

3M Renewable Energy Division

Managing Heat Transfer through Glazing

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Powering
the Future

Energy Savings in Residential Sector



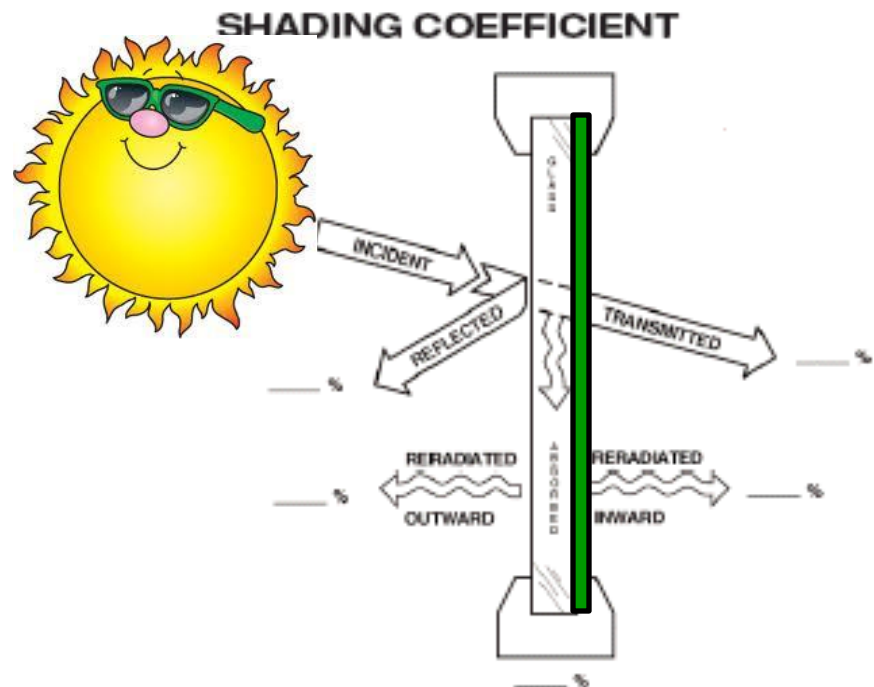
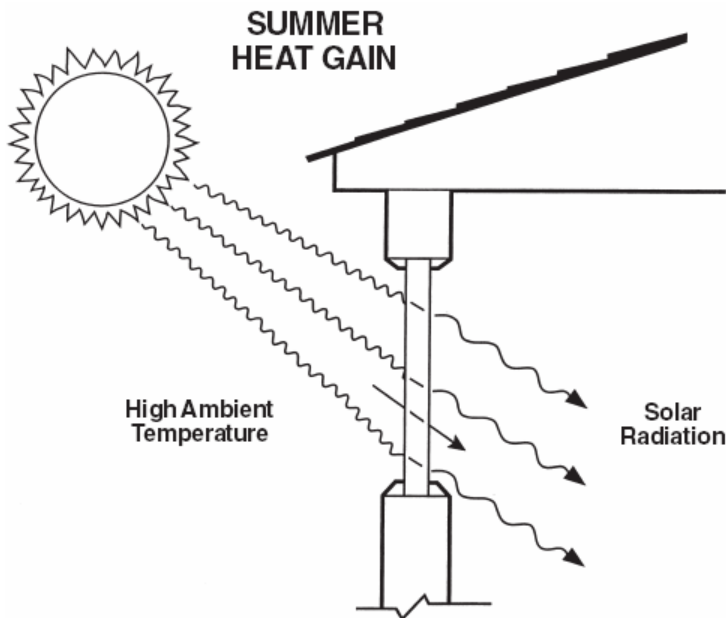
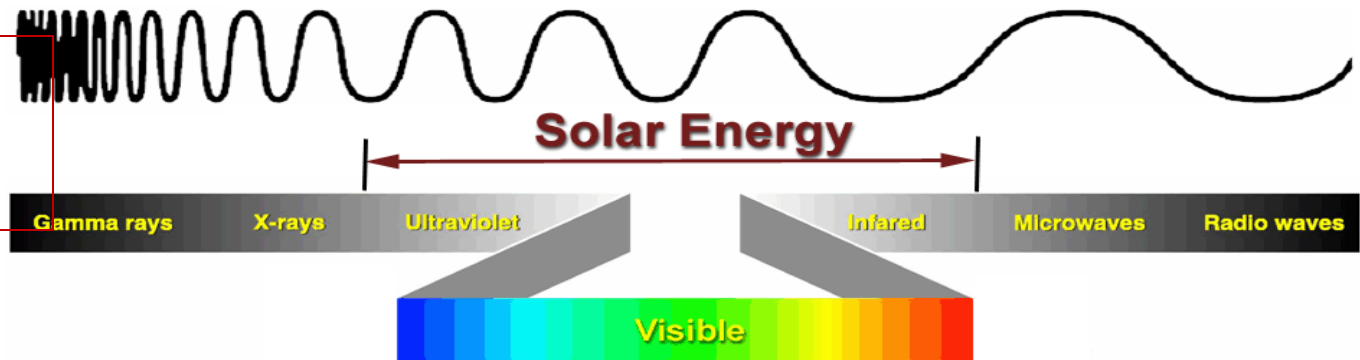
What is this presentation about?

