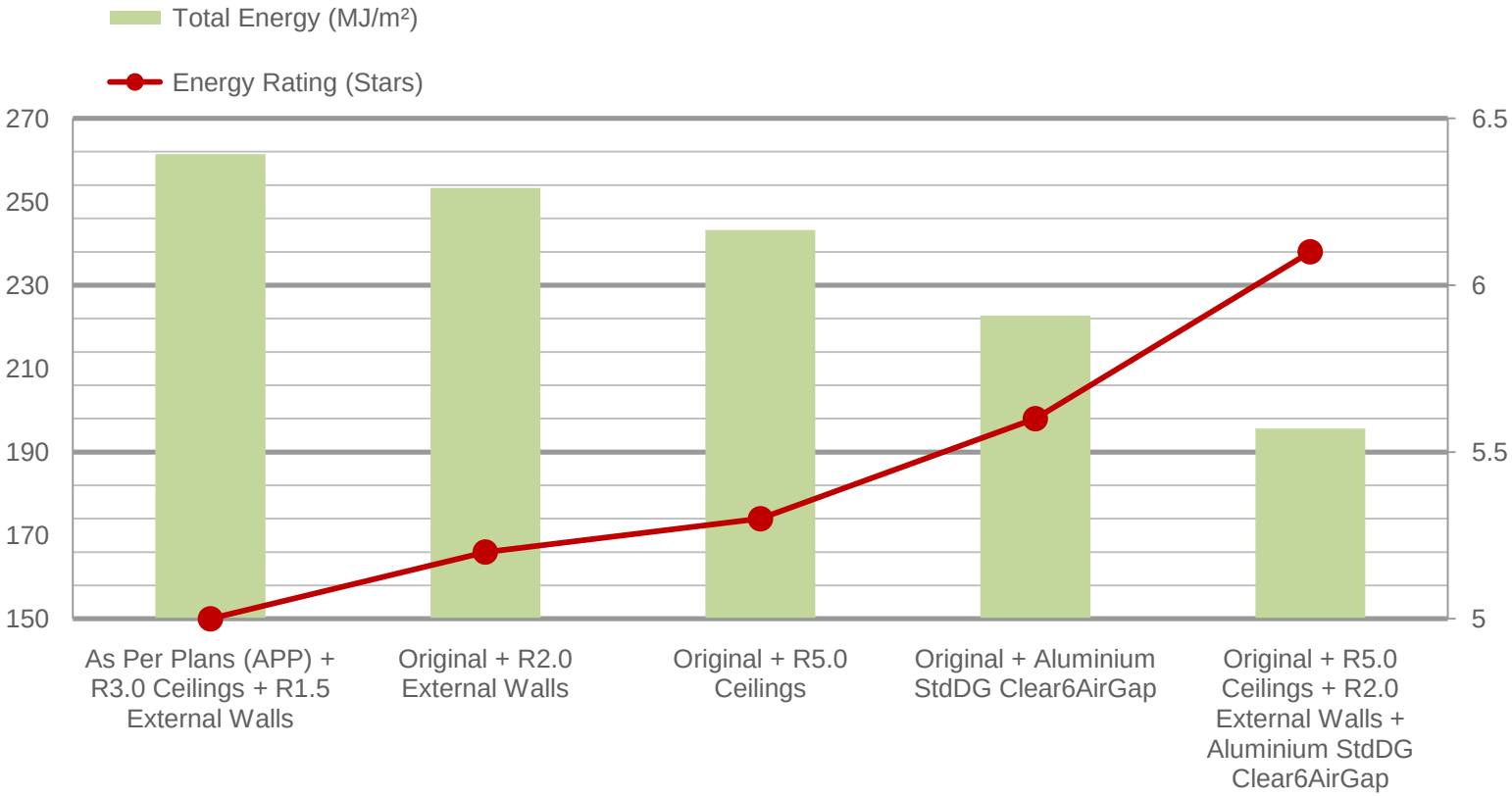
GLAZING ELEMENTS, ORIENTATION, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATION DATA			CALCULATED OUTCOMES - OK (if inputs are valid)			
Glazing element		Orientation	Size			Performance		P&H or device		Exposure		Size	Conductance - PASSED		Solar heat gain - PASSED	
ID	Description (optional)	Facing sector	Height (m)	Width (m)	Area (m²)	Total U-Value (AFRC)	SHGC (AFRC)	P (m)	H (m)	P/H	Es	Area used (m²)	U x area / winter access	Element share of % of allowance used	SHGC x Es x area	Element share of % of allowance used
1	BD1 W1	S	1.80	1.80	3.24	3.6	0.69				0.64	3.24	0.51	12% of 90%	1.4	8% of 77%
2	BD1 W12	E	1.00	1.50	1.50	3.6	0.69				1.21	1.50	0.24	6% of 90%	1.3	7% of 77%
3	WC1 W11	E	2.00	0.60	1.20	3.6	0.69				1.21	1.20	0.19	4% of 90%	1.0	6% of 77%
4	BD2 W4	W	1.20	1.80	2.16	3.6	0.69				1.19	2.16	0.34	8% of 90%	1.8	10% of 77%
5	BD3 W3	S	1.80	1.80	3.24	3.6	0.69				0.64	3.24	0.51	12% of 90%	1.4	8% of 77%
6	W5	N	1.00	1.20	1.20	3.6	0.69				0.96	1.20	0.19	4% of 90%	0.8	5% of 77%
7	W2	S	2.10	0.30	0.63	3.6	0.69				0.64	0.63	0.10	2% of 90%	0.3	2% of 77%
8	W6	W	1.80	0.90	1.62	3.6	0.69				1.19	1.62	0.26	6% of 90%	1.3	8% of 77%
9	W7	N	1.80	1.80	3.24	3.6	0.69				0.96	3.24	0.51	12% of 90%	2.1	12% of 77%
10	W8	N	2.10	1.80	3.78	3.6	0.69				0.96	3.78	0.60	14% of 90%	2.5	14% of 77%
11	W9	N	1.80	1.80	3.24	3.6	0.69				0.96	3.24	0.51	12% of 90%	2.1	12% of 77%
12	W10	E	1.80	0.90	1.62	3.6	0.69				1.21	1.62	0.26	6% of 90%	1.4	8% of 77%

