

Energy Efficiency in Tropical Region Housing



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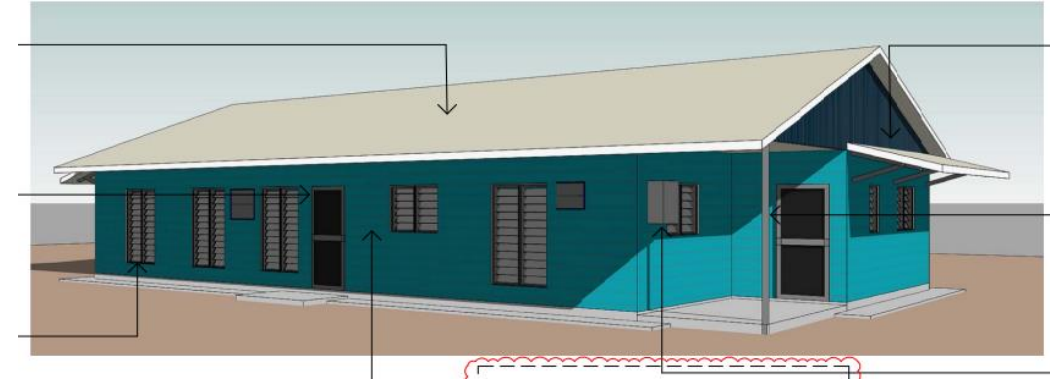
Project Director, Housing Program Office
Department of Infrastructure Planning and Logistics
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Background

Currently in the Northern Territory (NT) an EER of **5 Stars** under the NatHERS (National Housing Energy Rating Scheme) is allowed

Average star ratings for Remote Community Housing dwellings in the Tropical Region

COMMUNITY	DWELLING TYPE	STAR RATING
MANINGRIDA	1 Bed DUPLEX	7.7
PIRLANGIMPI	2 Bed TROPICAL DUPLEX	7.2
GALIWINKU	3 Bed TROP TYPE B	7.6
MANINGRIDA	4 Bed TYPE F	7.2
WADEYE	5 Bed TYPE AN	*6.8
	*125mm thick precast walls vs. 190mm blockwork	



Baseline Dwelling 7.4 Stars

Tropical 4 Bedroom Dwelling

Construction

Floor: Concrete slab on ground

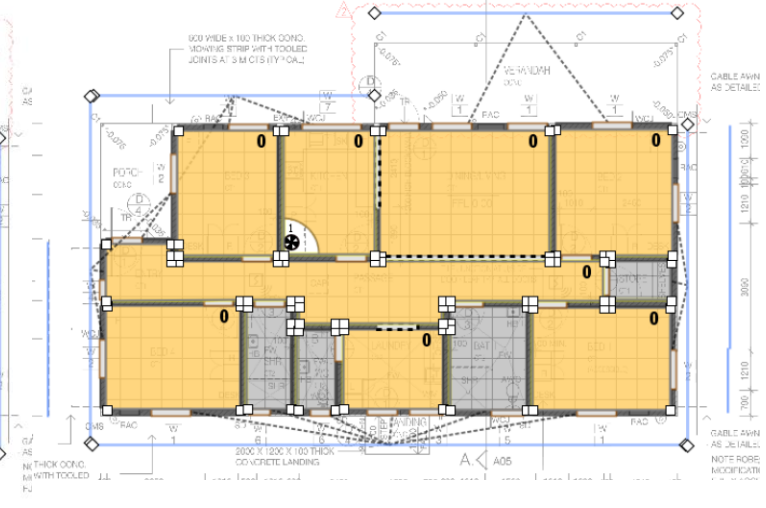
Walls: (External & Internal) 190 concrete block no insulation, paint finish.