- Retrofitting for *Existing Residential* Houses

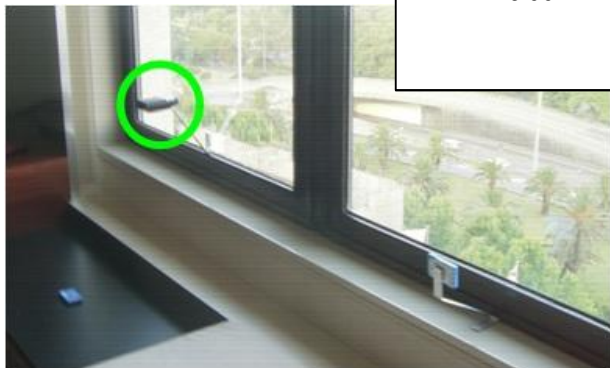
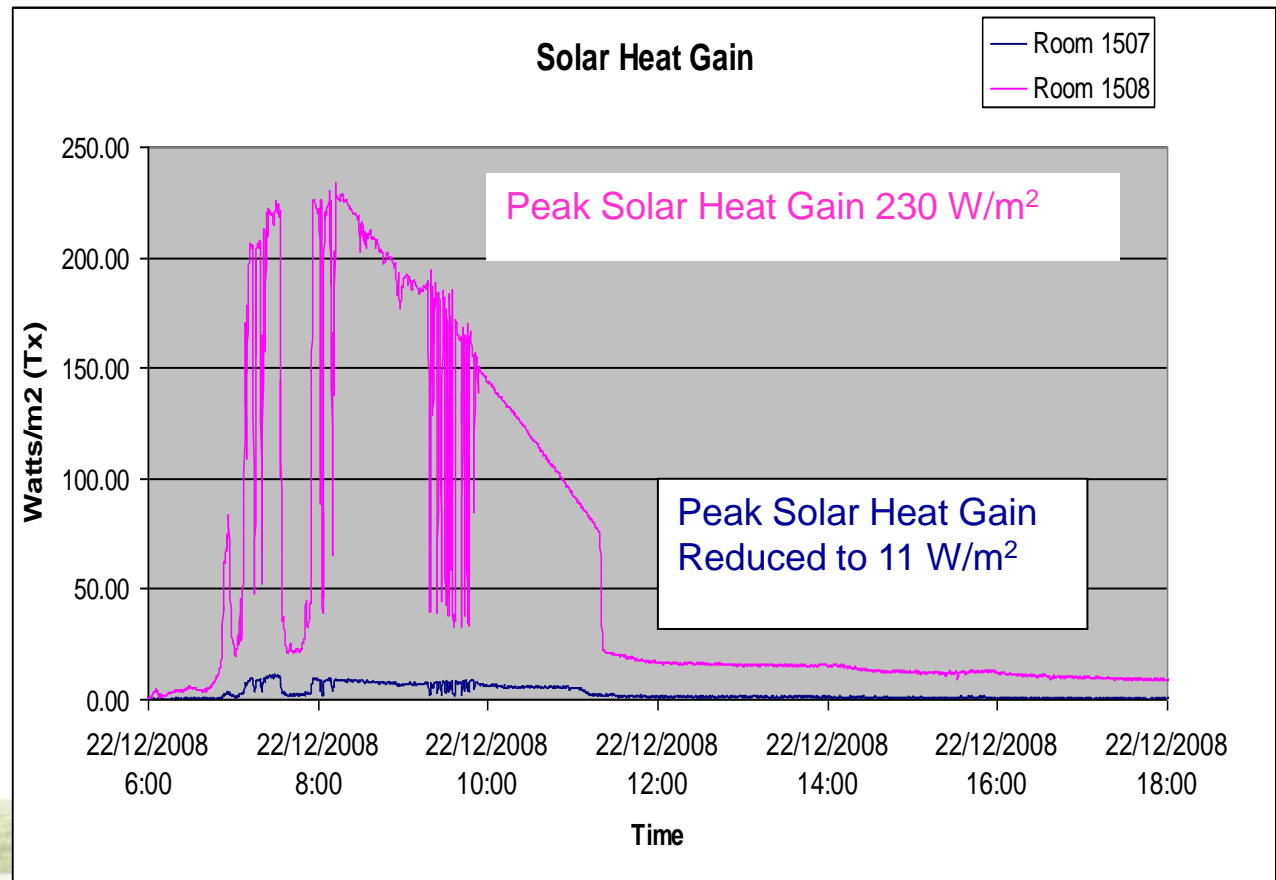


Can Window Film Help?

3% ultra violet
44% visible
53% infra red



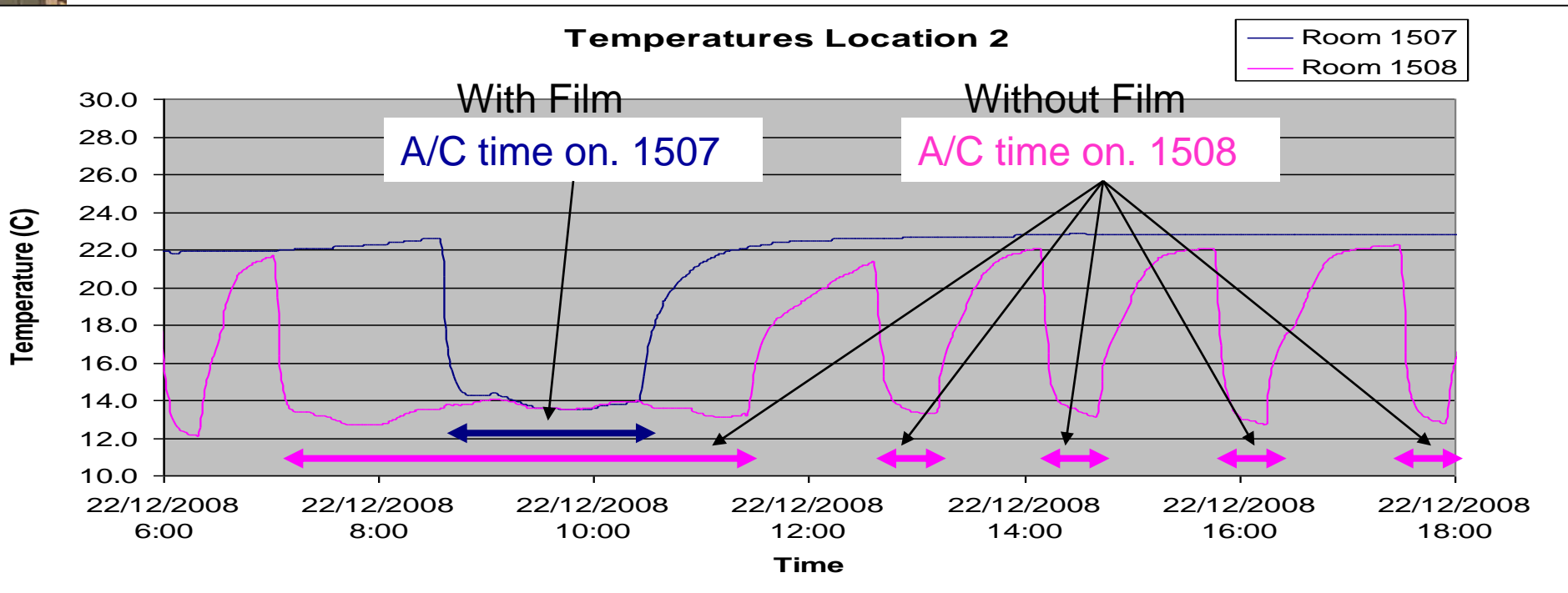
Peak Solar Heat Gain Reduction in Hotel Room