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

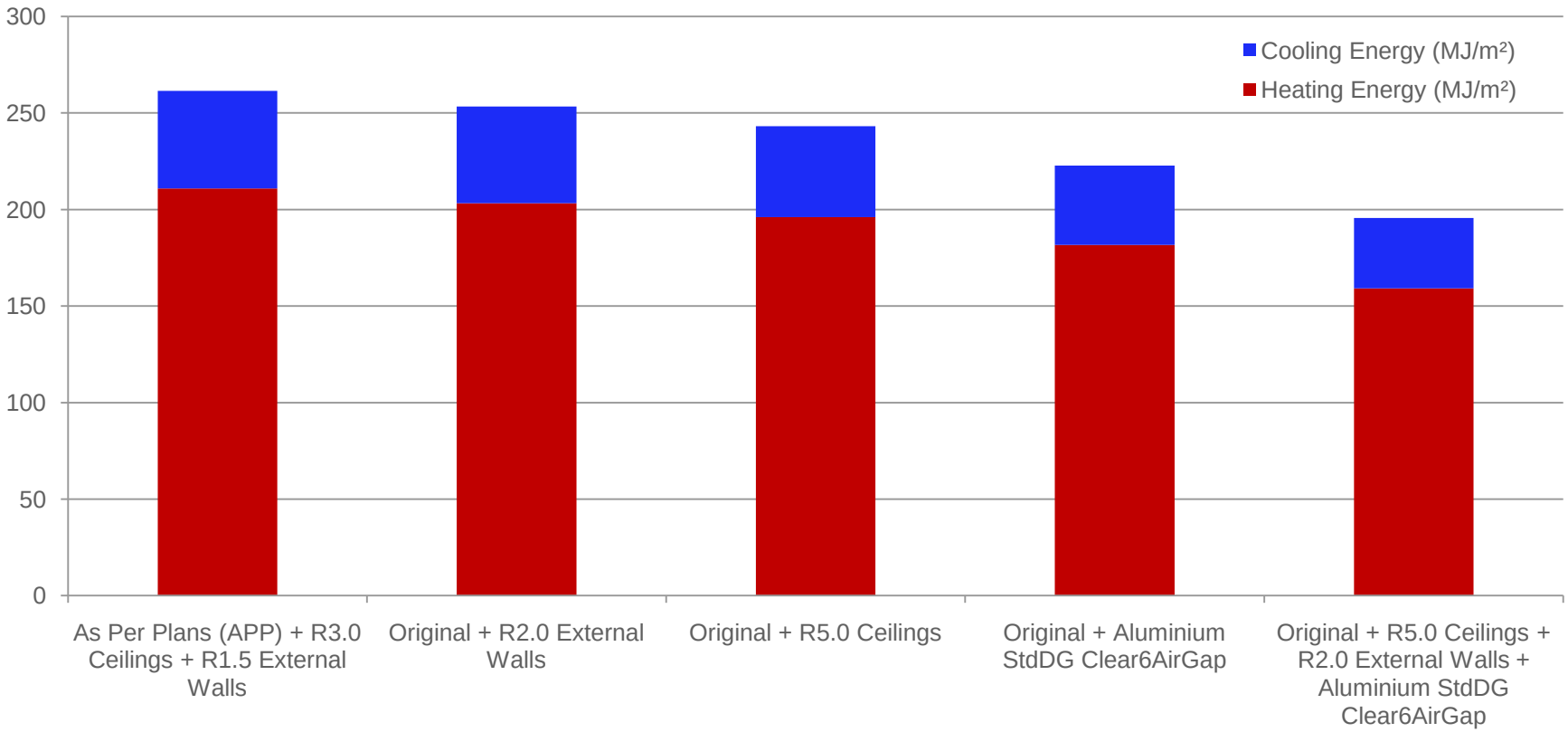
If inputs (including air movement levels) are valid

The Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters. While the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all. Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

