

A New Annual Energy Performance Star Rating for Windows



www.trendwindows.com.au

NFRC Nashville

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A New Annual Energy Performance Star Rating for Windows

Client:

**Australian Window
Association, Inc.**

Principal Contractor:

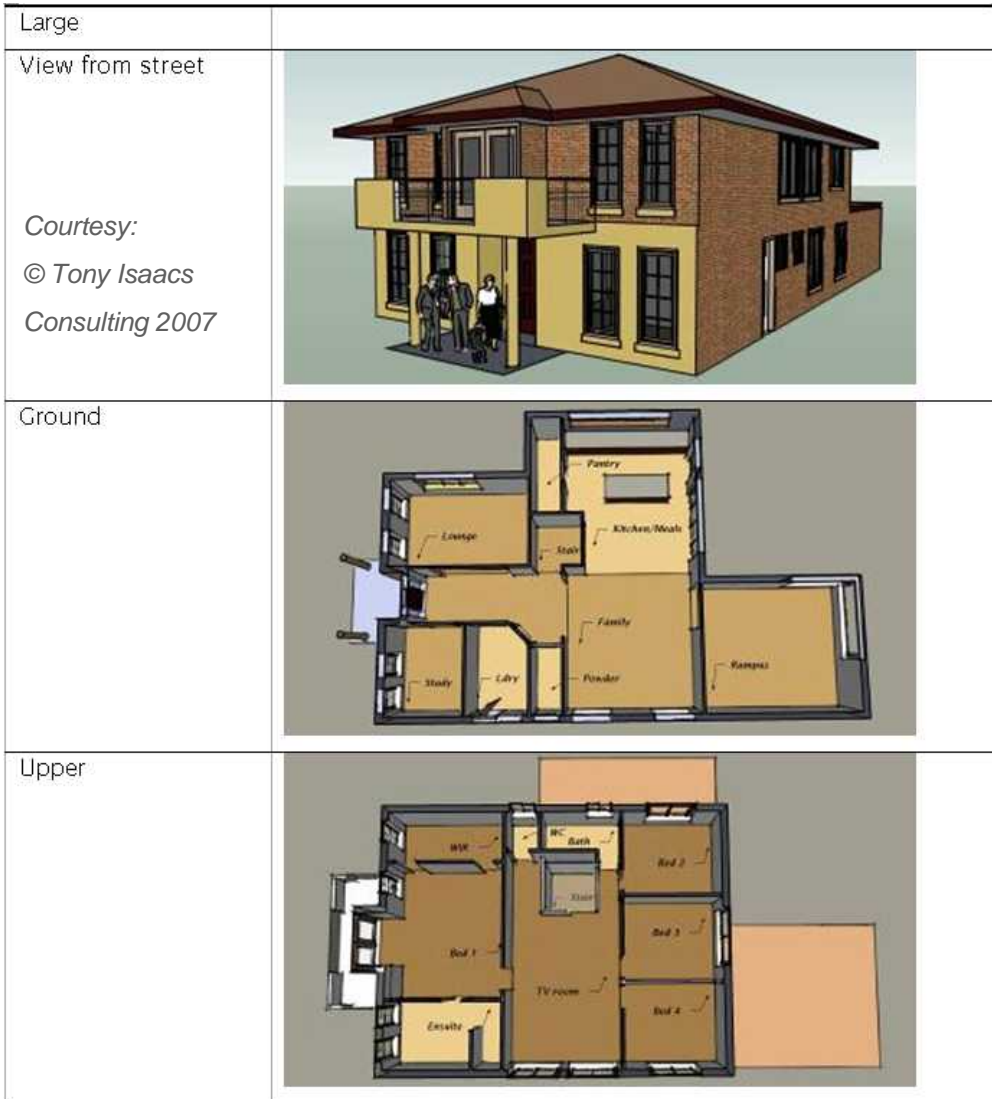
Peter Lyons

Collaboration and Peer Review:

***PC Thomas
Angelo Delsante
Ian Bennie***

U-factor / SHGC trade-offs

Completely different windows – same outcome
 E.g. Adelaide, 2-story house
 (237m² / 2550 ft² NCFA)