Temperature at HVAC Air Supply



- This graph indicates A/C activity 6am to 6pm on 22nd Dec 2008
- A/C active for **7hrs** in room 1508 **without film**
- A/C active for **2hrs** in room 1507 **with film**



From Commercial to Residential



Computer Modeling for Residential Houses

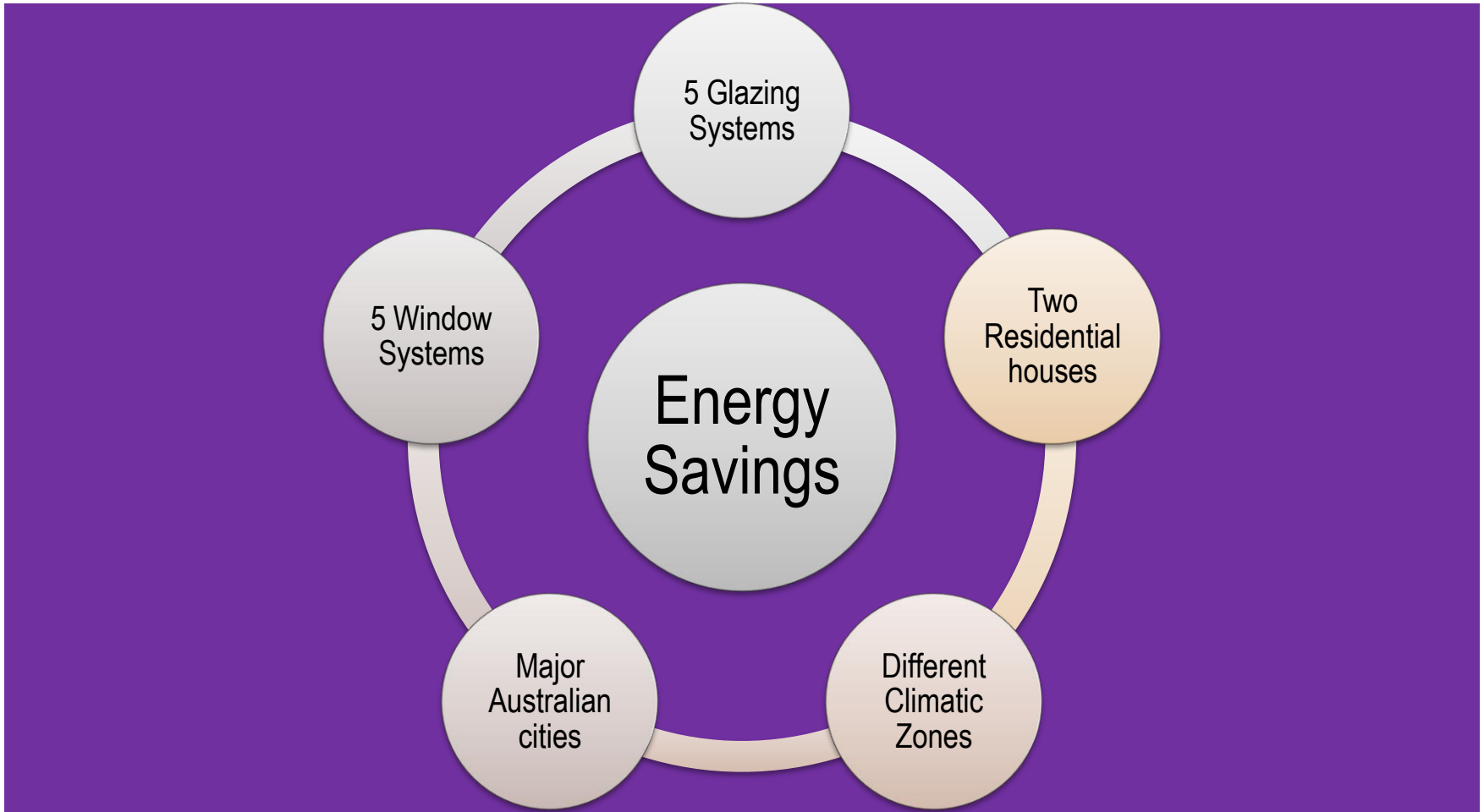


AccuRate Software

- Residential house energy rating software used in Australia
- Developed by CSIRO
- Calculates hourly **heating** and **cooling requirements** over a period of one year
- Houses are assumed to be occupied all the time
- Automatically switched between AC and natural ventilation when occupants thermal comfort is satisfied



AccuRate Modeling Inputs



AccuRate - Residential house energy rating software used in Australia



5 Glazing and Window System

Glazing System	U_c [W/m ² .K]	SHGC _c
PPG 4mm Clear	5.881	0.85
Affinity 15	5.730	0.20
Amber LowE 35	4.340	0.24
Ceramic 50	5.961	0.54
Night Vision 25	5.745	0.40
Prestige 40	5.694	0.41