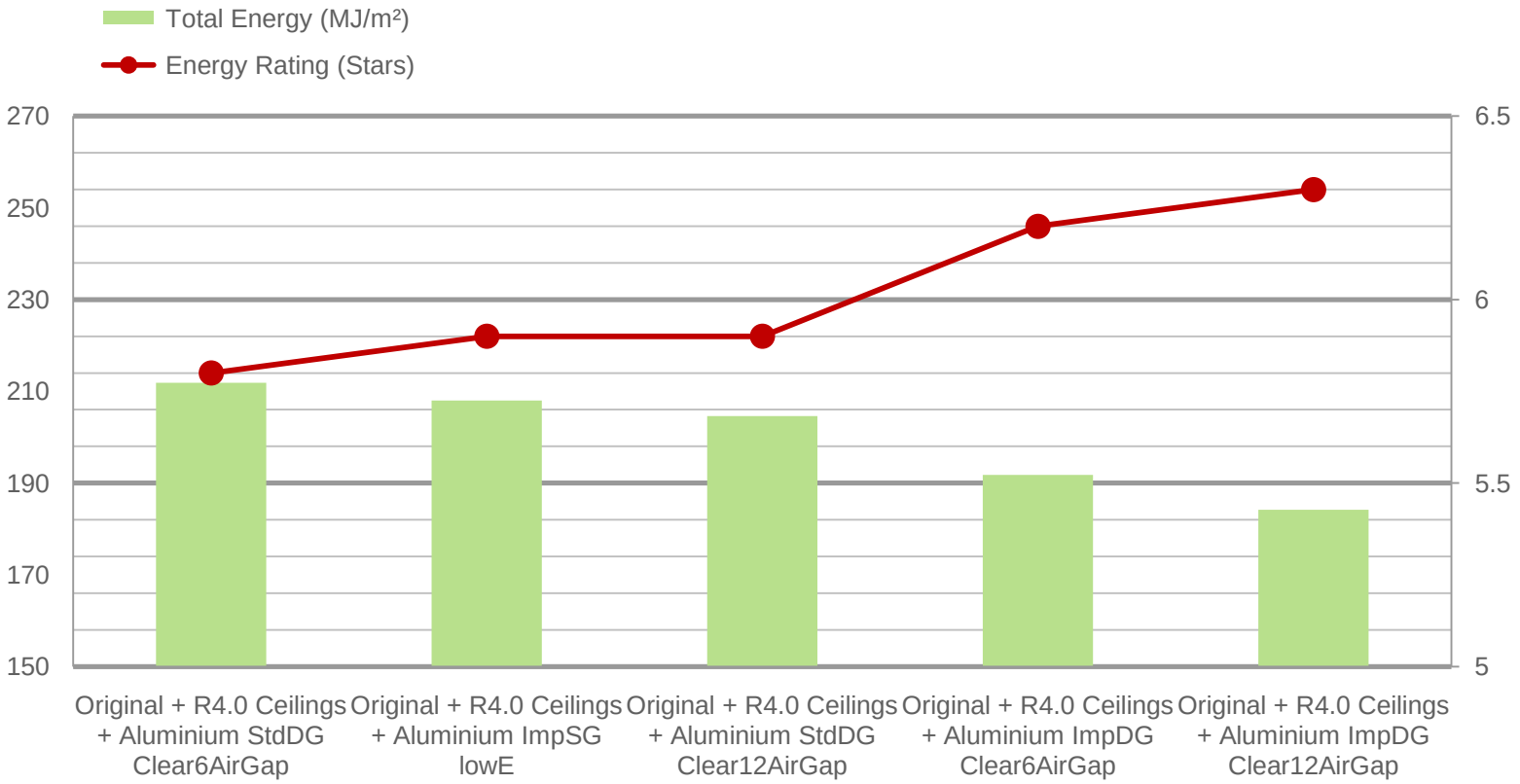
Change to Total Energy and Star Rating after Improvements to House



Change to Heating and Cooling Energy after the improvements of the house



Comparison of Different Windows



Seminar Format

Questions after each Section

- Introduction to the Regulations
- Envelope Requirements
- Fenestration (including roof glazing)
- From 5 Stars to 6 Stars
- **Services: lighting, hot water, HVAC**
- Mandatory Disclosure

What's new for residential lighting, hot water and HVAC in BCA 2010 (Part 3.12) ?

The following summary is courtesy of Greg Burghardt (Envirohome Pty Ltd)

- ***Lighting:*** the days of (legally) installing 50+ halogen downlights (producing 2 – 3 kilowatts of heat) in one dwelling are over
- General residential lighting: upper limit of 5 W/m^2 for hard-wired lighting
- 200 m^2 home means 1 kW lighting total
- 1 kW allowance more than enough to power sufficient compact fluorescent lamps (CFLs) or light-emitting diode (LED) lamps for whole house
- **BCA Lighting Calculator** available as free download
- New table included for increasing ceiling insulation if **penetrations** (*such as* downlights) exceed 0.5% of the ceiling area.

What's new for residential lighting, hot water and HVAC in BCA 2010? *(Continued)*

The following summary is courtesy of Greg Burghardt (Envirohome Pty Ltd)

- ***Hot water:*** minimum energy performance standards (MEPS) for hot water systems including gas (5 stars or better under AS 4552), solar and heat pump (choose a cold climate proven make).
- See *www.energyrating.gov.au*
- Hot water pipes must be insulated:

Figure 10.1 – AS/NZS 3500.5 Table 3.9 - Minimum thermal insulation of piping connected to a hot water service

Internal Locations	External Locations (This is an unenclosed area of a building such as an unenclosed sub floor, verandah, etc.)		
	AS/NZS 3500 Climate Region A	AS/NZS 3500 Climate Region B	AS/NZS 3500 Climate Region C
	BCA Climate Zone 1-3, 5	*BCA Climate Zone 4 & 6*	*BCA Climate Zone 7 & 8*
R0.3	R0.3	R0.6	R1.0

Canberra

All internal piping to have R0.3 insulation

All external piping to have R0.6 insulation

What's new for residential lighting, hot water and HVAC in BCA 2010? *(Continued)*

The following summary is courtesy of Greg Burghardt (Envirohome Pty Ltd)

HVAC and other services: *"Greenhouse intensity of heating and hot water service. The overall requirement is that the…greenhouse gas emissions from each unit of the measured heating load does not exceed 100g CO_2-e/MJ*

- *OR renewable*
- *OR reclaimed…"*

- swimming pools must only be heated by solar without boosting from electric resistance heating
- Increased stringency for building sealing: "…*a* ***draught protection device*** *to be fitted to the bottom edge of an external swing door with other edges of an external door or window to be sealed by a rubber compression strip, fibrous seal or the like."*
- Piping and ducting insulation requirements increased
- Evaporative coolers must be fitted with self-closing dampers