Large
 View from street
 Courtesy:
 © Tony Isaacs
 Consulting 2007

Ground

Upper

| <i>U-factor</i> SI (I-P) | <i>SHGC</i> | <i>Annual Heating Energy</i> (MJ/m ² .a) |
|-----------------------------|-------------|--|
| 4.1 (0.72) | 0.61 | 55 |
| 2.0 (0.35) | 0.17 | 56 |
| <i>U-factor</i> | <i>SHGC</i> | <i>Annual Cooling Energy</i> (MJ/m ² .a) |
| 6.4 (1.1) | 0.49 | 84 |
| 4.1 (0.72) | 0.61 | 83 |

Other houses also modelled

Start with 15 real windows modelled at standard NFRC 100-2002 conditions

Table 1. Matrix of windows used in AEP simulations. Windows ordered by decreasing U-value. All windows are 2-lite standard NFRC size, 1200 (h) x 1500 (w). All frames modelled using THERM5, all glazing units modelled using WINDOW5 at NFRC 100-2001 conditions.

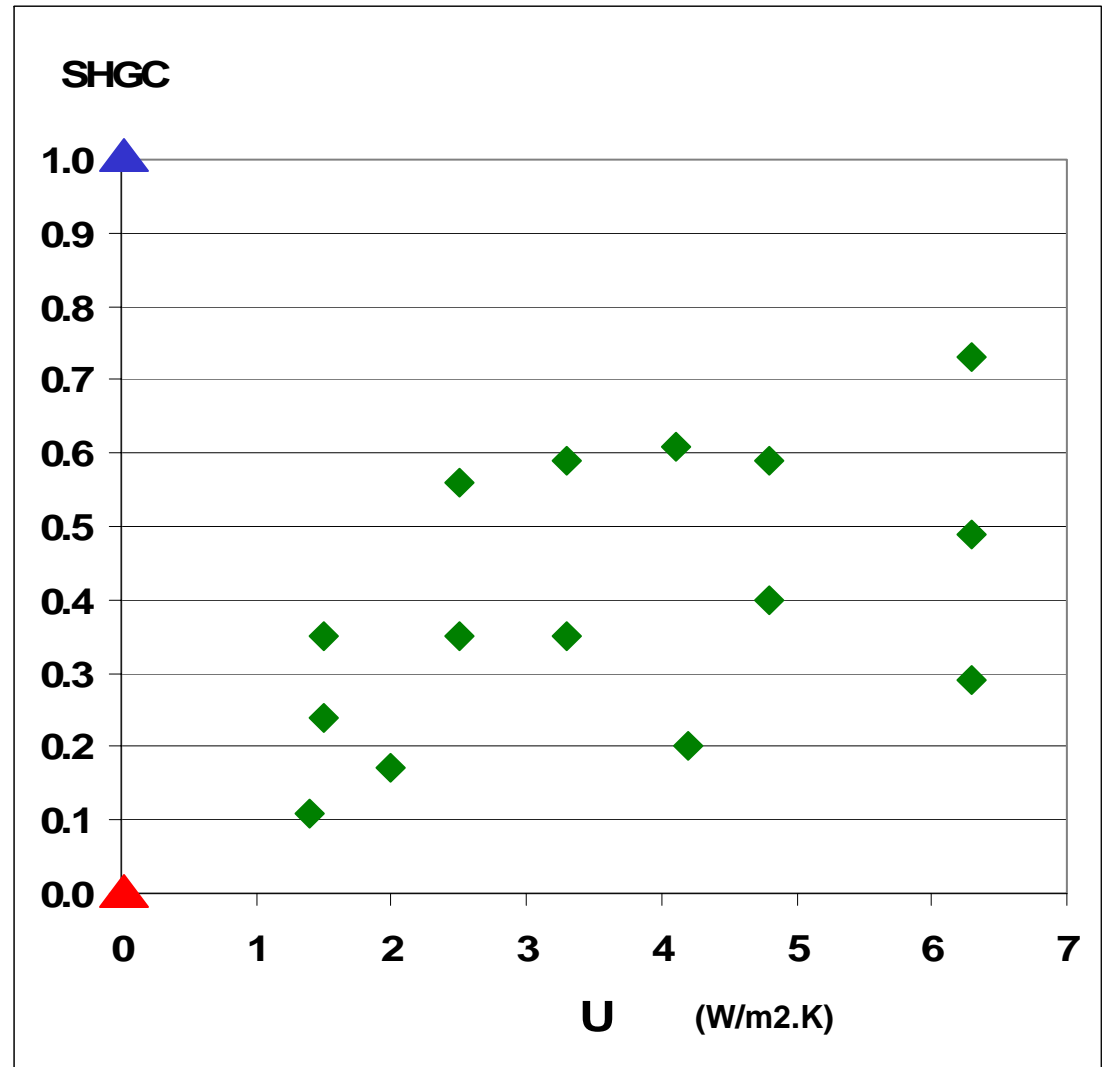
Key: e = emissivity, LE = low-e, # = surface with low-e coating (numbered from outside going in), SS = spectrally selective