Window Frame	Window Type
Timber	Fixed



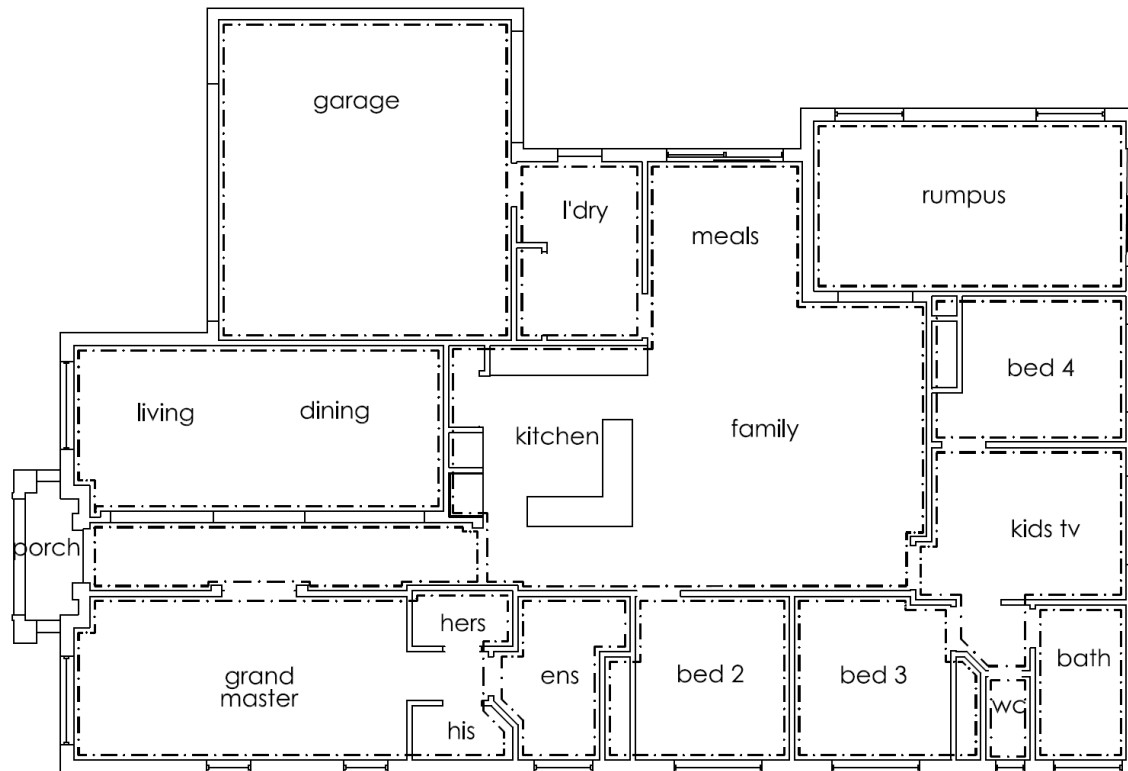
Window Films used in Glazing

	Affinity	Night Vision	Ceramic	Prestige	Low E
IR Heat Rejection	Excellent	Very good	Moderate	Very good	Excellent
Reflectivity	High	Moderate	Low	Very Low	High
Aesthetic Appeal	Good	Good	Very Good	Excellent	Good
Clarity	Moderate	Moderate	Excellent	Excellent	Moderate
Technology	Metallic	Metallic + Nano-tech	Nano-Ceramics	Multi-layer optical Films + Nano-tech	Metallic Low E



Residential House No. 4

House	Type	Wall Type	Storey	Beds	Net Floor Area [m ²]	Window/ Floor ratio	Window Frames
4	House	Cavity Brick	1	4	263	0.15	Timber



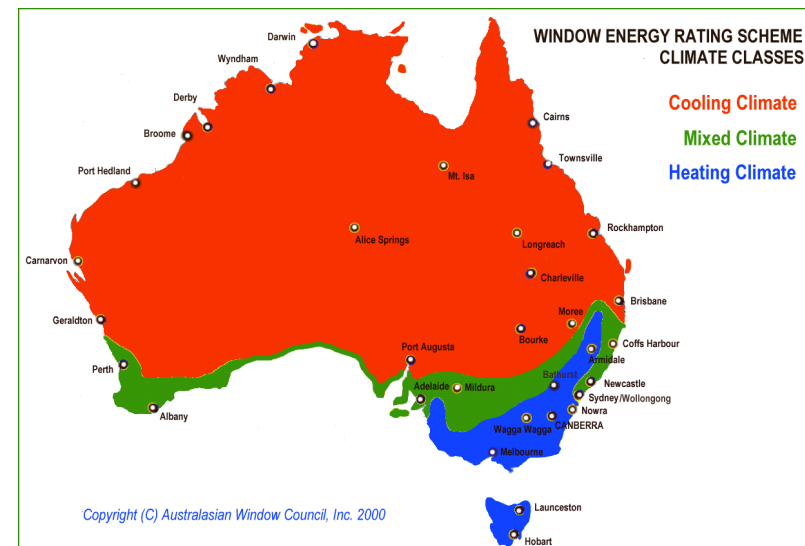
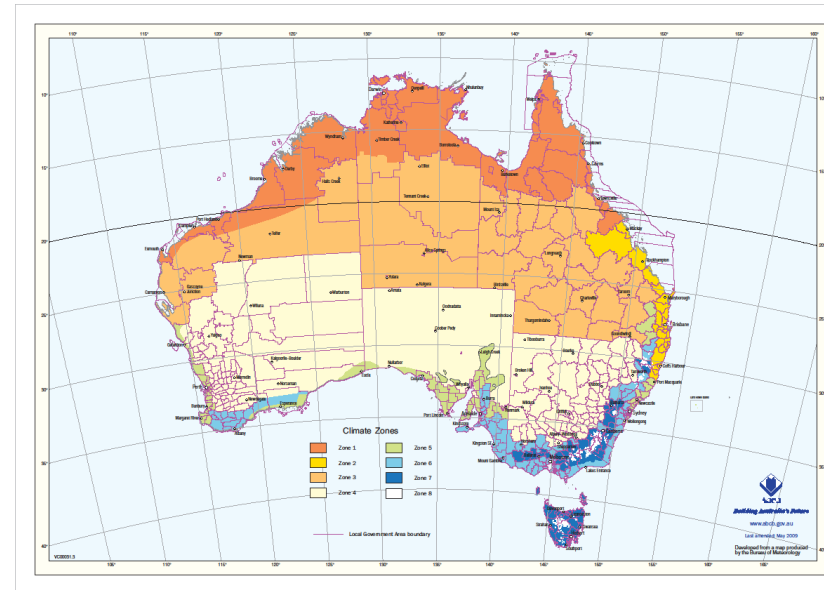
Accreditation Residential Houses

- NatHERS accreditation houses
- Modeled at N, E, S, and W orientations

House No.	Window Direction	Window Area [m ²]
4	East	10.8
	South	12.6
	West	6.5
	North	10.6
9	East	7.8
	South	9.0
	West	4.4
	North	0.0

Cities and Climatic Zones

City	Climatic Zone	Predominant Class
Darwin NT	1	Cooling
Brisbane QLD	2	Cooling
Sydney NSW	5	Mixed
Perth WA	5	Mixed
Adelaide SA	5	Mixed
Melbourne VIC	6	Heating
Hobart TAS	7	Heating
Canberra ACT	7	Heating





