IDEALINGSARCHITECTURE

The Benefits of Passive House (PH)

13.08.2020

Timo Bleeker - Architect and Passive House Designer

Introduction

OUR DRIVING PASSION

- Get people into healthier and more comfortable living environments
- Provide educative sessions to empower the community and organisations to know and consider better living solutions for themselves and their clients.

TODAY'S OUTCOME

1. INTRODUCE THE CONCEPT
2. UNDERSTAND THE 5 PRINCIPLES
3. KNOW THE 5 CRITERIA
4. DISCOVER THE BENEFITS IN AUSTRALIA
5. CONSIDERATION AND SUPPORT IN AUSTRALIA

Introduction

POLL

1. Concept

What is Passive House?

FACTS

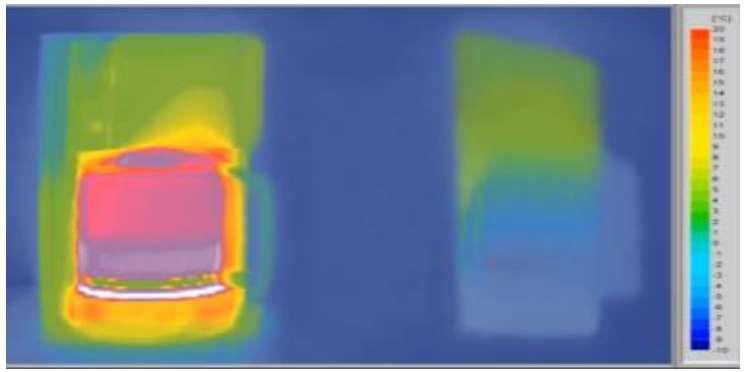
Conventional Australian houses :

- are loosing a lot of energy due to their poor built
- rely on expensive active heating or cooling systems
- rely on systems usually powered by fossil fuels that add to Australia's greenhouse gas emissions.

SOLUTION

- A thermos flask is the solution for a coffee machine losing a lot of energy to the outside.
- **A Passive House is a solution applicable to buildings of all Classes (Class 1-10).**
- Passive House is a building standard, developed by the Passivhaus Institute in Germany.
- **PH is a construction concept that provides**

Energy efficiency	Healthy indoor environment	Comfortable indoor 20-25°C	Affordability



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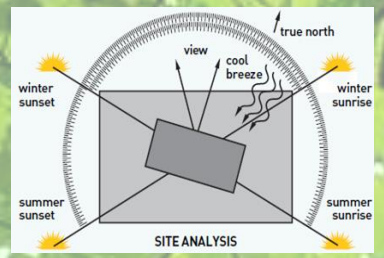
Imagery source: Passive House Institute

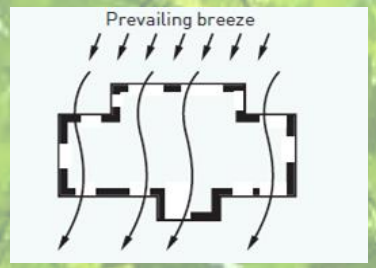
1. Concept

Terminology

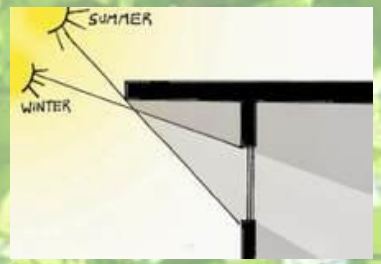
SOLAR PASSIVE



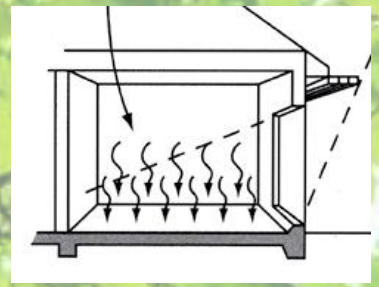
ORIENTATION



NATURAL (CROSS-) VENTILATION

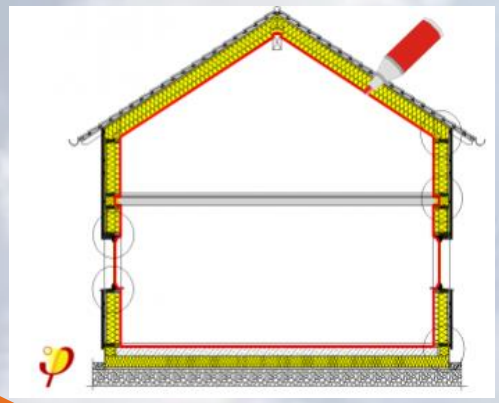


SHADING

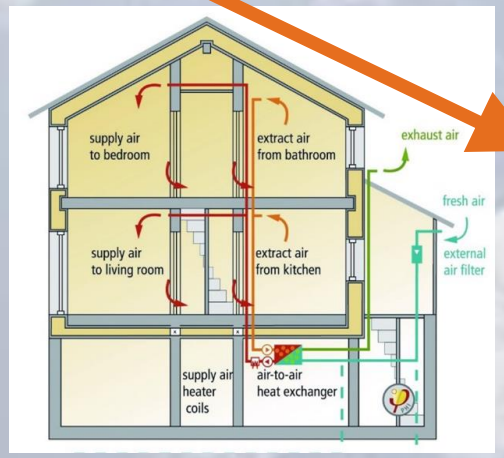


THERMAL MASS

PASSIVE HOUSE



BUILDING ENVELOPE

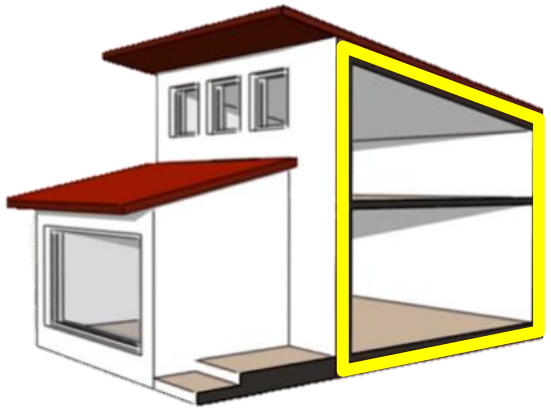


24/7 FRESH AIR

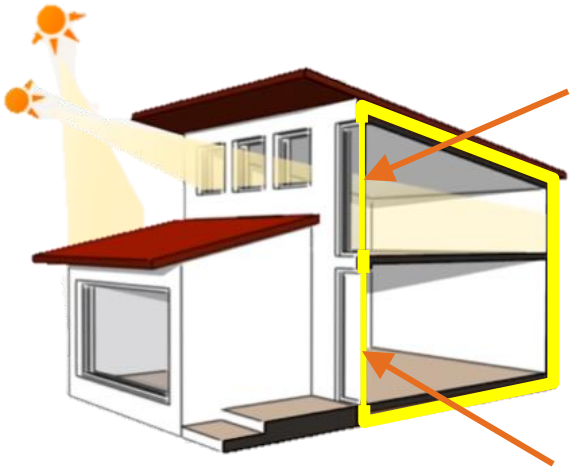
Imagery sources: **Left: :** Yourhome.gov.au – Passive Design, **right**: Passive House Institute