| System # | Frame / glazing description | (W/m ² .K) | |
|----------|--|-----------------------|-------------------|
| | | U _w | SHGC _w |
| 1 | Thermally unbroken aluminium slider - 4mm solar control blue-green tint, type 1 | 6.3 | 0.29 |
| 2 | Thermally unbroken aluminium slider - 4mm solar control blue-green tint, type 2 | 6.3 | 0.49 |
| 3 | Thermally unbroken aluminium slider - 4mm clear | 6.3 | 0.73 |
| 4 | Cedar slider - 4mm clear | 4.8 | 0.59 |
| 5 | Cedar slider - 5mm high-perf. green | 4.8 | 0.40 |
| 6 | Cedar slider - 6mm reflective #2 | 4.2 | 0.20 |
| 7 | Thermally unbroken aluminium slider - 5/6/5 clear, argon | 4.1 | 0.61 |
| 8 | Thermally broken aluminium awning - 4/10/4 clear, air | 3.3 | 0.59 |
| 9 | Cedar slider - 6.38mm LE green, e=0.157, #2 | 3.3 | 0.35 |
| 10 | Thermally broken aluminium awning - 4mm blue/10/high solar gain LE, e=0.155, #3, argon | 2.5 | 0.35 |
| 11 | Thermally broken aluminium awning - 4/10/4 high solar gain LE, e=0.155, #3, argon | 2.5 | 0.56 |
| 12 | Cedar slider - 4/8Ar/4SSLE, e=0.024, #2 | 2.0 | 0.17 |
| 13 | uPVC slider - 4EnAdv/6Kr/HM88/6Kr/4, e=0.155 #2, 0.122 #4 | 1.5 | 0.35 |
| 14 | Cedar slider - 4/6Kr/HM88/6Kr/4, e=0.035 #2, 0.122 #4 | 1.5 | 0.24 |
| 15 | uPVC slider - 4/6Kr/HM55/6Kr/4, e=0.024 #2, 0.034 #4 | 1.4 | 0.11 |