Average Temperatures



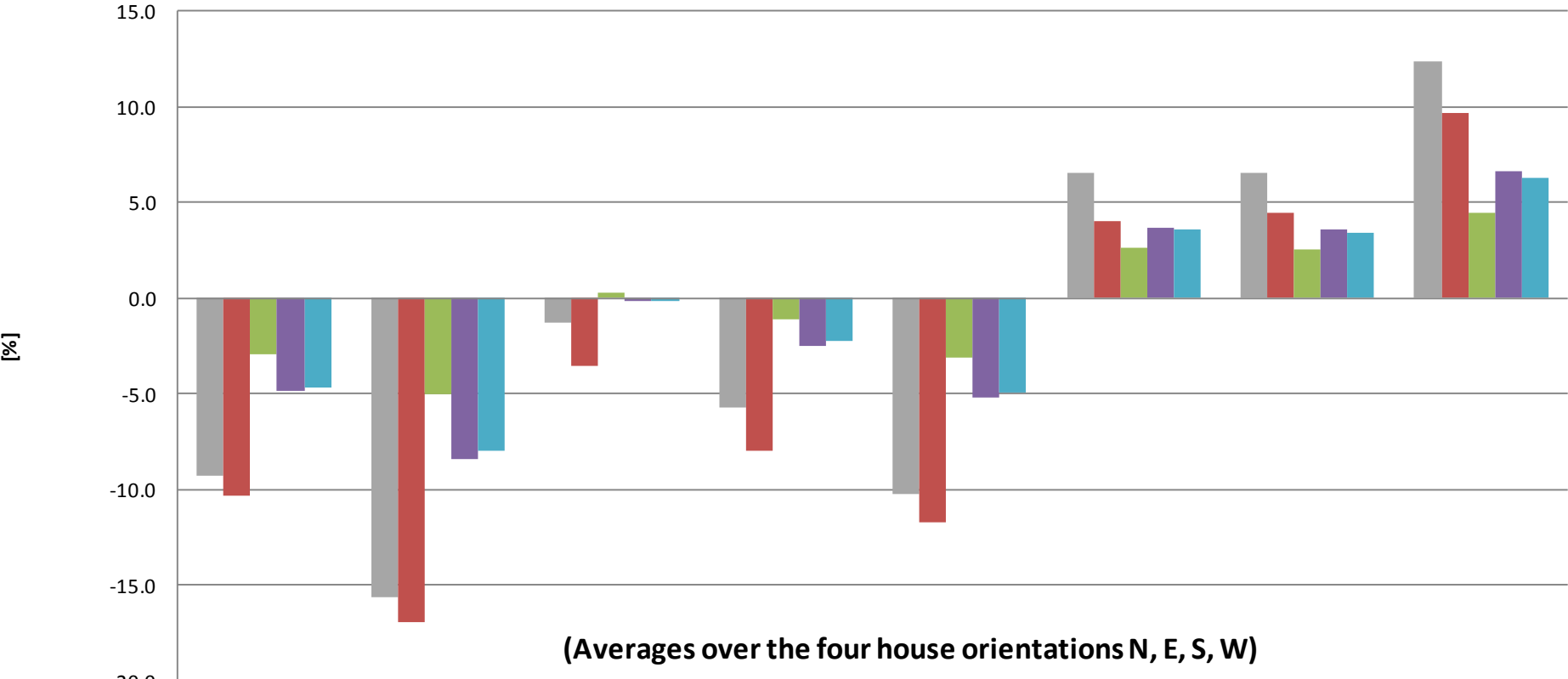
	Maximum [°C]	Minimum [°C]
Darwin	32.1	23.4
Brisbane	25.3	15.7
Sydney	22.3	14.4
Perth	24.5	12.5
Adelaide	22.1	12.1
Melbourne	20.1	11.2
Hobart	17.1	8.8
Canberra	19.7	6.7

***1301.0 - Year Book Australia, 2012**



Mostly East & West film installation

Annual Energy Consumption Difference for House 4 (Compared with the Clear Glass)