2. Principles

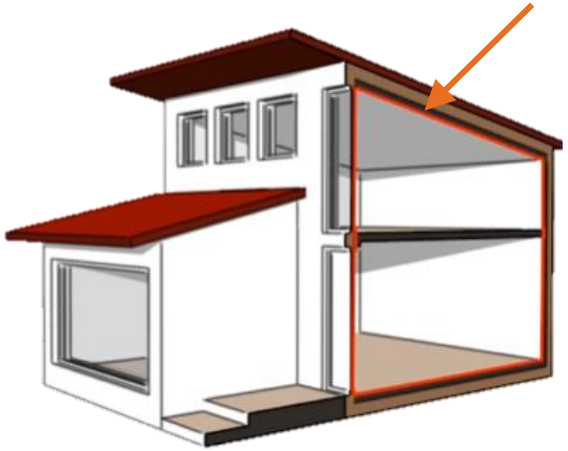
The 5 Passive House Principles



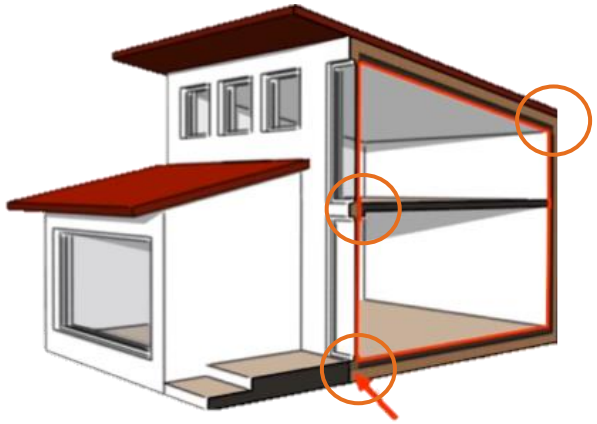
A. Continuous insulation



B. High performance windows



C. Continuous airtightness



D. No thermal bridges

E. Heat recovery ventilation

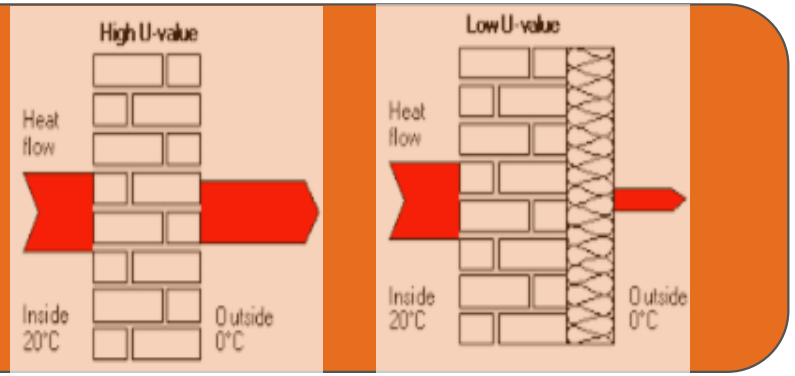
Imagery source: Passive House Institute

2. Principles

A. Continuous Insulation

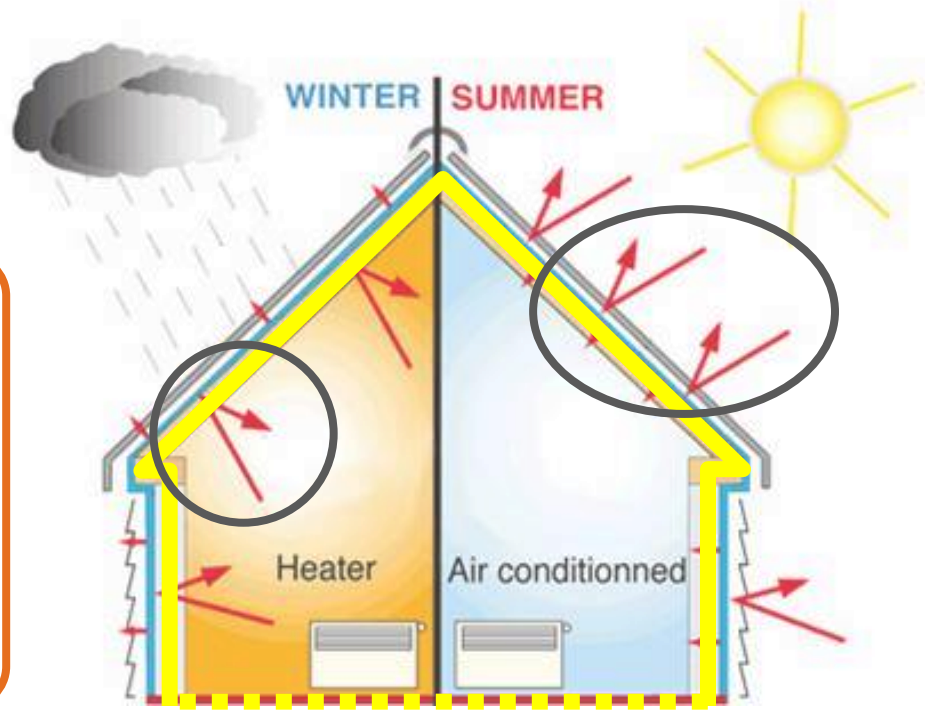
FACTS

- Partial or insufficient insulation
- Non-continuous insulation
- High U-values **>2.0 W/m²K**



SOLUTION

- Insulation installed as a continuous layer.
- Low U-values required (considering all building layers):
  Best **<0.3 W/m²K**
- Colder climates: sometimes under-slab insulation needed



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Imagery source: Passive House Institute

2. Principles

B. High Performance Windows

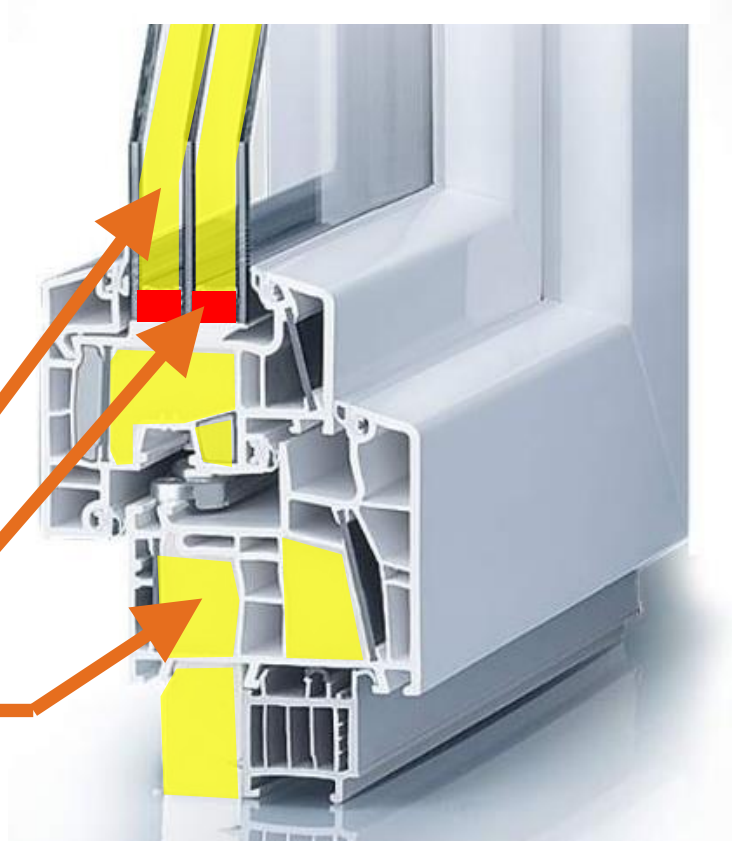
FACTS

- No single panel or single laminated glass can achieve the thermal transmittance performance required to avoid energy wastage!
- **Why? They do not have an insulation layer.**