(Continued) 15 real windows modelled at standard NFRC 100-2002 conditions

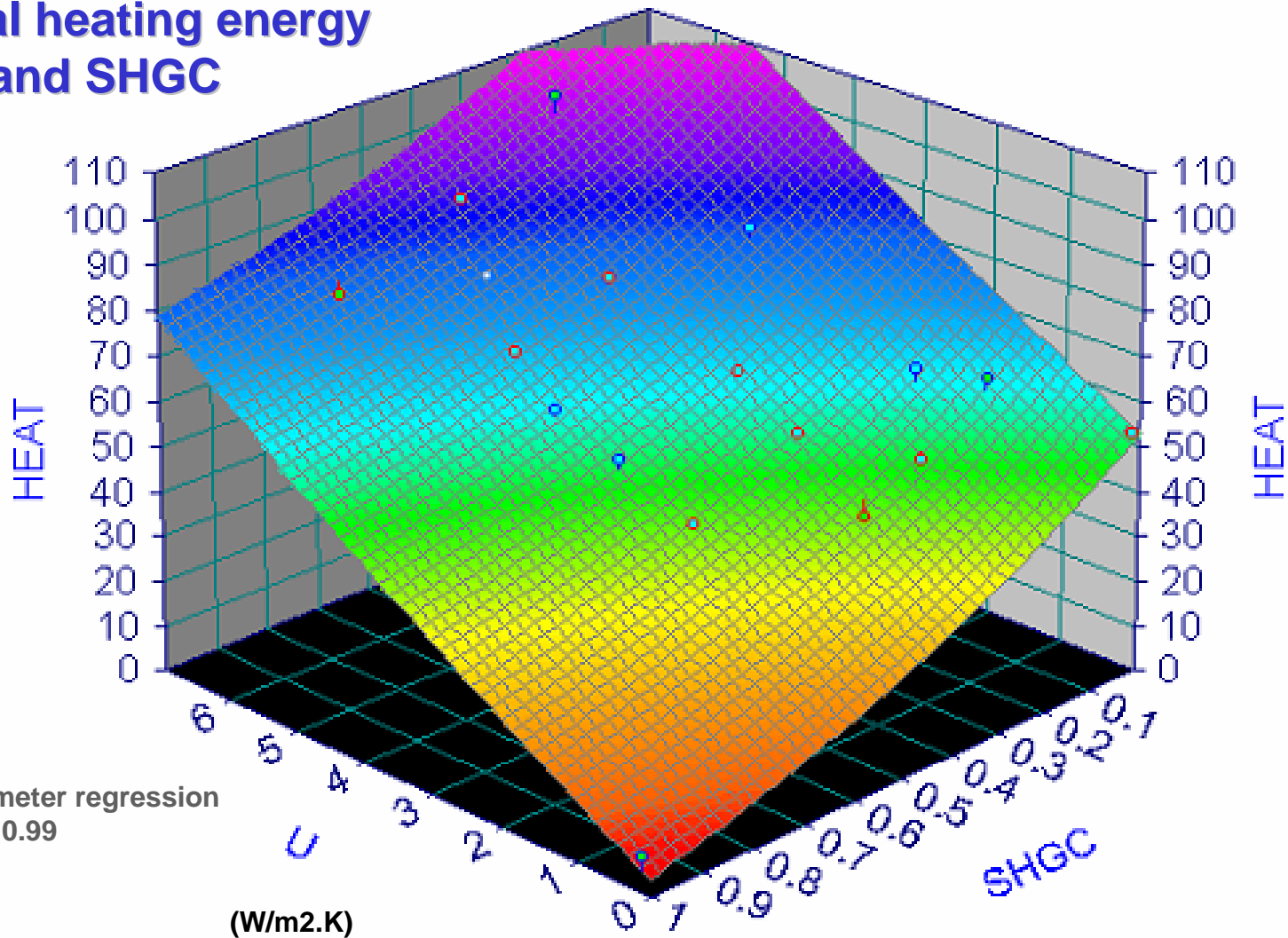
plus a 'perfect heating
window'
(Window 16)

plus a 'perfect cooling
window'
(Window 17)