Roof: Metal Deck

Cooling energy used: equivalent of **9.4 metric tons** of CO₂ per annum



Colour Map Cooling Energy Levels



Colour Map Heating Energy Levels

Star Rating	NOTES	Cooling MJ/m ²
7.4	<p>Floor: Concrete Slab On Ground (No Insulation)</p> <p>Ceiling: 75mm Bondor (R2.1 min.)</p> <p>Roof: Metal - Insulbreak 70 R0.2 under roof creating reflective roof space</p> <p>Windows: Aluminium Frames, Louvred 6mm Clear</p> <p>Ceiling Fans: 1400mm Diam.</p> <p>Lights: Ceiling Mounted LED Oysters</p> <p>Roof Colour: Medium</p> <p>Wall Colour: Medium</p> <p>Verandah: 3.4m wide</p> <p>Awnings: 1600 wide awnings to East & West windows</p> <p>Eaves: 900mm wide</p>	260.9



north

Dwelling Version 1

'Worst Design'

This dwelling is a test rating **removing** a number of the current design features incorporated in the current housing stock. This is to show the improvements in energy efficiency that has been made over time to the dwellings with different design features.

There is a drop in **3.0 stars** and an increase in Megajoules per day of 190.5 MJ/m² for cooling compared with the current design for this dwelling type.

The increase in cooling energy over a year is the equivalent of **6.8 metric tons of CO²**



Colour Map Cooling Energy Levels



north

Star Rating	NOTES	Cooling MJ/m ²
4.4	<p>Floor: Concrete Slab On Ground (No Insulation)</p> <p>Ceiling: Bondor (R2.1)</p> <p>Roof: Metal only, no Insulbreak 70 (R0.2)</p> <p>Windows: Aluminium Frames, Louvred 6mm Clear</p> <p>Ceiling Fans: 900mm Diam.</p> <p>Lights: Recessed Downlights</p> <p>Roof Colour: Dark</p> <p>Wall Colour: Dark</p> <p>Verandah: 900mm wide</p> <p>Awnings: No awnings to East & West windows</p> <p>Eaves: 900mm wide</p>	451.4

Dwelling Version 2

This dwelling has the following design modifications in **red** below:

This has improved the rating by **0.9** stars against V1 simply by changing the walls and roof colour to medium as opposed to a dark colour. Having a lighter colour on external walls and roof is one of the easiest and economical design features that have been included in the dwellings

There is a decrease in Megajoules used per day of 132.5 MJ/m2 for cooling



Colour Map Cooling Energy Levels



Star Rating	NOTES	Cooling MJ/m2
5.3	Floor: Concrete Slab On Ground (No Insulation) Ceiling: Bondor (R2.1) Roof: Metal only, no Insulbreak 70 (R0.2) Windows: Aluminium Frames, Louvred 6mm Clear Ceiling Fans: 900mm Diam. Lights: Recessed Downlights Roof Colour: Medium Wall Colour: Medium Verandah: 900mm wide Awnings: No awnings Eaves: 900mm wide	393.4

Dwelling Version 2a

This dwelling has the following design modifications in **red** below:

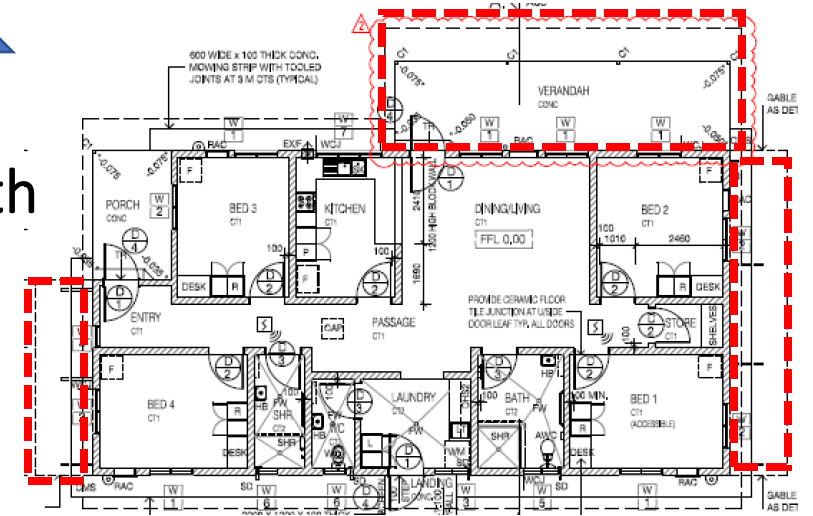
This has increased rating by **0.4** stars against V2 by adding a verandah to the living area and eaves to the bedroom windows.