SOLUTION

As a continuation of the insulation layer, windows must have:

- Gas infills
- Low conductivity spacers (i.e. PVC)
- Thermally broken frames (i.e. Alu, uPVC, Timber)



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Imagery source: Neuffer German window manufacturer

2. Principles

C. Continuous Airtightness

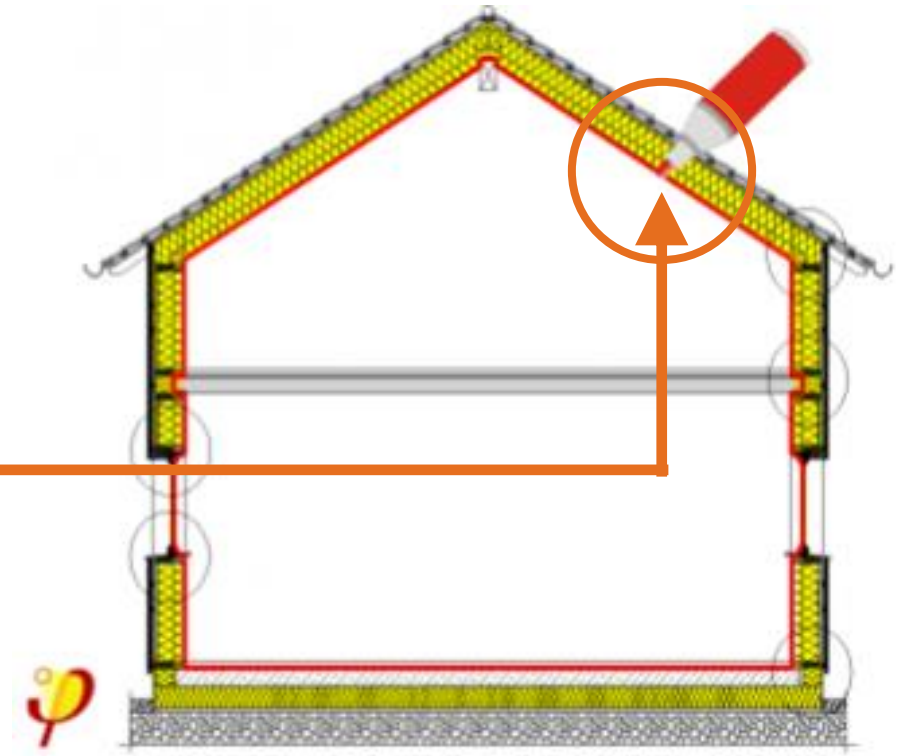
FACTS

29.07.2020 GBCA CEO Davina Rooney – “FUTURE HOMES STRATEGY”

Airtightness is a key criterion with more than 25% of heat loss in winter estimated to be caused by draughts. Good insulation when combined with airtightness can save homes up to 40% in energy bills every year.

SOLUTION

- Avoid leaky buildings and uncontrolled ventilation!
- **Plan the airtightness layer**
- Avoid penetrating this layer
- Plan the necessary penetrations for services etc.



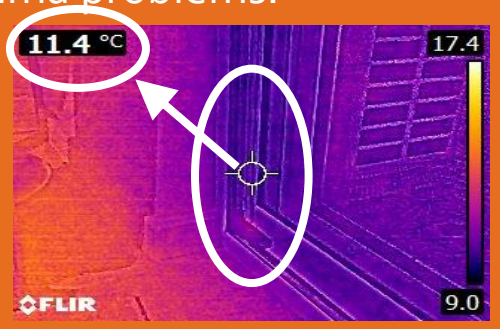
Imagery sources: **Back:** Yourhome.gov.au – Passive Design, **front:** Passive House Institute

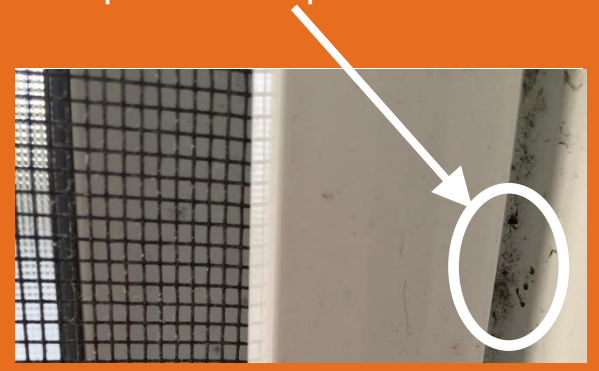
2. Principles

D. No Thermal Bridges

FACTS

- Thermal bridges are weaknesses in the building envelope.
- They waste heating and cooling energy.
- They can create condensation issues and mould built-up. Mould spores can create allergy and asthma problems.





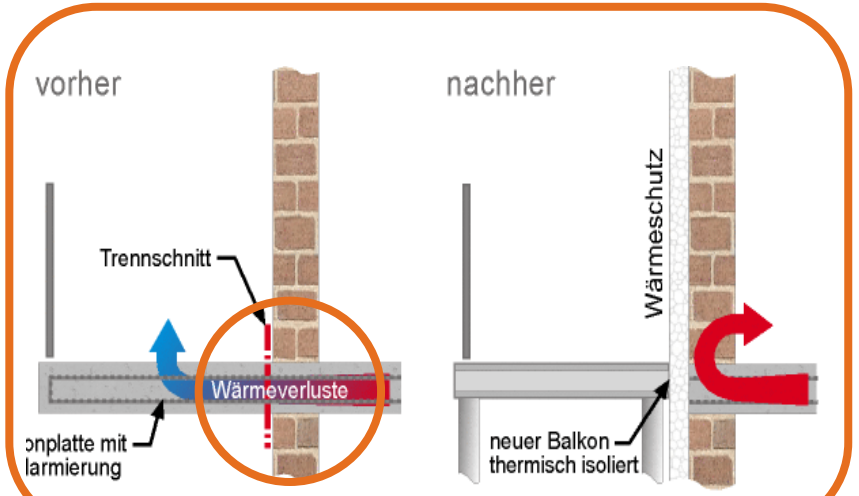
Images: NatHERS 6* Perth Class 1 residence, constructed 2015

SOLUTION

Avoid within the thermal envelope:

- Gaps
- Penetrations by highly conductive materials (e.g. steel, aluminum, concrete)

All edges, corners, connections and penetrations must be planned and executed with great care!