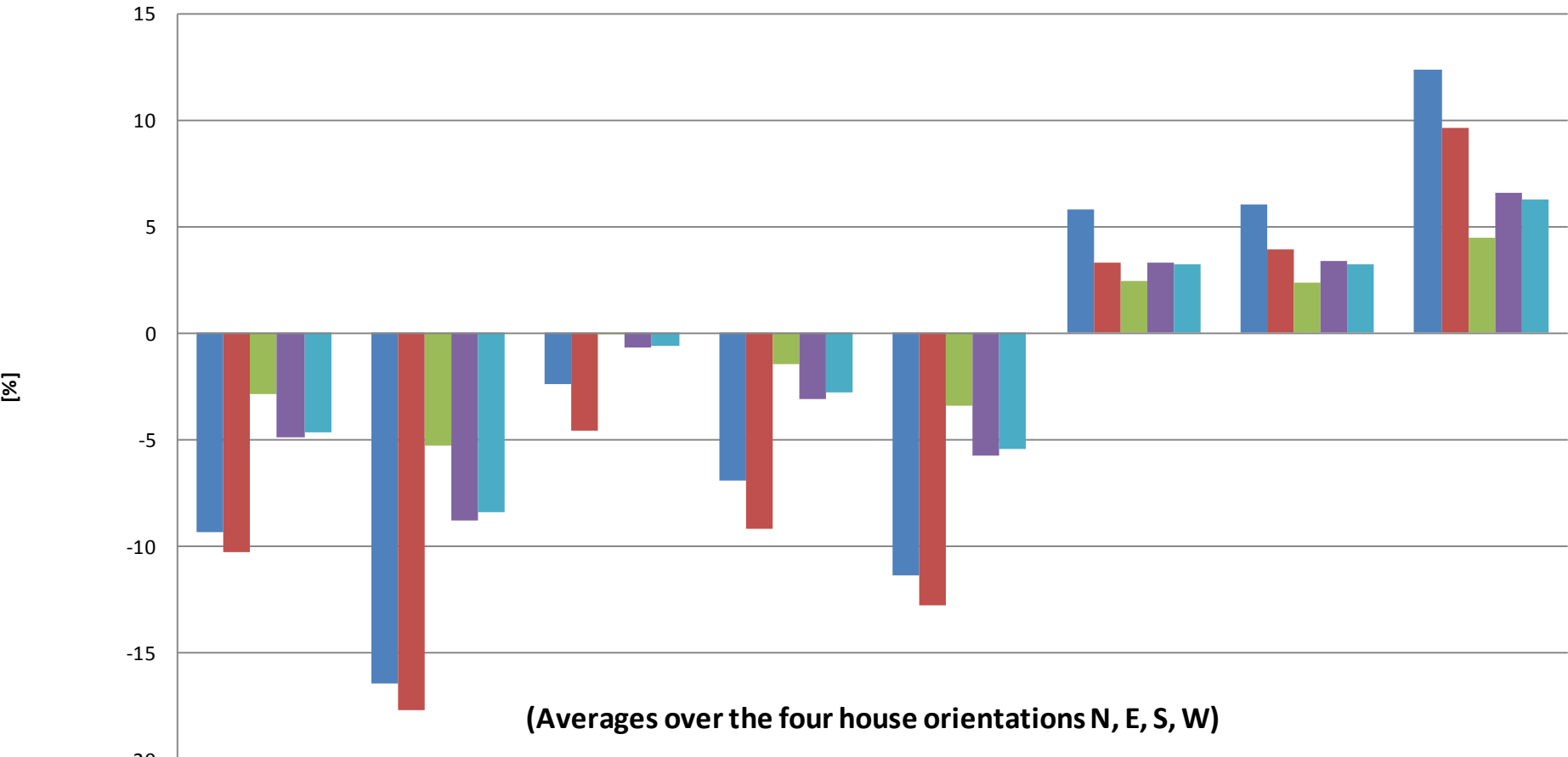


(Averages over the four house orientations N, E, S, W)

	Darwin	Brisbane	Adelaide	Perth	Sydney	Melbourne	Canberra	Hobart
Affinity 15	-9.3	-15.6	-1.3	-5.7	-10.2	6.5	6.5	12.4
Amber LowE 35	-10.3	-16.9	-3.5	-8.0	-11.7	4.0	4.5	9.7
Ceramic 50	-2.9	-5.0	0.3	-1.1	-3.1	2.7	2.5	4.5
Night Vision 25	-4.9	-8.4	-0.1	-2.5	-5.2	3.7	3.6	6.6
Prestige 40	-4.7	-8.0	-0.1	-2.2	-4.9	3.6	3.4	6.3

Mostly East & West film installation

% Annual Gas Heating and RCAC Cost Savings

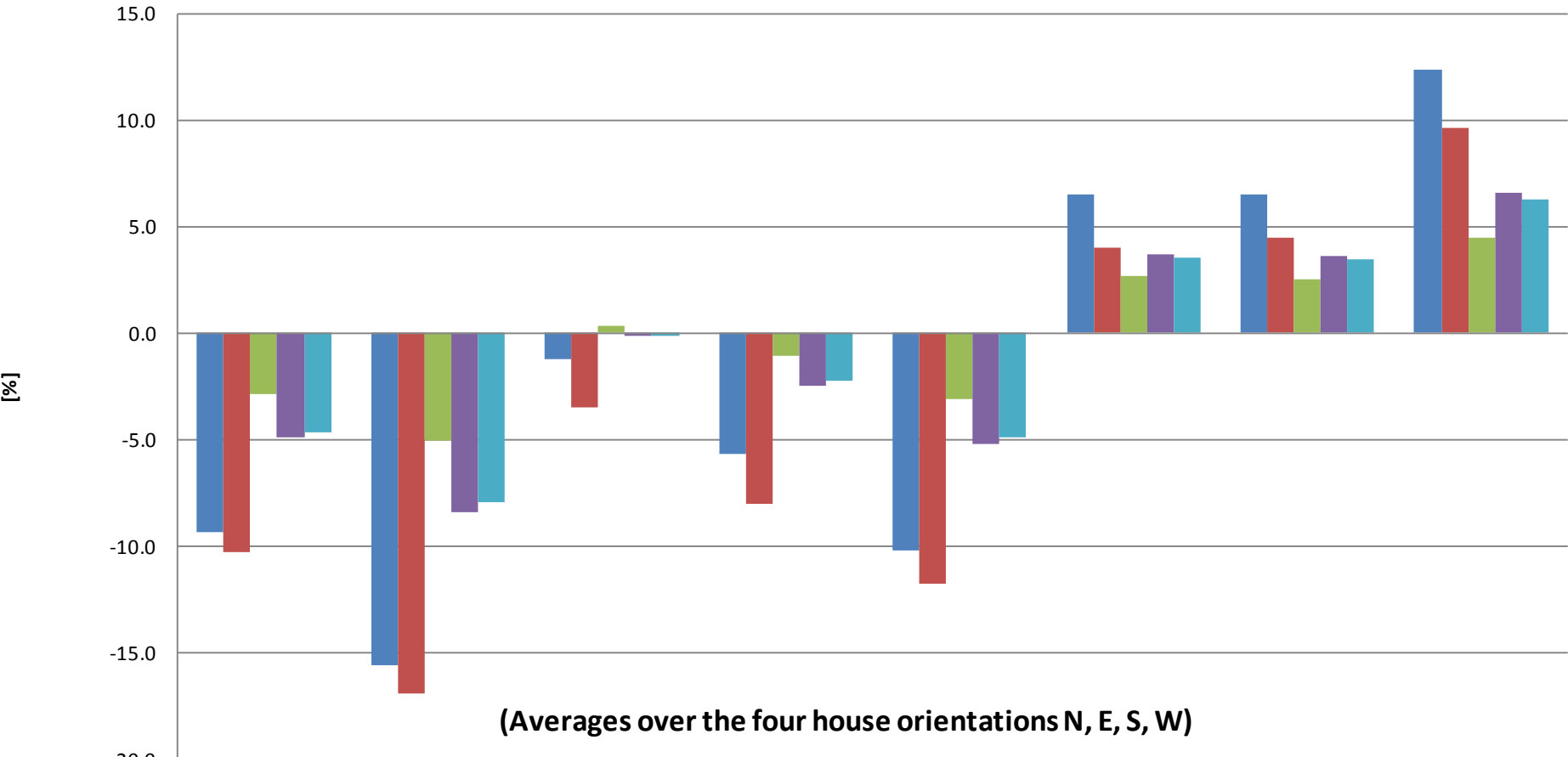


(Averages over the four house orientations N, E, S, W)

	Darwin	Brisbane	Adelaide	Perth	Sydney	Melbourne	Canberra	Hobart
Affinity 15	-9	-16	-2	-7	-11	6	6	12
Amber LowE 35	-10	-18	-5	-9	-13	3	4	10
Ceramic 50	-3	-5	0	-1	-3	2	2	4
Night Vision 25	-5	-9	-1	-3	-6	3	3	7
Prestige 40	-5	-8	-1	-3	-5	3	3	6