What's new for residential lighting, hot water and HVAC in BCA 2010? *(Continued)*

Ducts must be a lot better:

	Duct Wall U-Value (W/m2.K)		
Duct Description	Heating	Cooling	Indicative Annual Energy Savings over 2009
Foil only	2.65	4.04	
Pre-2009	1.37	1.37	
2009	0.89	0.89	
Duct boot	0.50	0.50	
2010	**0.47**	**0.47**	**4.3%**
Ultimate, 150mm dia	0.24	0.24	
Ultimate, 200mm dia	0.25	0.26	**6.1%**
Ultimate, 250mm dia	0.26	0.27	
Ultimate, 300mm dia	0.26	0.27	
Ultimate, 450mm dia	0.28	0.29	

What's new for residential lighting, hot water and HVAC in BCA 2010? *(Continued)*

Reverse-cycle heat pumps: *www.energyrating.gov.au*

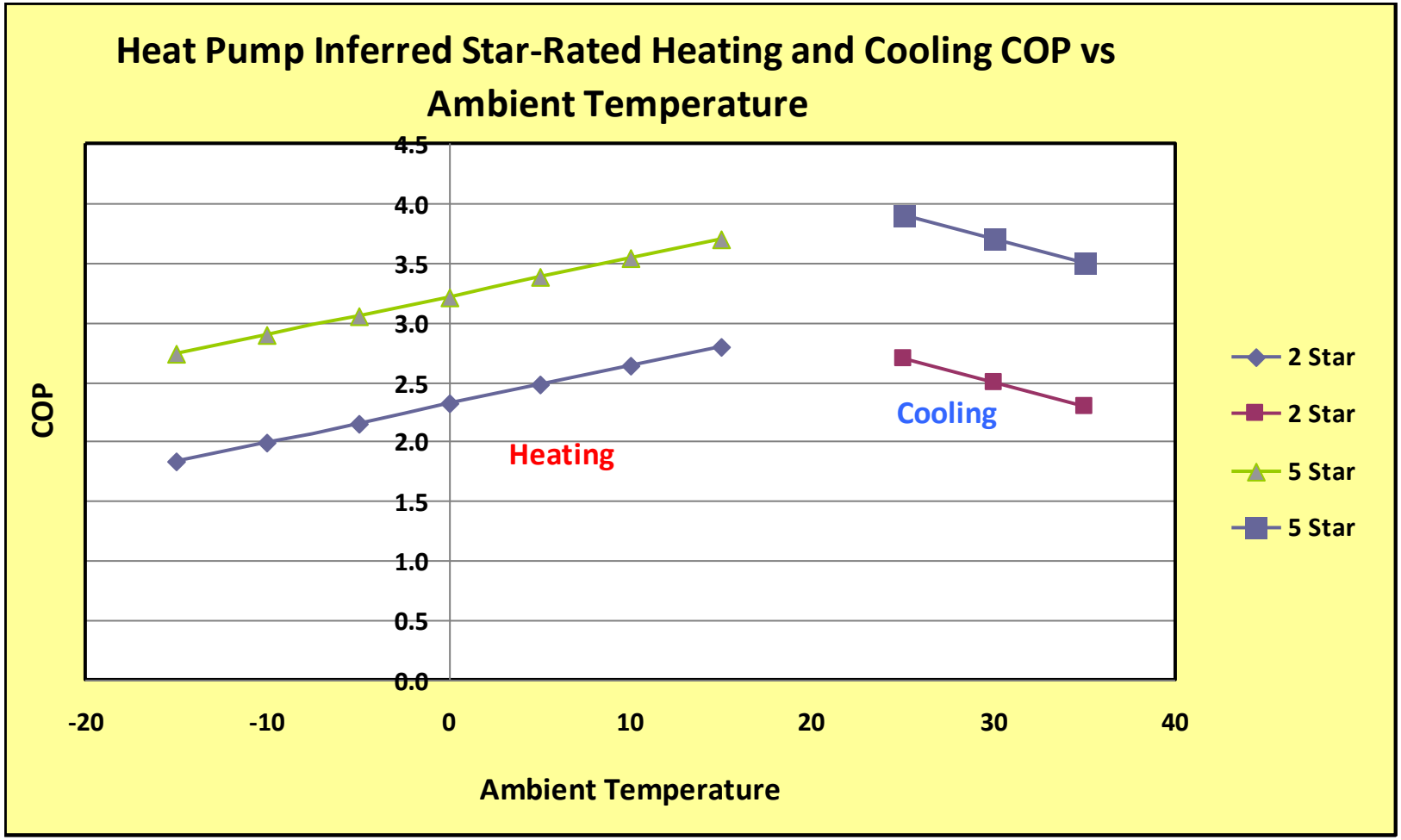
2000 Version

Old Star	Min EER (cooling)	Min COP (heating)
1	2.0	2.3
2	2.3	2.6
3	2.6	2.9
4	2.9	3.2
5	3.2	3.5
6	3.5	3.8
7	3.8	4.1
8	4.1	4.4
9	4.4	4.7
10	4.7	5.0
11	5.0	5.3