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Imagery sources: **Top:** Idealings Architecture, **bottom right:** Karl Schanz Betonschneiden - Energetic renovation of balconies and platforms

2. Principles

E. Heat Recovery Ventilation

FACTS

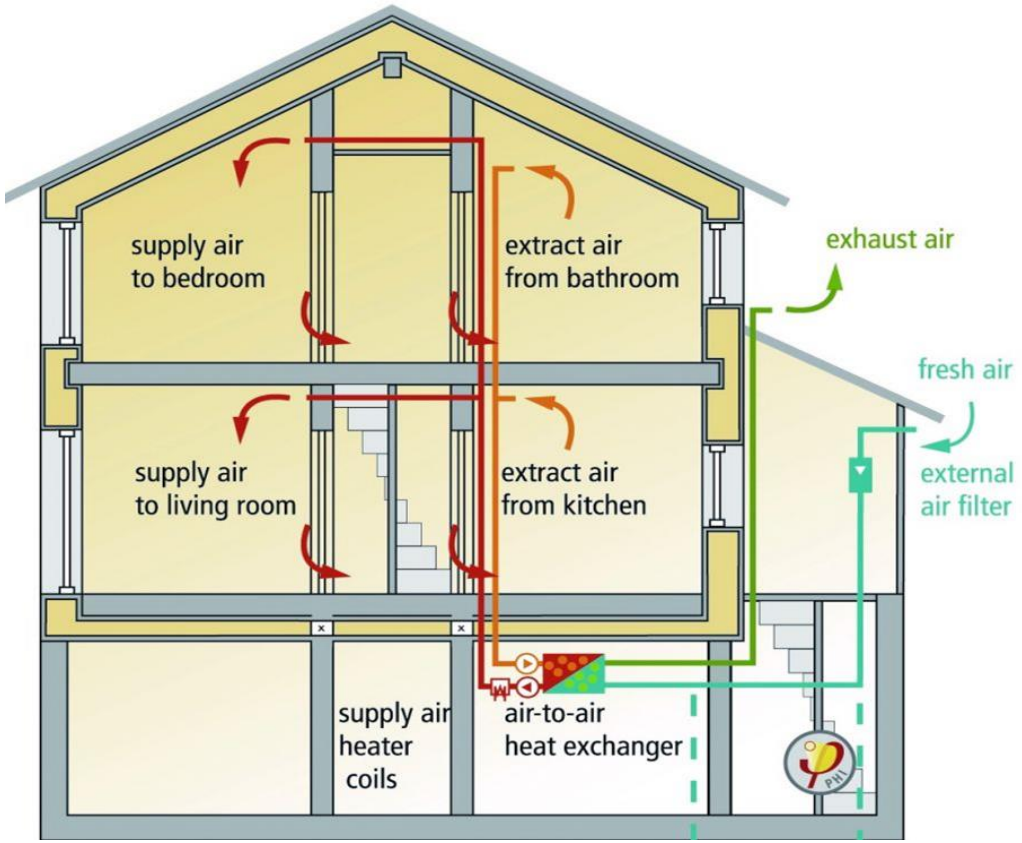
- How to maintain a 24/7 fresh air inside a Passive House?
- How to remove pollutants from incoming air?

SOLUTION

Heat Recovery Ventilation (HRV)

- Supplies fresh air to habitable rooms
- Extracts warm air from kitchens and bathrooms
- Fresh air is pre-warmed (or pre-cooled) via a heat exchanger.

- Up to 92% heat recovery efficiency
- Saving on energy bills



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Imagery source: **Back:** Pexels.com, **middle**: Ventilation Control Products, Sweden, **front:** Passive House Institute

3. Criteria

The five Passive House Criteria

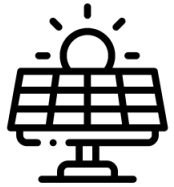
Heating demand ≤ 15 kWh/(m2a)
Or heating load ≤ 10 W/m2

Cooling demand ≤ 15 kWh/(m2a)
Or cooling load ≤ 10 W/m2

Frequency of Overheating:

- 8,760 hrs per year x 10% = 876 hrs
- Assuming 8 month warm period in AUS (spring – summer – autumn)
- 876 / 8 = ~110 hrs per month / 30 days = ~3.5 hrs per day Temp > 25°C

Airtightness (at 50 pa) ≤ 0.6 ACH



Primary Energy Renewables:

- No fossil fuel generated energy
- Renewable energy to cover the building's total energy consumption

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Imagery source: Flaticon.com, information from Passive House Institute

3. Criteria

Passive House Design with PHPP

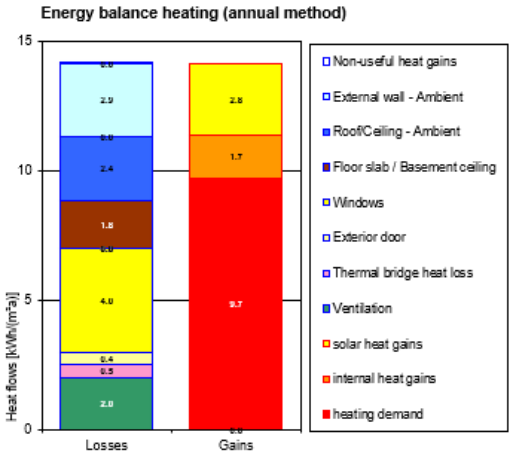
FACTS

- How do we know and measure the Passive House criteria are met?

SOLUTION

Passive House Planning Package PHPP

- Building energy modelling software
- Developed with aid of dynamic simulation tools
- Very accurate – performance checked over 25 years



Specific building characteristics with reference to the treated floor area

						Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	175.0					
Space heating	Heating demand	kWh/(m²a)	15	≤		15	-	yes
	Heating load	W/m²	13	≤		-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤		-	-	-
	Cooling load	W/m²	-	≤		-	-	
	Frequency of overheating (> 25 °C)	%	10	≤		10		yes
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤		20		yes
Airtightness	Pressurization test result n_{50}	1/h	0.6	≤		0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	100	≤		-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	55	≤		60	60	yes
	Generation of renewable energy (in relation to projected building footprint area)	kWh/(m²a)	0	≥		-	-	