There is a decrease in Megajoules per day by 108.2 MJ/m² for cooling compared with the baseline design for this dwelling type.

Star Rating	NOTES	Cooling MJ/m ²
5.7	Floor: Concrete Slab On Ground (No Insulation) Ceiling: Bondor (R2.1) Roof: Metal only, no Insulbreak 70 (R0.2) Windows: Aluminium Frames, Louvred 6mm Clear Ceiling Fans: 900mm Diam. Lights: Recessed Downlights Roof Colour: Medium Wall Colour: Medium Verandah: 3400mm wide Awnings: 1600 wide awnings to east and west windows Eaves: 900mm wide	369.1



Colour Map Cooling Energy Levels



Dwelling Version 3

This dwelling has the following design modifications in **red** below:

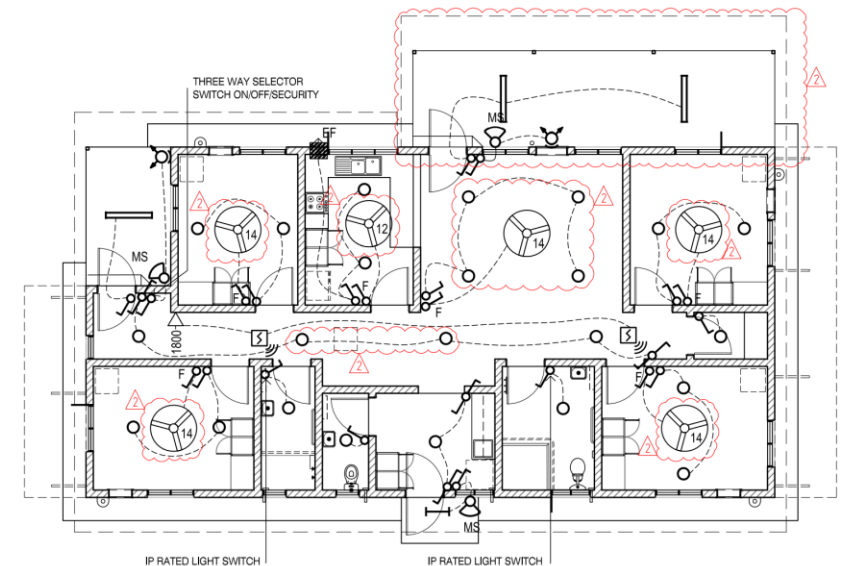
This has increased rating by **1.0 stars** against V2a by changing recessed downlights to surface mounted oyster lights.

The use of recessed downlights involve cutting holes in the ceiling to install the lights which causes significant loss of thermal insulation.

Star Rating	NOTES	Cooling MJ/m2
6.7	Floor: Concrete Slab On Ground (No Insulation) Ceiling: Bondor (R2.1) Roof: Metal only, no Insulbreak 70 (R0.2) Windows: Aluminium Frames, Louvred 6mm Clear Ceiling Fans: 900mm Diam. Lights: Recessed Downlights REMOVED Ceiling Mounted Oysters added. Roof Colour: Medium Wall Colour: Medium Verandah: 3400mm wide Awning: 1600 wide awnings to east and west windows Eaves: 900mm wide	301.2



Colour Map Cooling Energy Levels



Dwelling Version 4

This dwelling has the following design modifications in **red** below and has achieved the 7.4 rating.