2010 Version

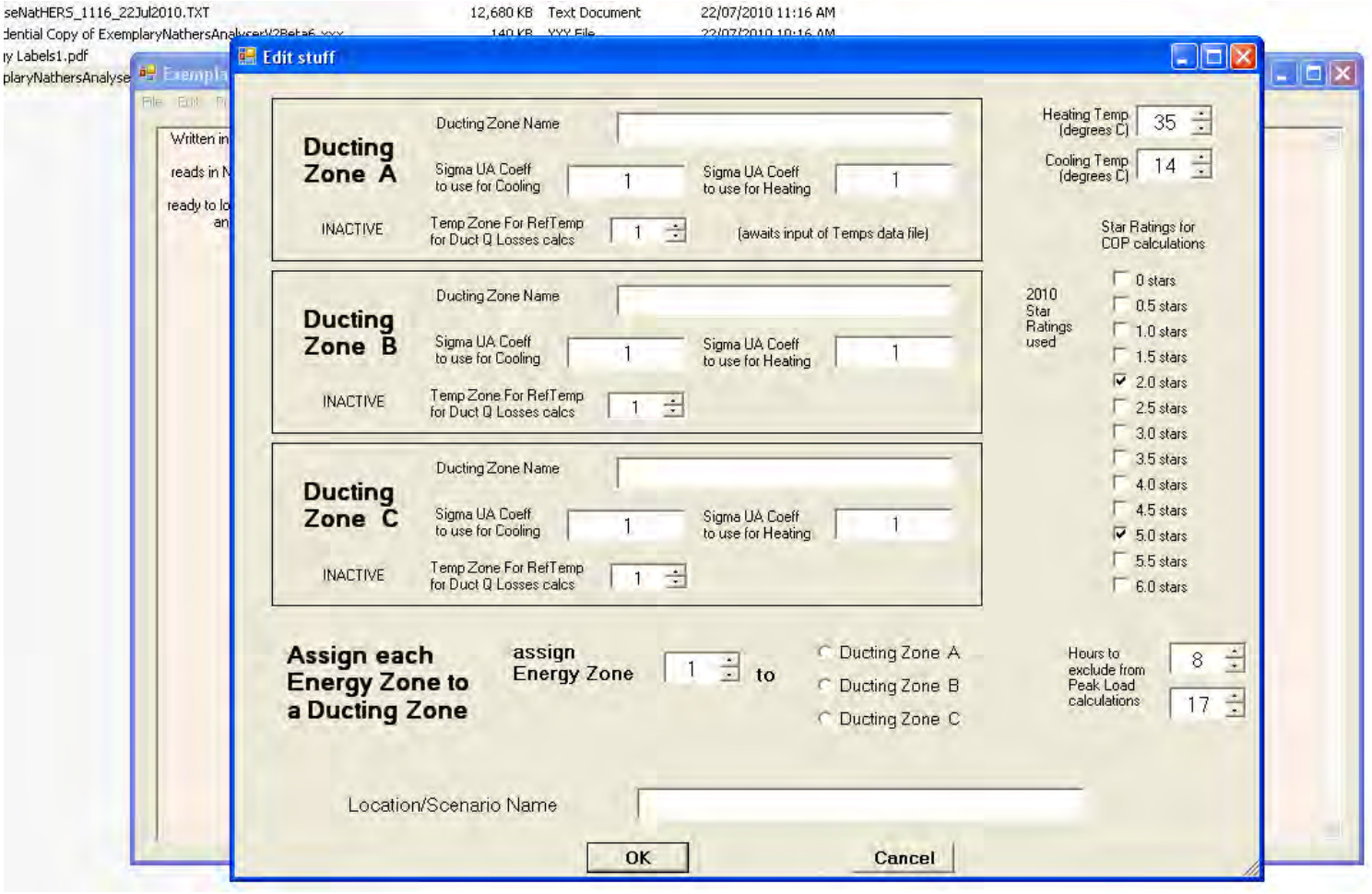
2010 Star Rating	Min EER (cooling)	Min COP (heating)
1.0	2.75	2.75
1.5	3.00	3.00
2.0	3.25	3.25
2.5	3.50	3.50
3.0	3.75	3.75
3.5	4.00	4.00
4.0	4.25	4.25
4.5	4.50	4.50
5.0	4.75	4.75
5.5	5.00	5.00
6.0	5.25	5.25

What's new for residential lighting, hot water and HVAC in BCA 2010? *(Continued)*



Energy Partners, Manuka ACT 2009-2010

What's new for residential lighting, hot water and HVAC in BCA 2010? *(Continued)*



Metered Energy from "Exemplary NatHERS Analyser" - Energy Partners (C) 2009-2010

Seminar Format

Questions after each Section

- Introduction to the Regulations
- Envelope Requirements
- Fenestration (including roof glazing)
- From 5 Stars to 6 Stars
- Services: lighting, hot water, HVAC
- Mandatory Disclosure