[2] Empty field: Data missing; '-': No requirement

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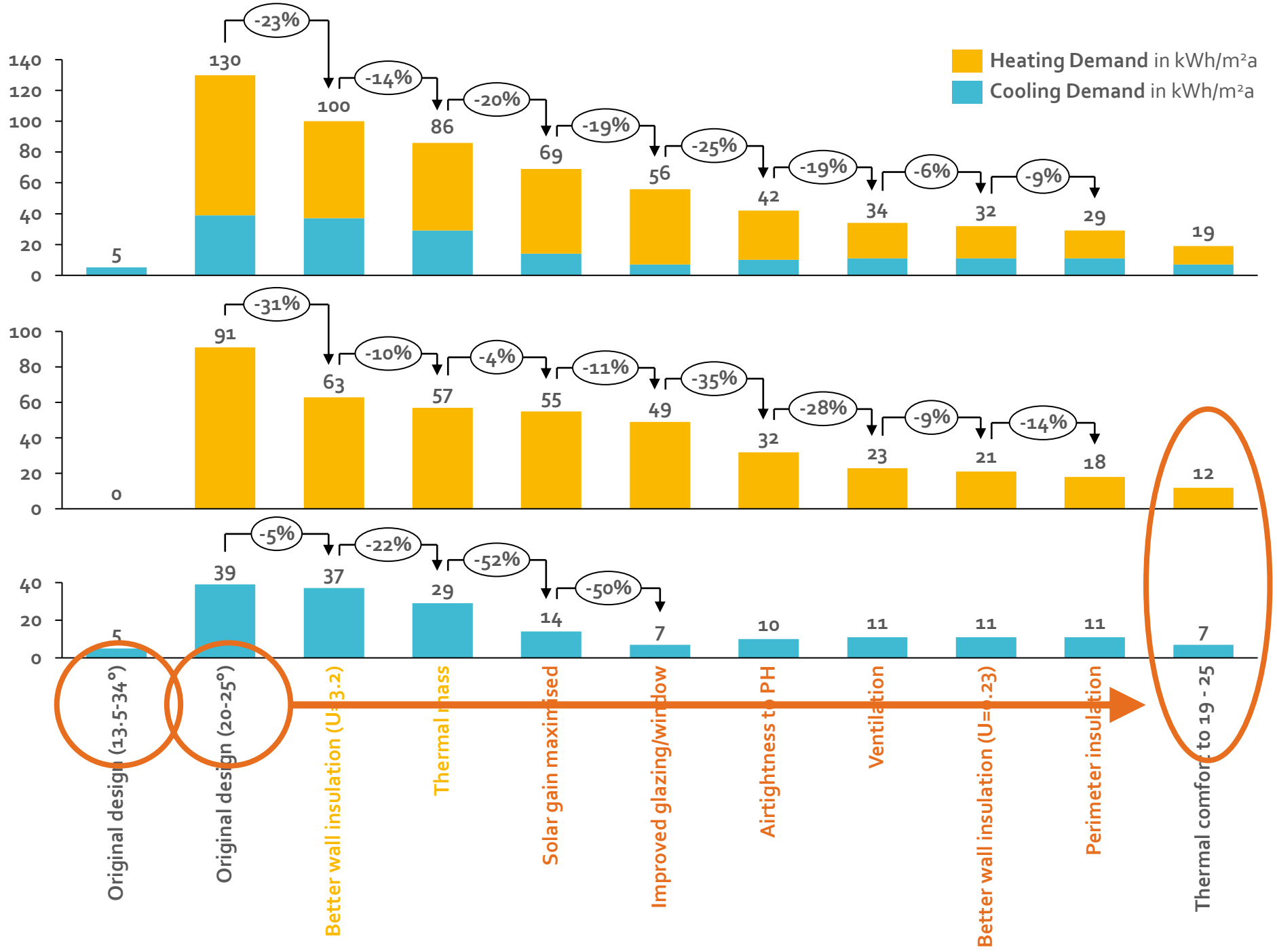
Imagery source: Idealings Architecture

4. Benefits

Case Study A: Passive House principles impact on a NatHERS 6 residence Hamilton Hill WA (Class 1)



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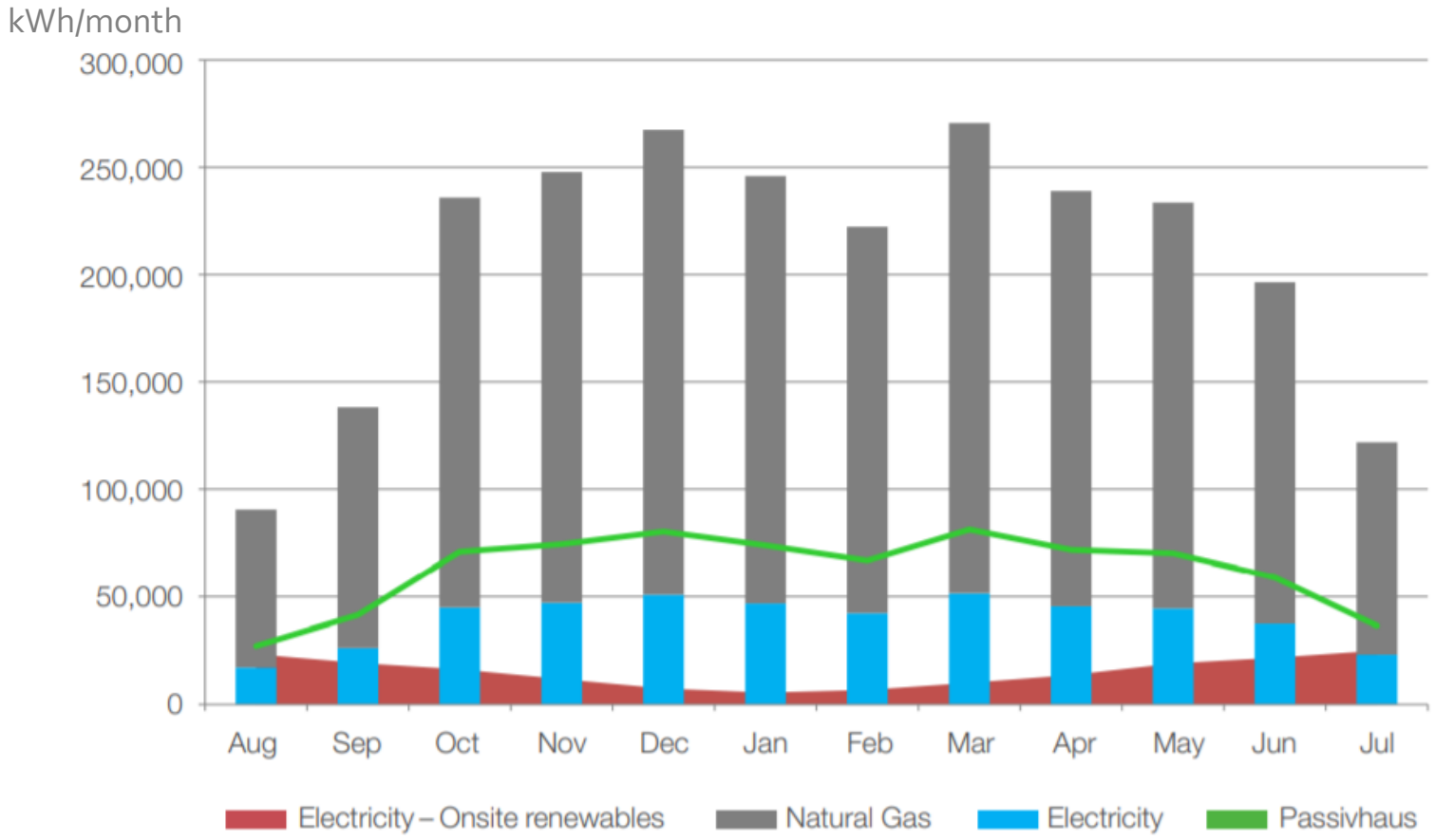
4. Benefits

Case Study B:
Passive House principles impact on a NatHERS 9 multi-residential building (Class 2)