Run all 17 windows in AccuRate using reference house in wide range of climates

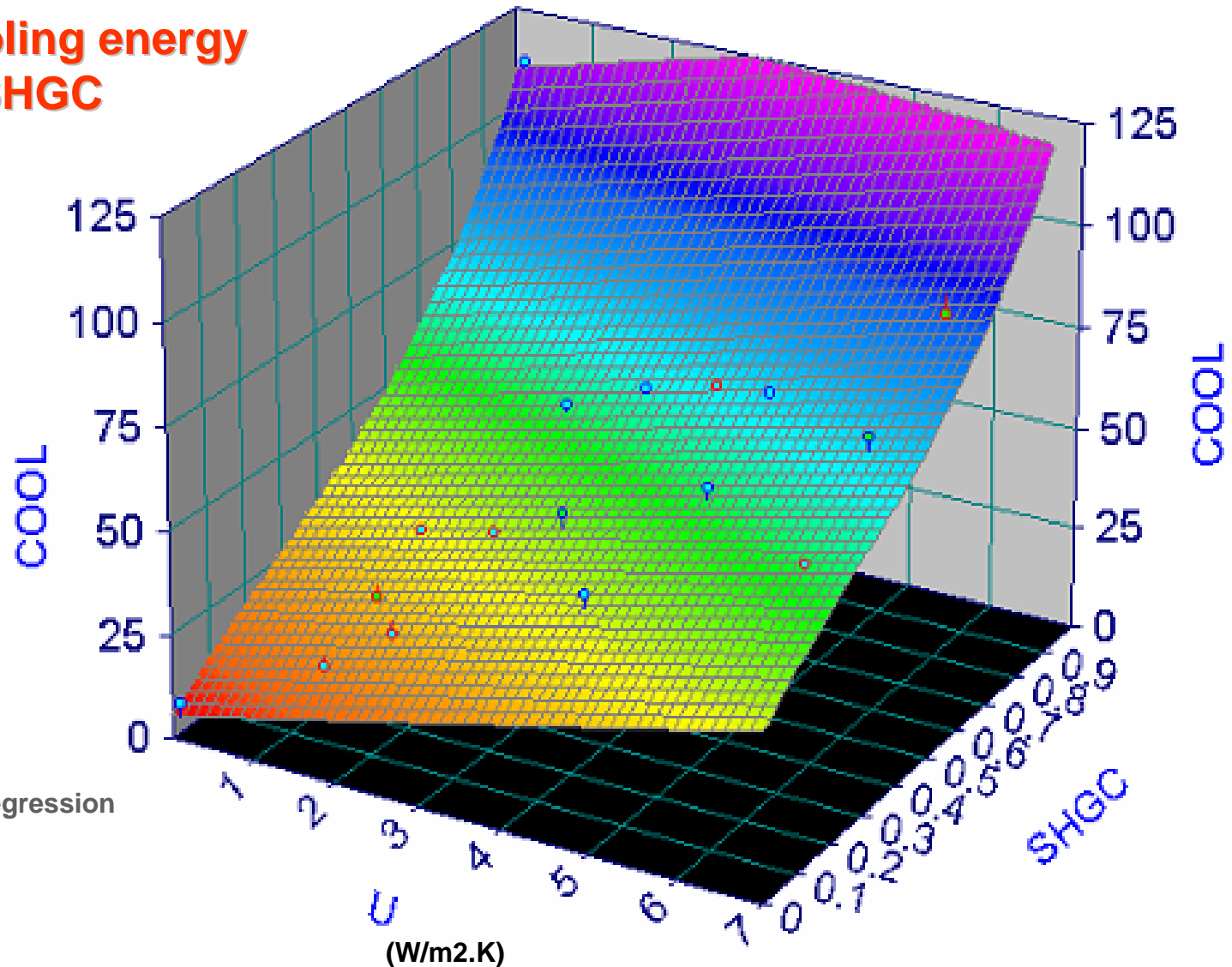
Annual heating energy vs. U and SHGC



Simple 4-parameter regression equation, $R^2 = 0.99$

Run all 17 windows in AccuRate using reference house in wide range of climates

Annual cooling energy vs. U and SHGC



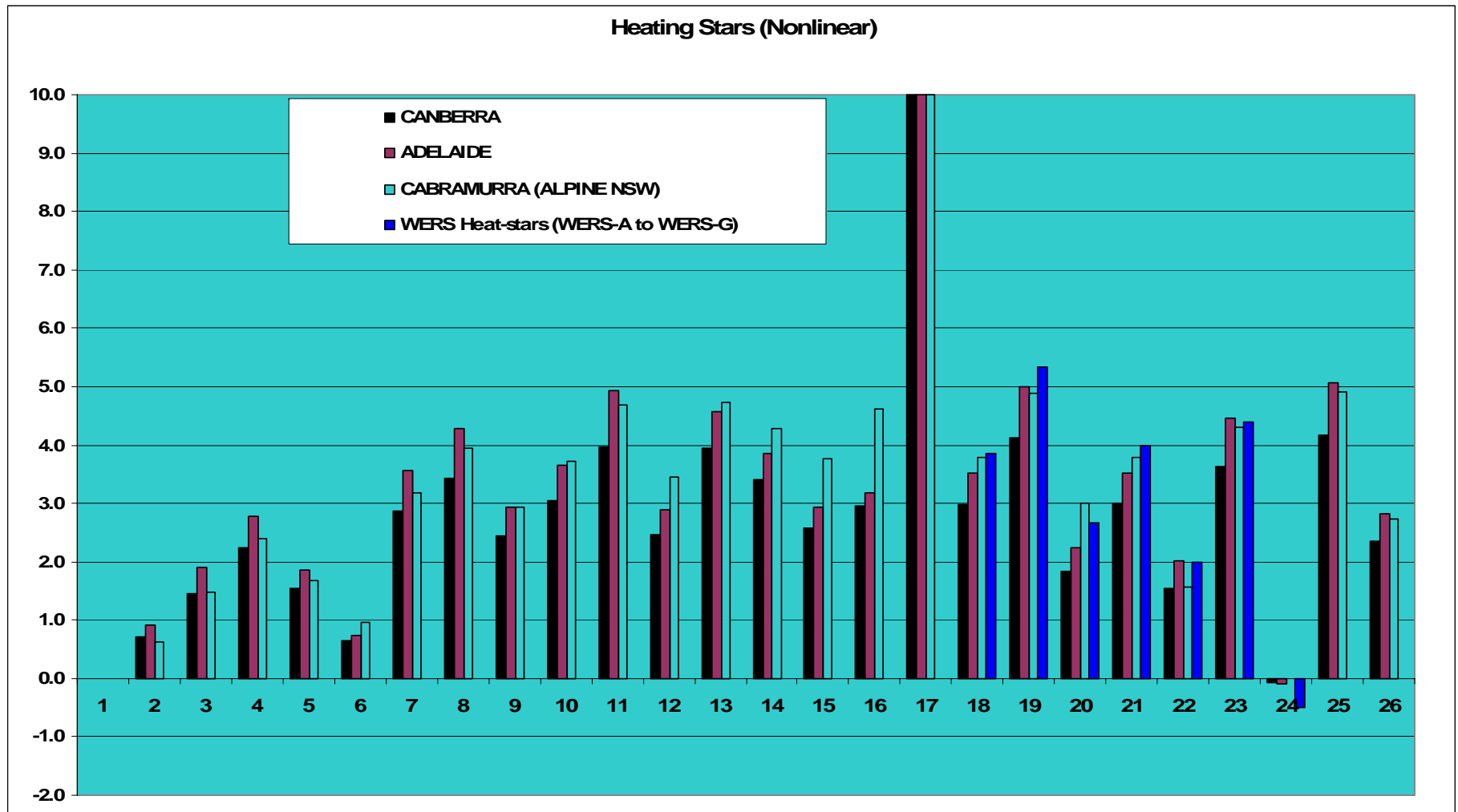
Simple 4-parameter regression equation, $R^2 = 0.99$

Examples of possible future very high-performance products that would not force the re-scaling of existing ratings: *futureproof*

| | U-factor SI (I-P) | SHGC | NEW Heating Stars | NEW Cooling Stars | % Heating Improv. | % Cooling Improv. |
|-----------------------|-------------------------|------|-------------------------|-------------------------|-------------------------|-------------------------|
| <i>Super 1</i> | 1.1 (0.19) | 0.70 | 7.3 | 1.9 | 80 | 39 |
| <i>Super 2</i> | 1.5 (0.26) | 0.10 | 3.4 | 7.0 | 43 | 84 |
| <i>Super 3</i> | 1.0 (0.18) | 0.30 | 5.2 | 5.2 | 61 | 72 |