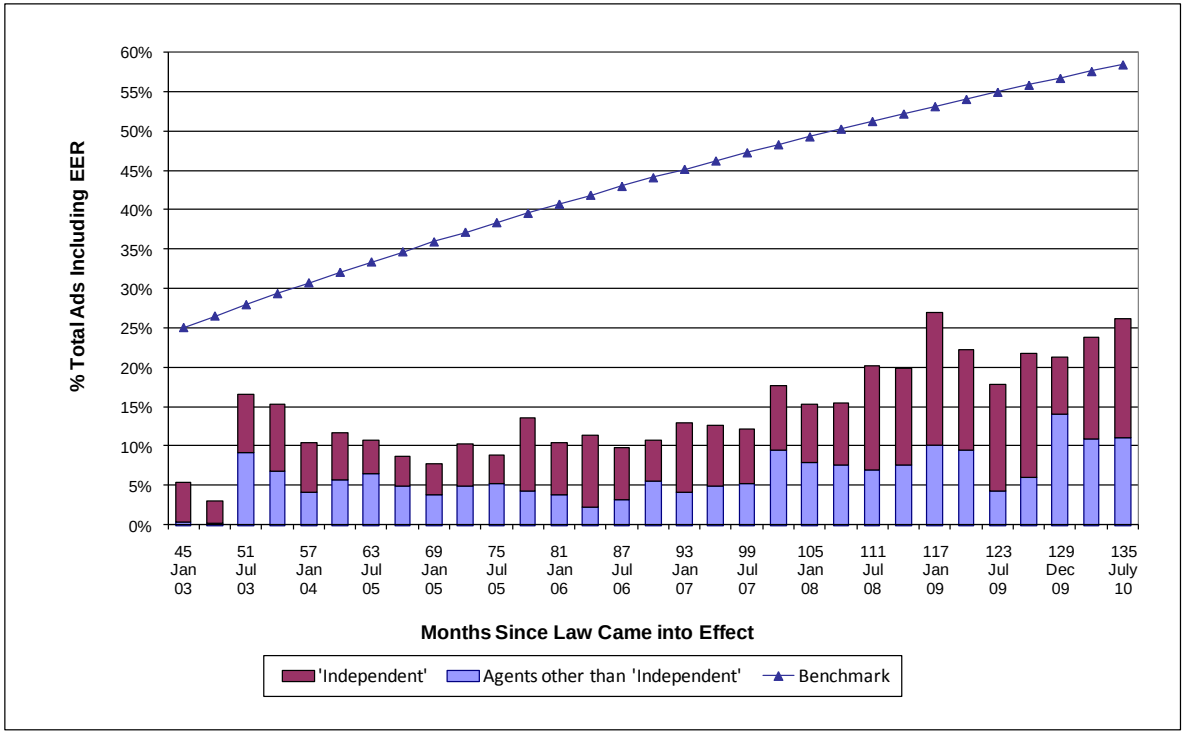
Mandatory Disclosure

- **Energy Efficiency Ratings (Sale of Premises) Act 1997**
  - Requirement for EERs in effect in 1999
- **Civil Law (Sale of Residential Property) Act 2003**
- **ACT Residential Tenancies Act**
  - Amendment for EERs in effect in 1999

Landlords or their real estate agents are required to disclose any existing Energy Efficiency Ratings (EERs) in advertisements for properties to lease.

Rentals

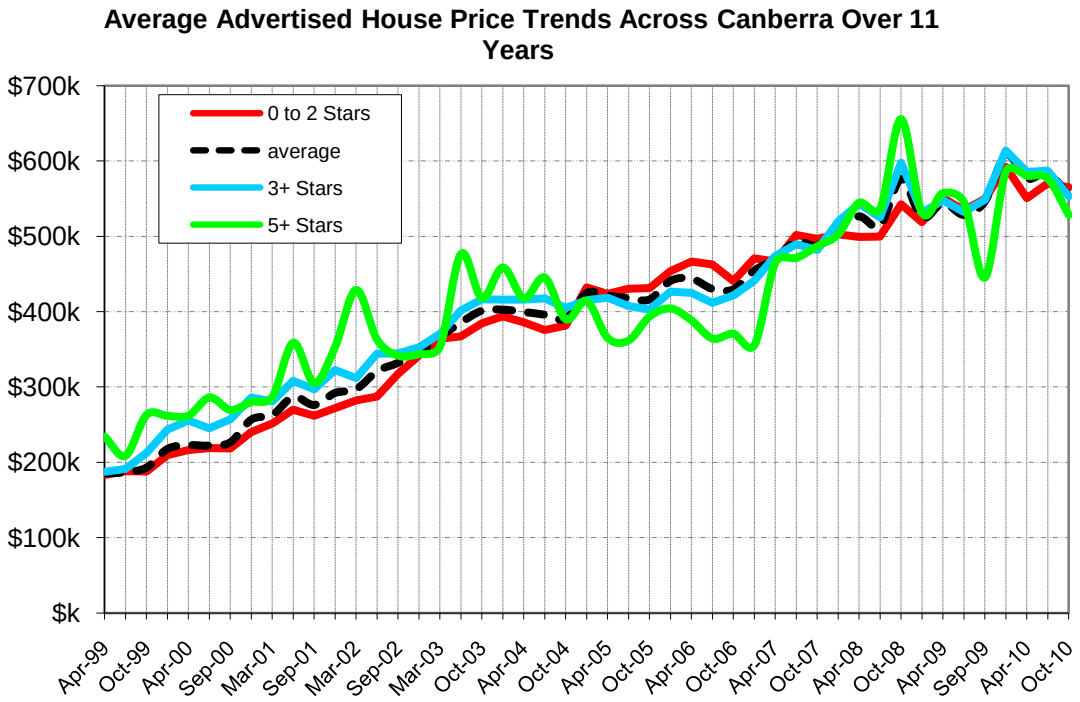
Advertisements which include EER as a percent of total advertisements compared with benchmark



- Minimum compliance of 2.3% in April 2003 (month 48)
- Maximum compliance of 26.97% in Jan 2009 (month 117)
- Gap between actual and predicted values continuing to increase