Scenario - Building Description	Scenario - Assumptions
• Multi-Residential (Class 2) • 300+ dwellings	• Compared to achieve Passive House standard. • Projection against Green Star Multi-Unit Residential v1 • Energy usage in kWh/month



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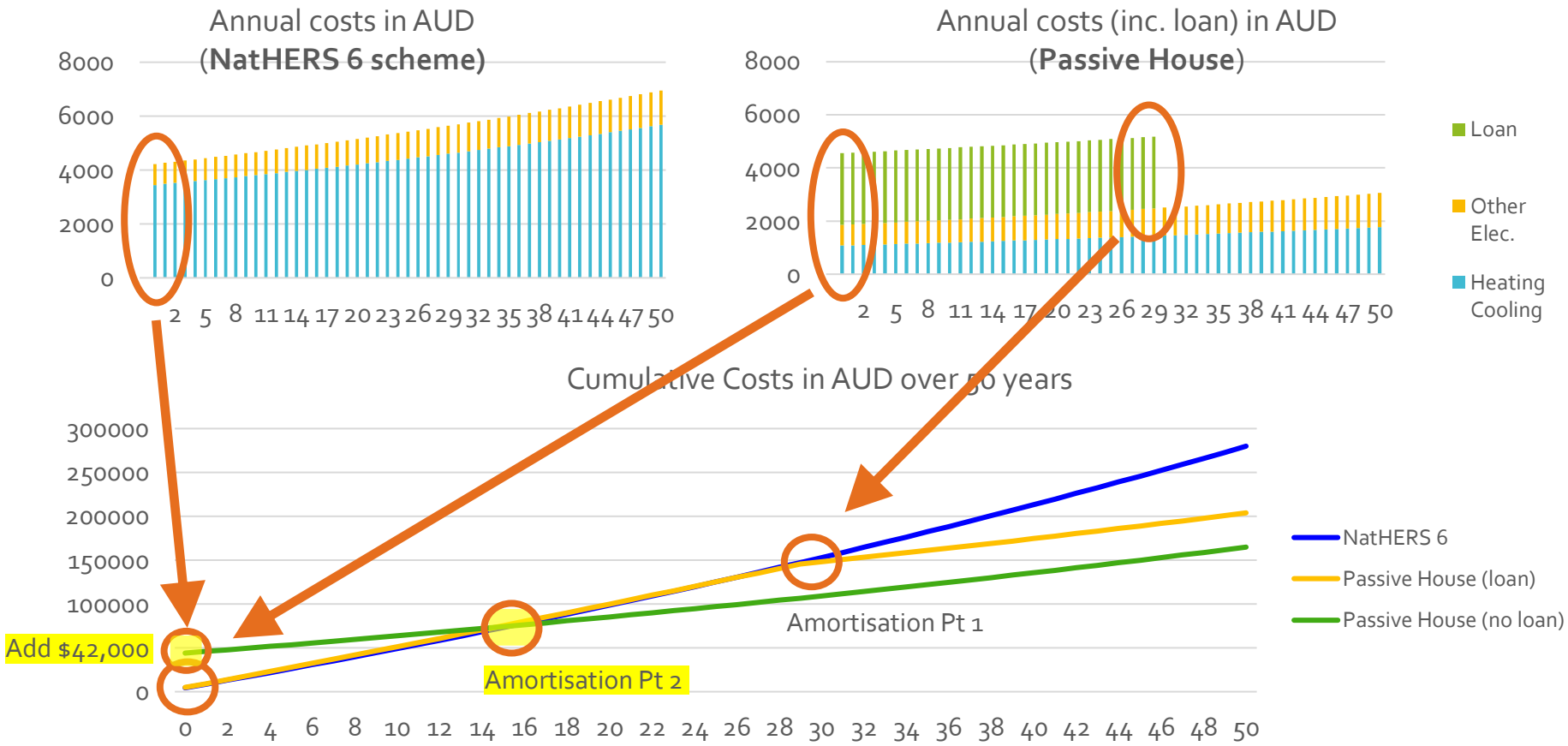
Information source: Green Star Council of Australia - Streamlined recognition for Passive House certified buildings in Green Star

4. Benefits

Cost Comparison between Passive House and Conventional House

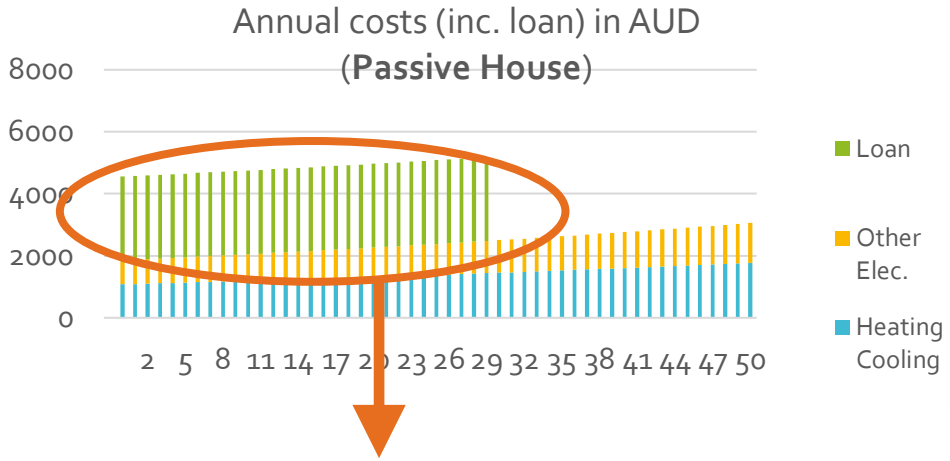
Scenario - Building Description	Scenario (average case) - Assumptions

• 2 Storey Residential (Class 1)
• 160m2
• Estimated 420,000 AUD project cost (NatHERS 6)
• Heating/cooling demand 100kWh/m2a for **similar comfort to PH** (Internal temperature between **20 and 25 degrees**)
	• Compared to NatHERS 6 Stars design/built,
	  • **increased project costs** for Passive House by 10% **(loan costs)**
	  • **reduced heating/cooling** demand for Passive House by 75%
	• Electricity demand other than heating/cooling est. 18 kWh/m2a.
	• Electricity costs estimated 0.27AUD per kWh, **inflation at 1%.**
	• Loan interest – over 30 years at interest rate of 5%.
	• Services maintenance costs assumed equivalent and minor.



4. Benefits

Cost Comparison - Additional Costs for Passive House?



DRIVING COST FACTORS ?

- Material availability / Cost
- Design knowledge in the industry
- Construction knowledge in the industry
- Building design complexity

BASELINE FOR COMPARISON ?

- NatHERS 6 ?
- Already includes energy efficient design principles ?