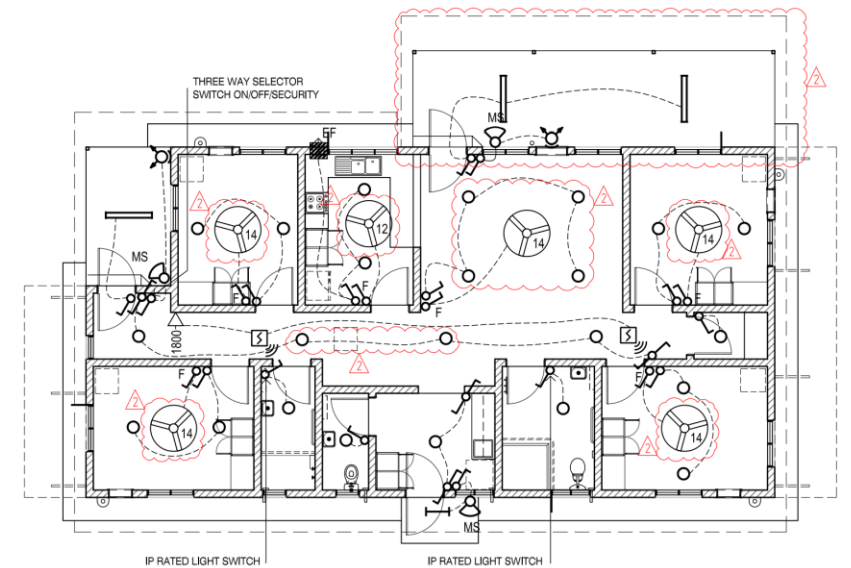
This has increased rating by **0.7 stars** against V3 by changing the five 900mm diameter ceiling fans to 1400mm diameter (1200mm in kitchen). This simple low tech change has increased thermal/energy performance by almost a whole star.

Almost 40 Megajoules per day are also reduced on the previous dwelling design.

Star Rating	NOTES	Cooling MJ/m2
7.4	Floor: Concrete Slab On Ground (No Insulation) Ceiling: Bondor (R2.1) Roof: Metal only, no Insulbreak 70 (R0.2) Windows: Aluminium Frames, Louvred 6mm Clear Ceiling Fans: increased to 1400mm Diameter. Lights: Recessed Downlights removed, Ceiling Mounted Oysters added Roof Colour: Medium Wall Colour: Medium Verandah: 3400mm wide Awning: 1600 wide awnings to east & west windows Eaves: 900mm wide	261.8



Colour Map Cooling Energy Levels



Dwelling Version 5

This dwelling has the following design modifications in **red** below.

Roof Sarking is now insulbreak 70 with a min, R-value of 0.2 as opposed to the simple uninsulated vapor barrier typically used

This is a modest increase in insulation (with negligible cost) has not increase the overall star rating however, it has a slight reduction in the average daily cooling MJ/m2, enough to charge your smartphone **579 times (approx. 1.6 years of recharges)**

(source: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>)

Star Rating	NOTES	Cooling MJ/m2
7.4	<p>Floor: Concrete Slab On Ground (No Insulation)</p> <p>Ceiling: Roof Insulation (R2.1 min.) ADDED Insulbreak 70 (R0.2) creating reflective roof space</p> <p>Windows: Aluminium Frames, Louvred 6mm Clear</p> <p>Ceiling Fans: 1400mm Diameter.</p> <p>Recessed Downlights removed, Ceiling Mounted Oysters added</p> <p>Roof Colour: Medium</p> <p>Wall Colour: Medium</p> <p>Verandah: 3400mm wide</p> <p>Awning: 1600 wide awnings to east & west windows</p> <p>Eaves: 900mm wide</p>	260.9



Colour Map Cooling Energy Levels

Colorbond 0.48BMT Custom Orb cladding or equivalent approved. Fixed as per DTC M/312/01 over Insulbreak 70 insulation.

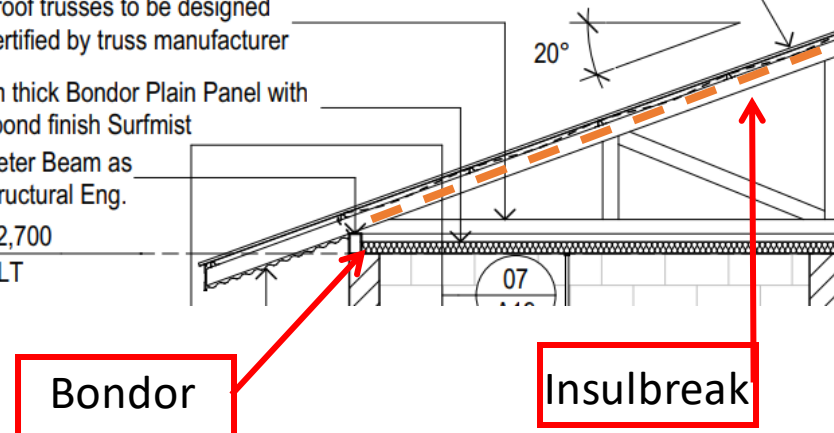
Steel roof trusses to be designed and certified by truss manufacturer

75 mm thick Bondor Plain Panel with Colorbond finish Surfsmist

Perimeter Beam as per Structural Eng.