Sales

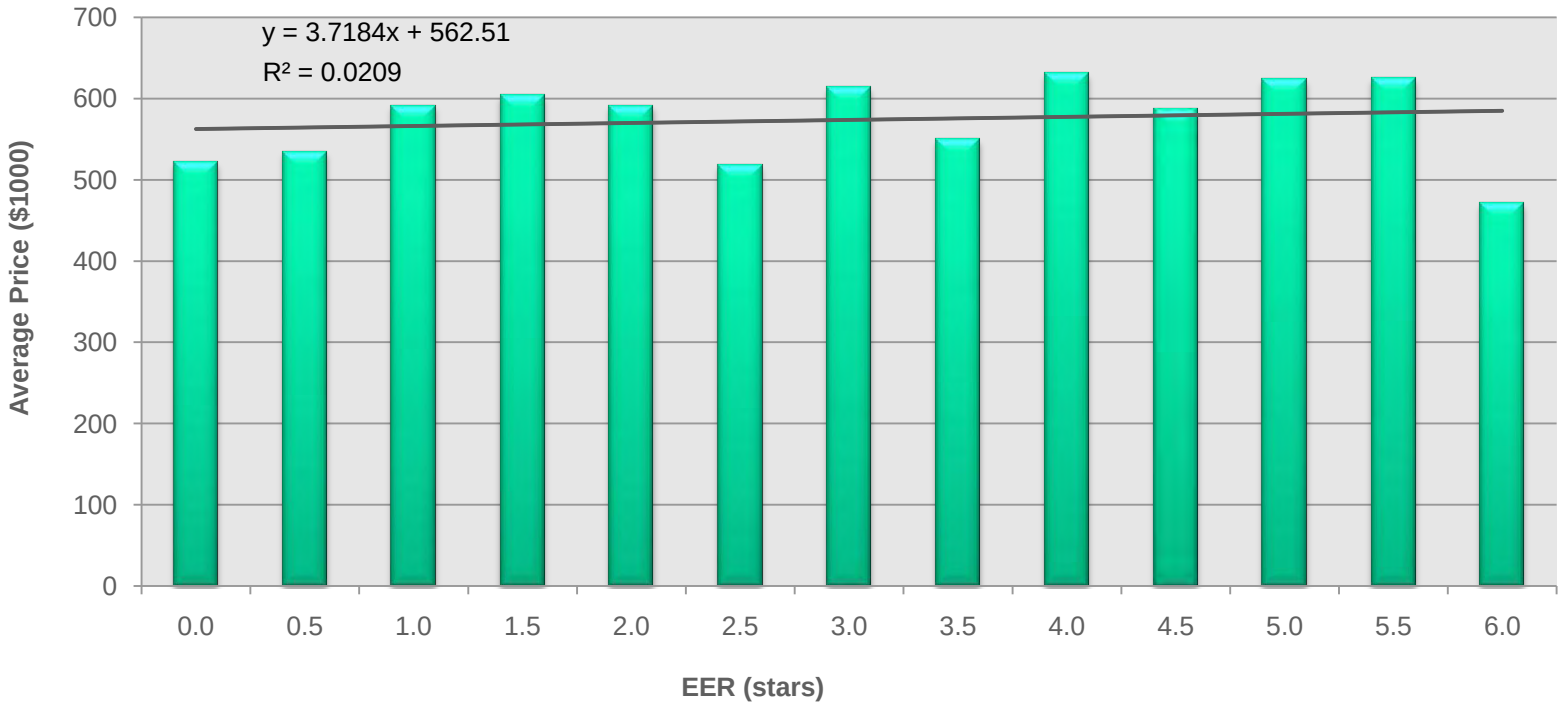
Distribution of EER Advertisements Across the Star Bands



(C) Prepared by **Energy Partners** from advertised house prices since the start of the EER(SOP) Act

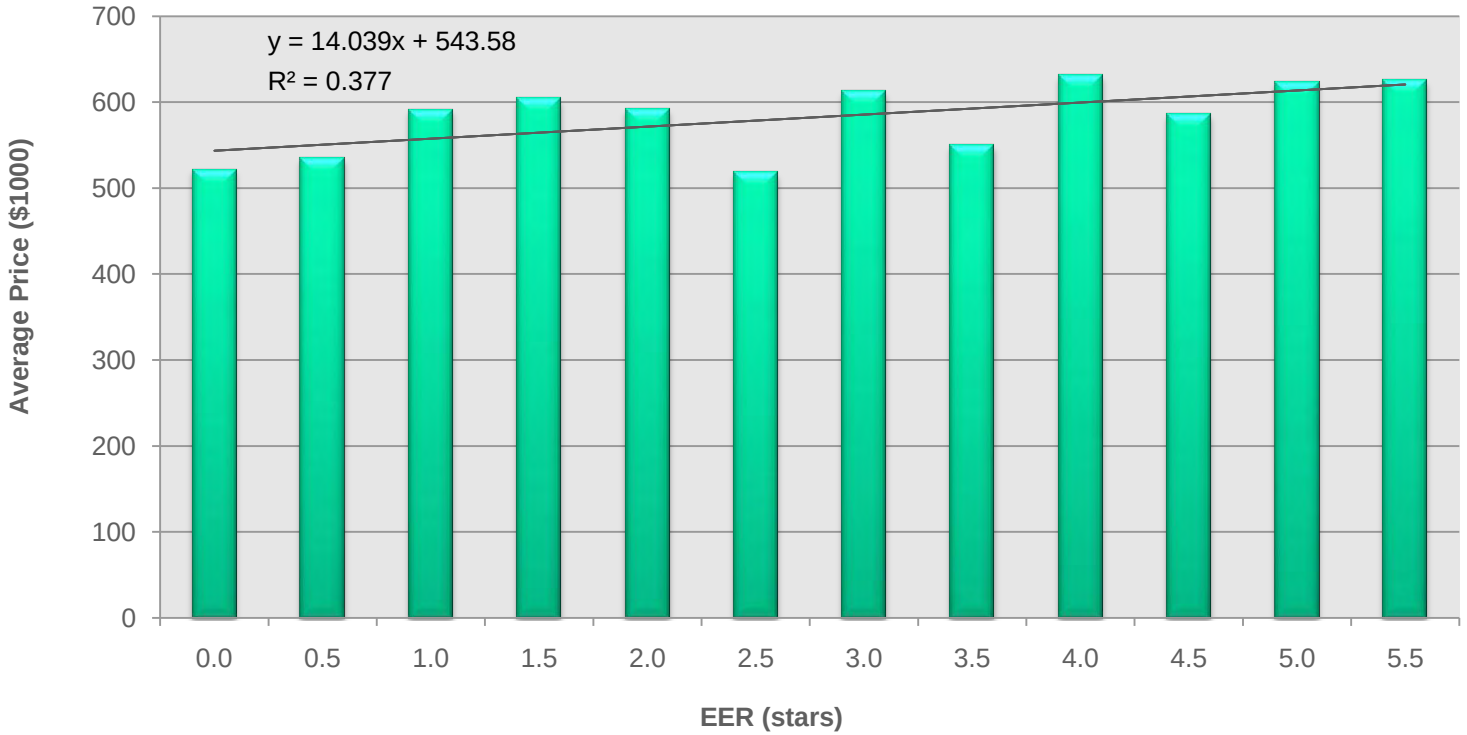
- Increasing trend of average advertised house price in Canberra for the period of 1999-2010
- Property with 5+ stars experienced the most fluctuation