Mostly East & West film installation

% Annual RCAC Heating and RCAC Cost Savings

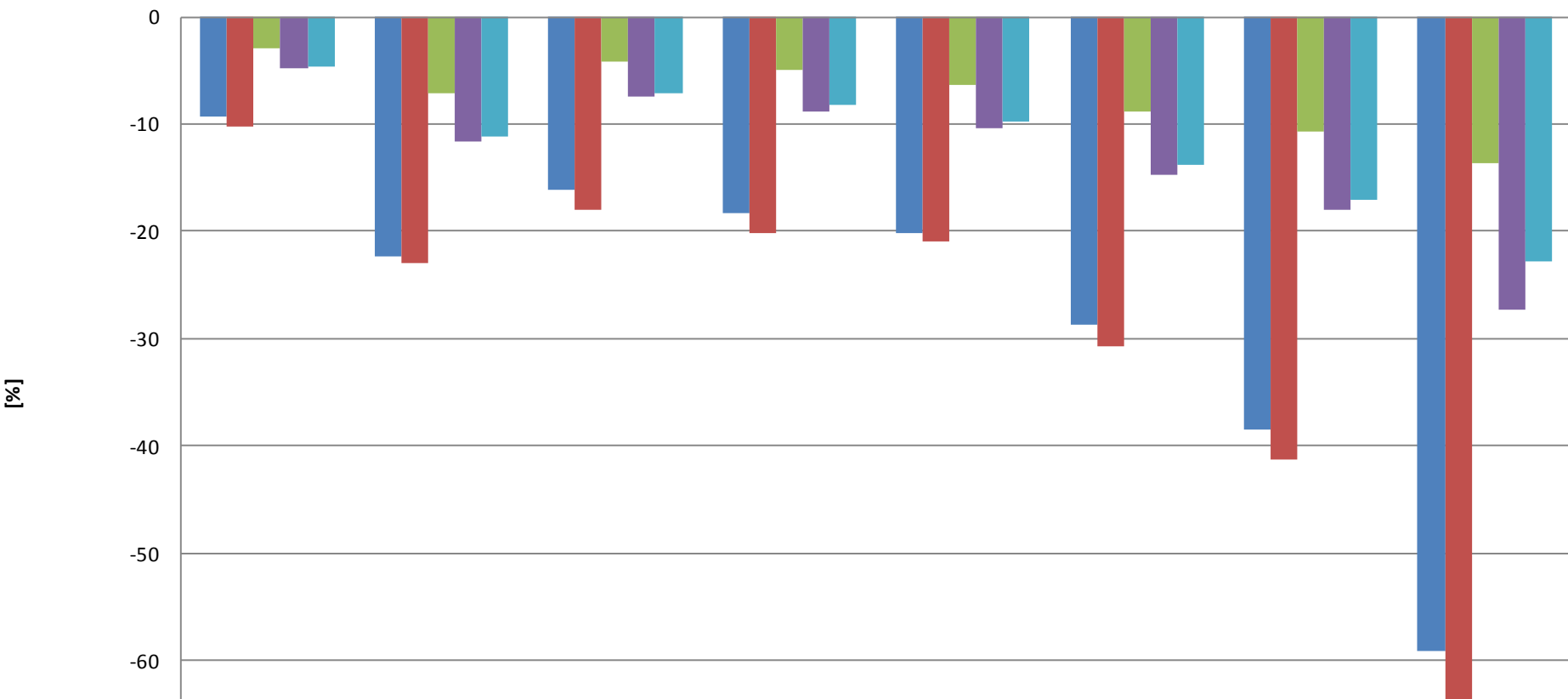


(Averages over the four house orientations N, E, S, W)

	Darwin	Brisbane	Adelaide	Perth	Sydney	Melbourne	Canberra	Hobart
Affinity 15	-9.3	-15.6	-1.3	-5.7	-10.2	6.5	6.5	12.4
Amber LowE 35	-10.3	-16.9	-3.5	-8.0	-11.7	4.0	4.5	9.7
Ceramic 50	-2.9	-5.0	0.3	-1.1	-3.1	2.7	2.5	4.5
Night Vision 25	-4.9	-8.4	-0.1	-2.5	-5.2	3.7	3.6	6.6
Prestige 40	-4.7	-8.0	-0.1	-2.2	-4.9	3.6	3.4	6.3