+2,700

PLT



Conclusions

The baseline dwelling has had a number of design improvements that has had an increase of **3.0** stars in thermal efficiency.

This represents a saving of 190 Megajoules a day on average or **6.8 metric** tons of greenhouse gas emissions per year.

The energy save represents the average yearly cooling consumed by **1.3** similar dwellings.

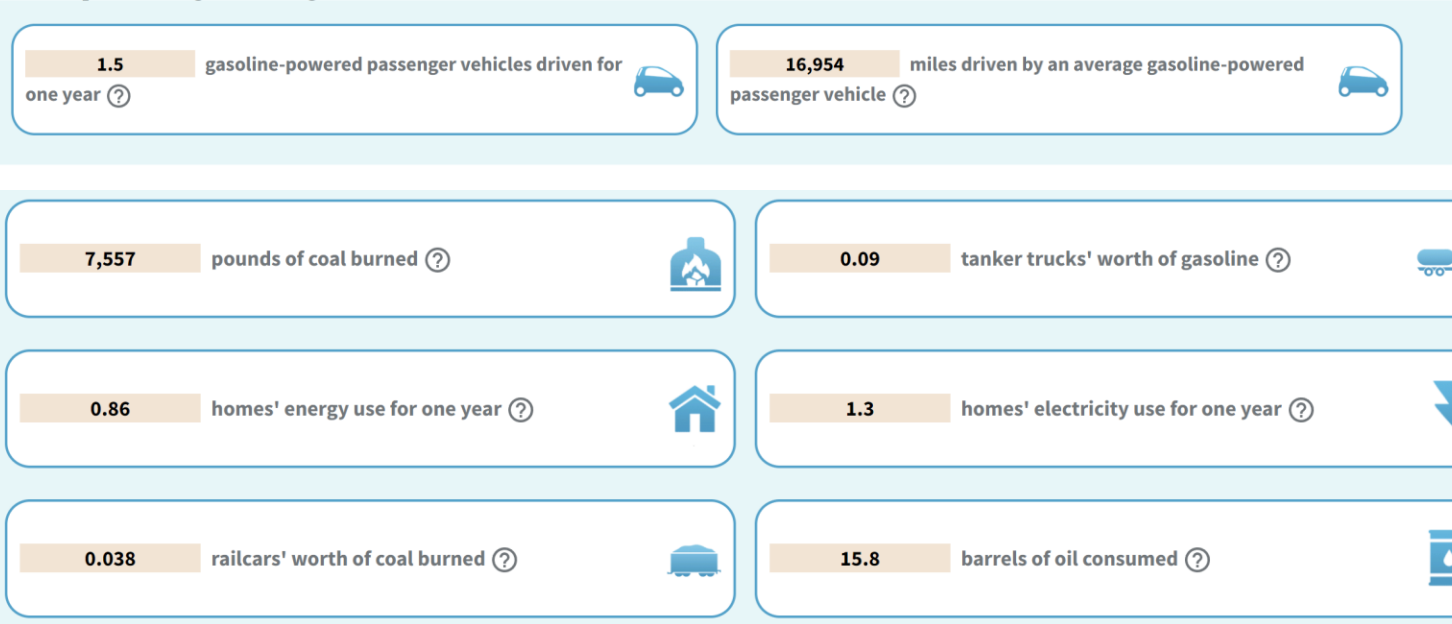


Annual Cooling Energy savings = approx. 1.3 dwellings*

(*source: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>)

6.8 Metric Tons of Carbon Dioxide (CO₂) equivalent

This is equivalent to greenhouse gas emissions from:



Environmental Positives

(source: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>)