Average Advertised sale price of homes across Canberra at beginning of July 2010



Note: Trend line shows average cost for Canberra homes approximately increase by $3700 per star.

Average Advertised sale price of homes across Canberra at beginning of July 2010



Note: Trend line shows average cost for Canberra homes approximately increase by $14000 per star.

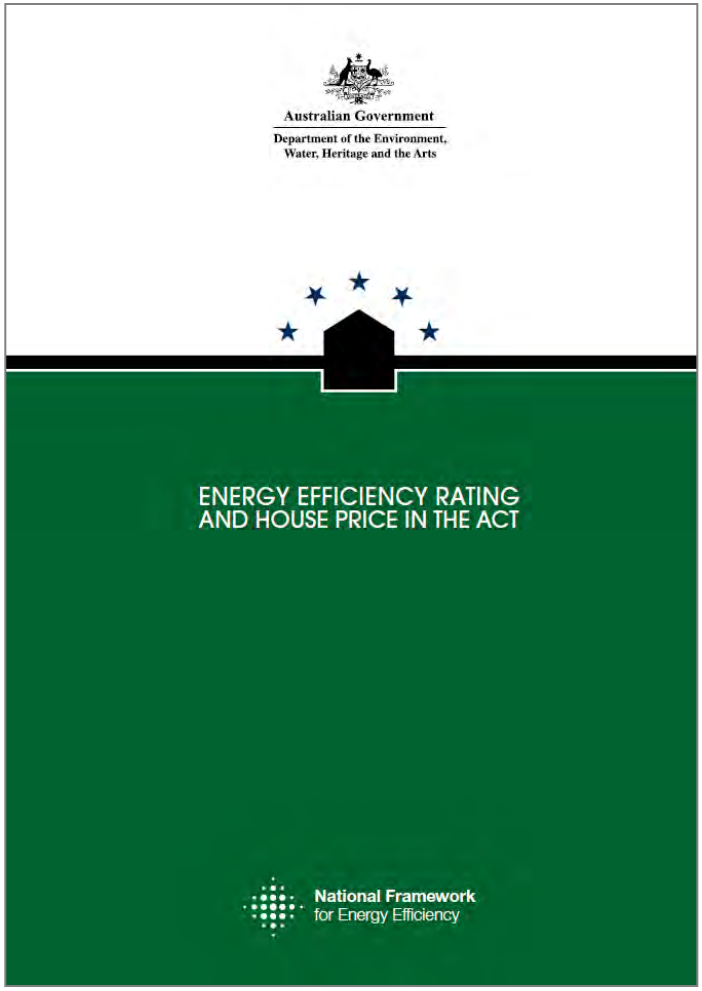
Suburbs	Average sale Prices for 6 Stars
Belconnen	$383,889
Bruce	$409,938
Bonner	$519,762
Casey	$516,245
Franklin	$552,557
City	$463,454
Total Average	**$474,307**

Table. 1 Average 6 Star Homes Sale Prices at end of July 2010

6 Stars Property types	Percentage	Average Prices	Weighted Average
Apartments/Flats	28%	$428,120	$119,873
Units/Townhouses	12%	$375,958	$45,115
House	41%	$491,412	$201,478
House and Land Package	19%	$521,428	$99,071
			$465,538

Table. 2 Percentage of property types advertised for 6 Star Homes

ABS Study



- Modelling the relationship of energy efficiency attributes to the house price: the case of detached houses sold in the Australian Capital Territory in 2005 and 2006

- "The ACT housing market ... places a higher value on energy efficiency ... (ABS) found that a statistically significant relationship does exist."

"As a professional working in the real estate industry, it has become evident to me that the prospective property purchaser has become more aware of the importance of energy efficient housing.
Gone are the days when a prospective home owner budgets for kitchen and bathroom renovations, now basic energy efficient improvements like light fitting and insulation are considered must do's before moving into a new property.
I feel this reflects a change in Australian society on the whole, where the plight of the climate becomes more of an influence in people's every day living".

Johnathan Davis, Real Estate Agent

Commercial Building Disclosure Legislation

CBD Important Dates

July 2010	Act commences – no disclosure obligation
1 November 2010	Implementation date – disclosure obligation commences for affected offices offered for sale, lease or sublease
	Transition period begins – NABERS Energy ratings are to be disclosed
mid-2011	BEECs can be obtained
31 October 2011	Transition period ends
1 November 2011	Full BEECs are to be disclosed from this date onwards

The End