COST PREMIUM FOR PH MIGHT BE LESS HIGH

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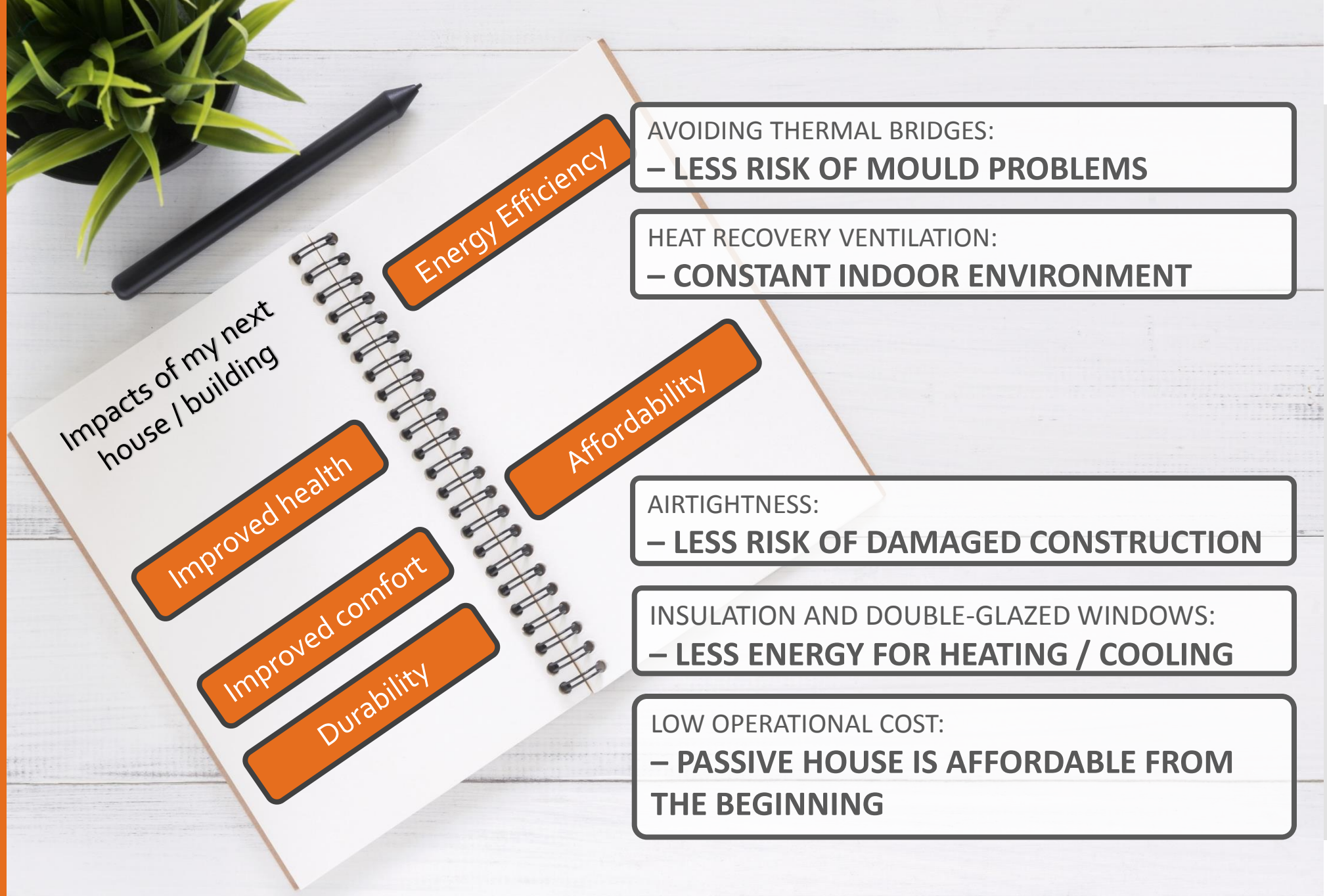
Imagery source: Pexels.com

4. Benefits

In simple terms



AVOIDING THERMAL BRIDGES:
– LESS RISK OF MOULD PROBLEMS

HEAT RECOVERY VENTILATION:
– CONSTANT INDOOR ENVIRONMENT

AIRTIGHTNESS:
– LESS RISK OF DAMAGED CONSTRUCTION

INSULATION AND DOUBLE-GLAZED WINDOWS:
– LESS ENERGY FOR HEATING / COOLING

LOW OPERATIONAL COST:
– PASSIVE HOUSE IS AFFORDABLE FROM THE BEGINNING

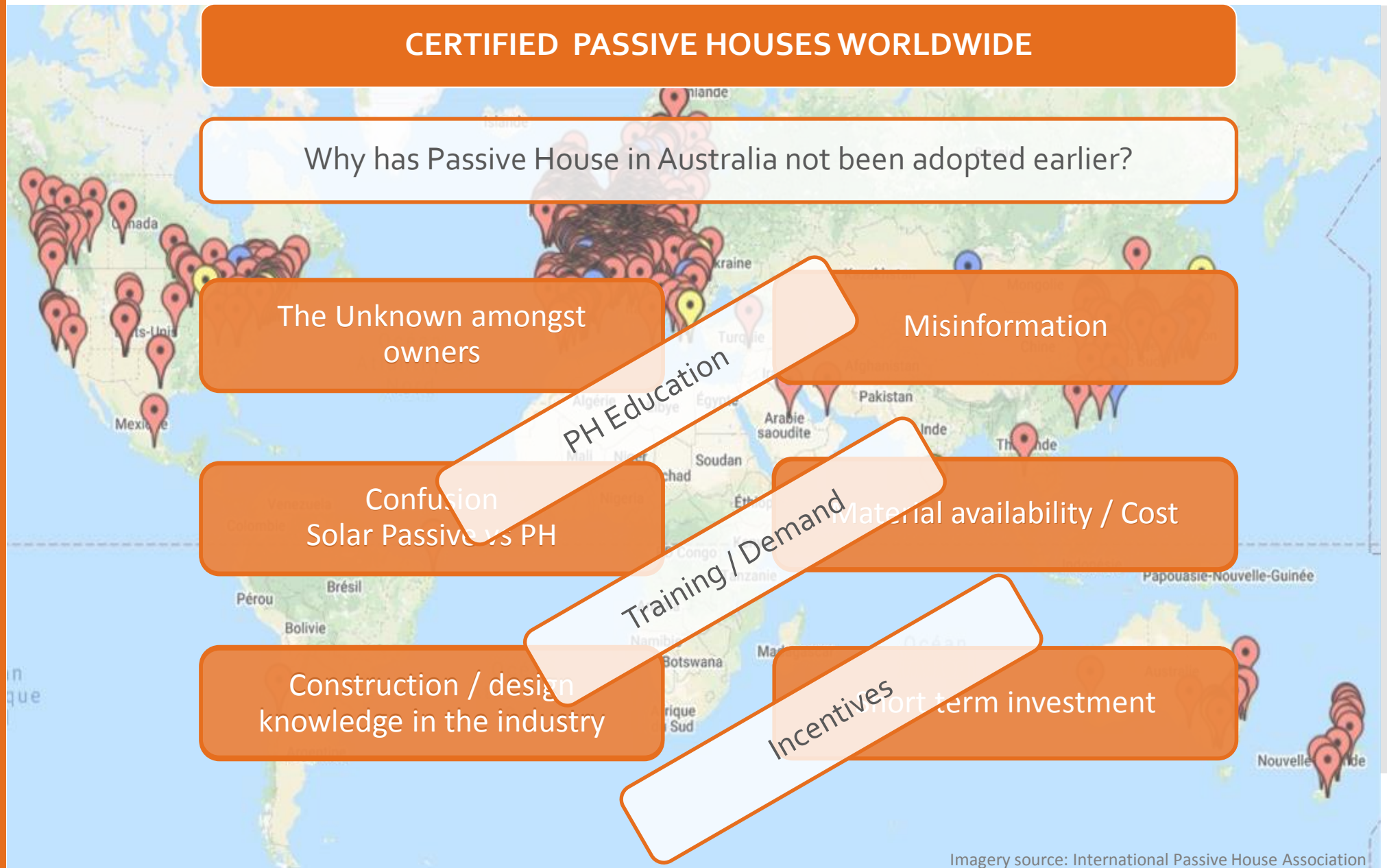
Imagery source: Tirachard Kumtanom from Pexels

5. Moving Forward

PH in Australia

CERTIFIED PASSIVE HOUSES WORLDWIDE

Why has Passive House in Australia not been adopted earlier?