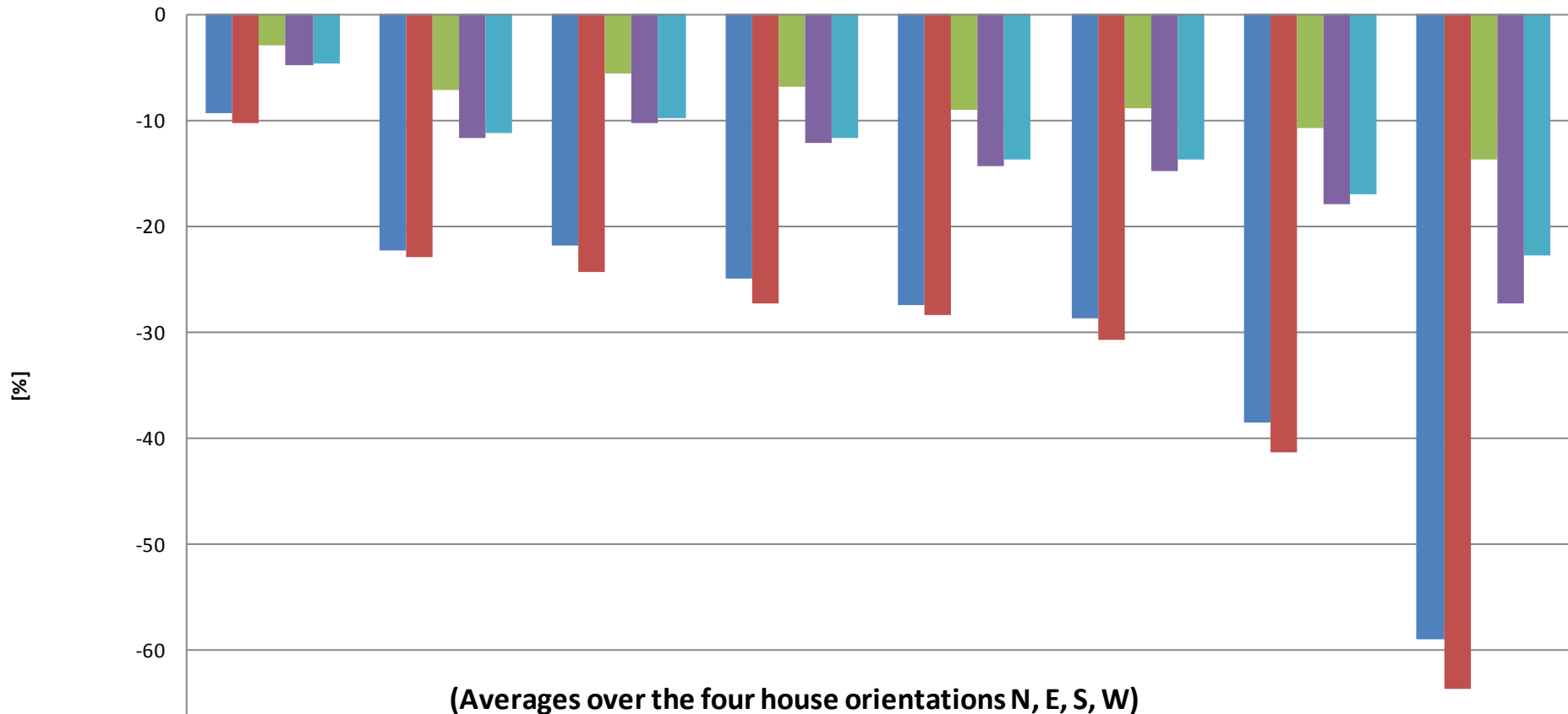
Mostly East & West film installation

% Cooling Cost Savings (East and West film installation)



(Averages over the four house orientations N, E, S, W)

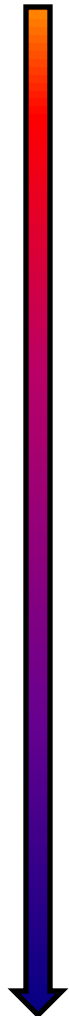
	Darwin 3D	Brisbane 3D	Adelaide 2D	Perth 2D	Sydney 2D	Melbourne 2D	Canberra 2D	Hobart 2D
Affinity 15	-9	-22	-16	-18	-20	-29	-39	-59
Amber LowE 35	-10	-23	-18	-20	-21	-31	-41	-64
Ceramic 50	-3	-7	-4	-5	-6	-9	-11	-14
Night Vision 25	-5	-12	-7	-9	-10	-15	-18	-27
Prestige 40	-5	-11	-7	-8	-10	-14	-17	-23

% Average Cooling Cost Savings (East, North & West film installation)

	Darwin 3D	Brisbane 3D	Adelaide 3D	Perth 3D	Sydney 3D	Melbourne 2D	Canberra 2D	Hobart 2D
Affinity 15	-9	-22	-22	-25	-27	-29	-39	-59
Amber LowE 35	-10	-23	-24	-27	-28	-31	-41	-64
Ceramic 50	-3	-7	-6	-7	-9	-9	-11	-14
Night Vision 25	-5	-12	-10	-12	-14	-15	-18	-27
Prestige 40	-5	-11	-10	-12	-14	-14	-17	-23

Annual Energy Requirements Reduction House 4


	MIN and MAX values	MIN and MAX values
Cooling Zone	Cooling Energy reduction	Total Energy Reduction
Brisbane E, N,W	6 – 25%	4 – 20%
Darwin E, N,W	2.8 – 12%	2.8 – 12%
Cooling and Heating Zone	Cooling Energy reduction	Total Energy Reduction
Sydney E,N,W	8 – 31%	3 – 16%
Sydney E,W	5 – 22%	2 – 14%
Perth E,N,W	6 – 30%	0.5 – 11%
Perth E W	4 – 22%	0.5 – 10%
Adelaide E,N,W	5 – 26%	3.5% max
Adelaide E,W	3 – 19%	5.1% max
Heating Zone	Cooling Energy reduction	Total Energy Reduction
Melbourne E,W	6 – 32%	Peak Demand Reduction
Hobart E,W	14 – 67%	Peak Demand Reduction
Canberra E,W	7 – 43%	Peak Demand Reduction



3M Sun Control Window Film Performance

Performance	Film	Benefits	Limitations
1	LowE 35	<ul style="list-style-type: none"> •Best IR rejection 	<ul style="list-style-type: none"> •High reflectivity •Dark •Will trap heat during summer
2	Affinity 15	<ul style="list-style-type: none"> •Very good IR rejection •Lower internal reflectivity •Low cost – fastest payback 	<ul style="list-style-type: none"> •High exterior reflectivity •Average esthetic appeal
3 - 4	Night Vision 25	<ul style="list-style-type: none"> •Favorite film for residential •Privacy – Low/High reflectivity 	<ul style="list-style-type: none"> •Average IR rejection
3 - 4	Prestige 40	<ul style="list-style-type: none"> •High VLT – natural light •Non-metallic – no corrosion •Low reflectivity – great visual impact 	<ul style="list-style-type: none"> •Average IR rejection •Premium – high cost
5	Ceramic 50	<ul style="list-style-type: none"> •High VLT – natural light •Exceptional clarity •Non-metallic – no corrosion 	<ul style="list-style-type: none"> •Lowest IR rejection •Relatively high cost

Film Recommendations for Specific Climate Zones



Climate Zone	Cooling Energy reduction	Recommended films
Brisbane E, N,W	6 – 25%	Affinity, Night Vision + Prestige
Darwin E, N,W	2.8 – 12%	Affinity, Night Vision + Prestige
Cooling and Heating Zone	Cooling Energy reduction	Total Energy Reduction
Sydney E,N,W	8 – 31%	Affinity, Night Vision + Prestige
Perth E,N,W	6 – 30%	Affinity, Night Vision + Prestige
Adelaide E,N,W	5 – 26%	Affinity, Night Vision + Prestige
Heating Zone	Cooling Energy reduction	Total Energy Reduction
Melbourne E,W	6 – 32%	Ceramic, Prestige, Night Vision
Hobart E,W	14 – 67%	Ceramic, Prestige, Night Vision
Canberra E,W	7 – 43%	Ceramic, Prestige, Night Vision

Conclusions



ENERGY SAVINGS in RESIDENTIAL HOUSES can be achieved by retrofitting the existing glazing with Solar Control Window Films (up to 20%)

In both Warm and Cold climates, Solar Control Window Films can significantly reduce Cooling Requirements during Summer (up to 30%)

*By selecting the Window Films with the best performance in specific climate zones, the Energy Savings for the entire Australian market can be achieved, including the **Electricity PEAK DEMAND REDUCTION** during Summer*