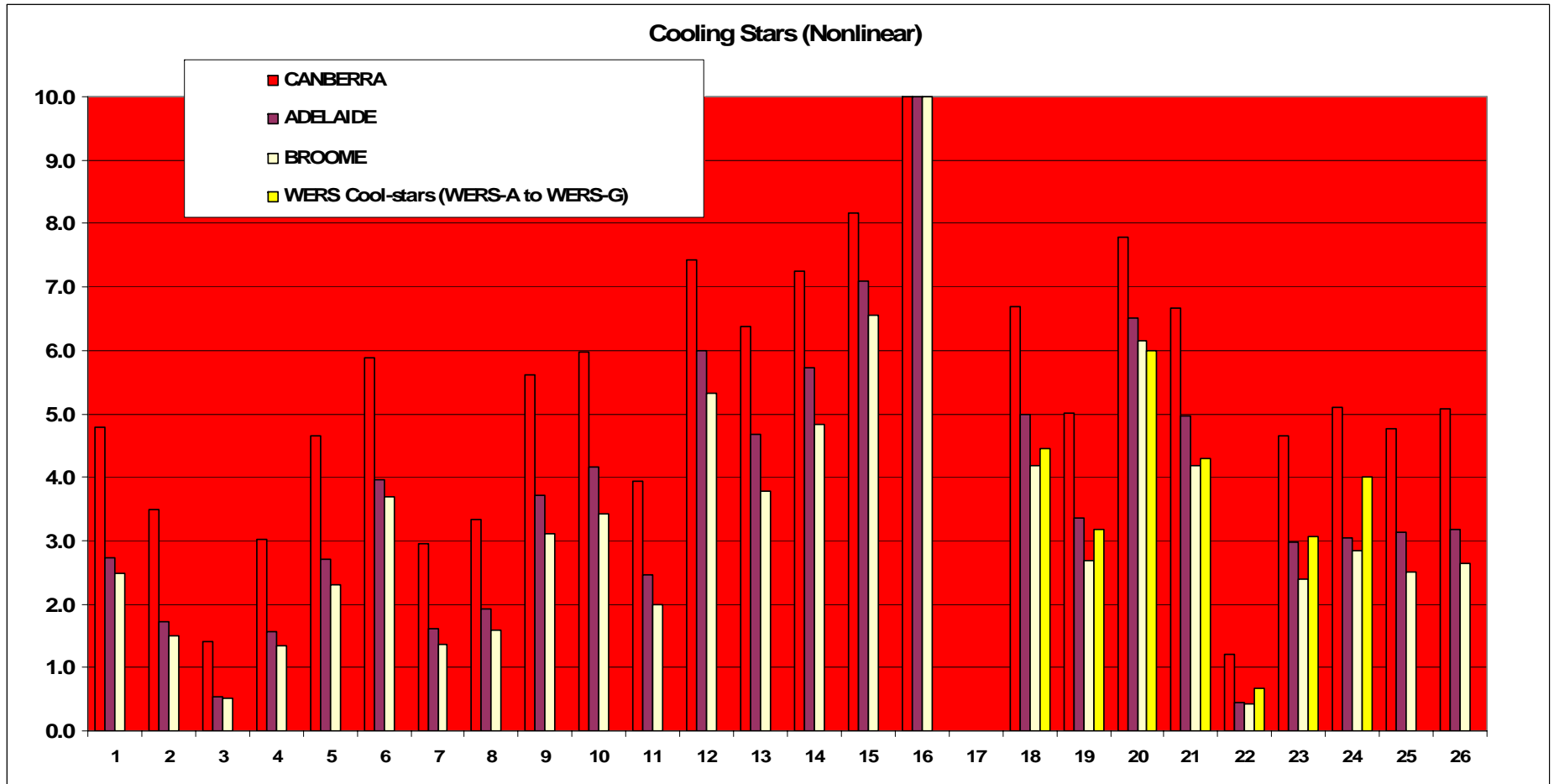
Consistent heating star ratings by orientation and climate when outliers discarded (alpine climate)

For all heating climates except alpine: no changes of rank with climate



Consistent cooling star ratings by orientation and climate when outliers discarded (Canberra)

Except for Canberra, no changes of rank with climate



Bringing it all together: U, SHGC and Air Leakage

| Window | U (Wm ² .K) | SHGC | Air Infiltration (L/s.m ²) | ADELAIDE | | | |
|---------------|---------------------------|-------------|--|-------------------|-------------------|---------------------|---------------------|
| | | | | AEP Heat Stars | AEP Cool Stars | AEP % Impr. Heat | AEP % Impr. Cool |
| WERS-A | 2.1 | 0.27 | 1.30 | 3.8 | 4.7 | 47% | 69% |
| WERS-B | 1.9 | 0.48 | 0.66 | 5.2 | 3.2 | 61% | 55% |
| WERS-C | 2.2 | 0.10 | 1.40 | 2.6 | 6.4 | 34% | 81% |
| WERS-D | 2.1 | 0.28 | 0.85 | 3.9 | 4.7 | 48% | 68% |
| WERS-E | 6.3 | 0.75 | 2.40 | 1.5 | 0.2 | 20% | 7% |
| WERS-F | 2.5 | 0.49 | 5.00 | 4.2 | 2.8 | 51% | 50% |

Thank you!