Imagery source: International Passive House Association

5. Moving Forward

PH Professionals that can help to achieve a Passive House

A quality assurance from concept design till the end of the project is recommended. The assurance can be provided by:

- a number of professionals:

Certified PH Designer or Consultant	Certified PH Trades (recommended to consider builders with certified staff)	PH Certifier (for certification)	Certified PH components (recommended)

- reliable and proven tools to help plan / optimise energy-efficient buildings:

Design PH	PHPP

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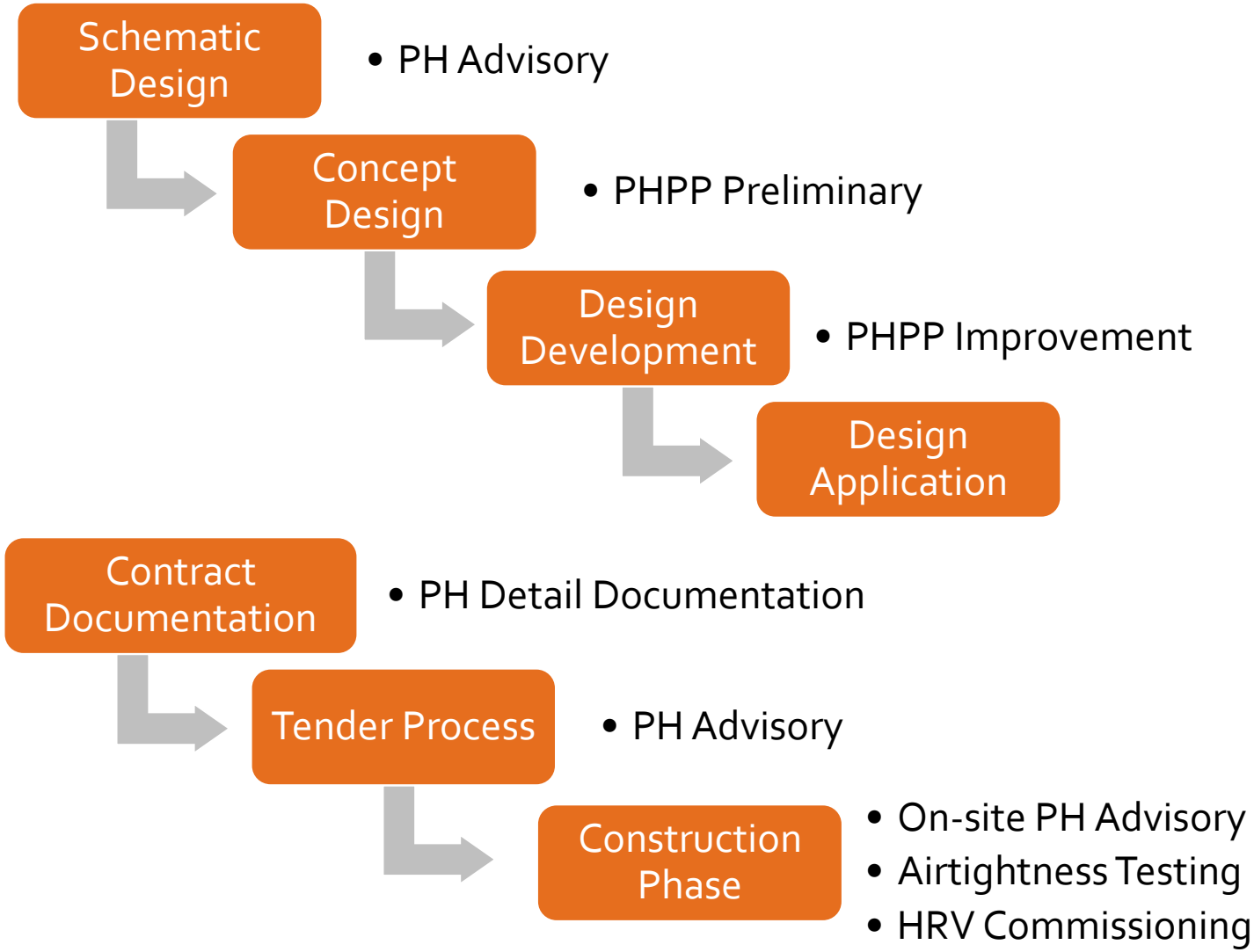
Architectural Design Services	PH Consultancy	DesignPH, PHPP	Green Star Assistance

Airtightness Testing	HRV Commissioning	Passive House Education

5. Moving Forward

PH Consultancy in Design and Construction Stages

To achieve a maximum energy efficient building, it is highly advisable to have Passive House professionals and specifically PH Designer and PH Builder working with you as a collaborative planning team right from the start of the project, at concept design stage.



5. Moving Forward

Green Star

GBCA / APHA Partnership

AUSTRALIAN PASSIVE HOUSE ASSOCIATION

Green Star scheme acknowledges up to **30 pts** when Passive House principles are applied

- **Green House Gas Emissions - 12 - 20 pts**
- **Thermal Comfort - 2 pts**
- **Indoor Air Quality - 4 pts**
- **Innovation - 2 pts**
- **Peak Electricity Demand Reduction - 2 pts**

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Information source: Australian Passive House Association

5. Moving Forward

Green Star

New standard unveiled for greener Australian homes of the future

29.07.2020 GBCA CEO Davina Rooney – "FUTURE HOMES STRATEGY" – aimed for the residential sector:

"To achieve Green Star certification, as a minimum, homes will need double glazed windows and doors, air filtration and LED lighting, good access to daylight in living areas and bedrooms, sufficient renewable energy generation to support the home's operations and no fossil fuel use," Ms Rooney said.

1. Healthy

Green Star Certified homes will need to be well ventilated to prevent the growth of mould and built to minimise the entry of pollutants, such as bushfire smoke. They will need to be thermally comfortable, use materials that are low or non-toxic and have high quality lighting installed.

2. Resilient

a Green Star Certified home achieve a 40% reduction in water usage

3. Positive

Green Star Certified homes will need to be net zero energy meaning that they have been built to generate sufficient renewable energy to power all estimated regulated loads as well as estimated appliances and plug loads. They do not use gas, major appliances including refrigerators, washing machines and dishwashers must have a minimum 4-star energy efficiency rating, solar systems must be battery ready and all windows must be factory built double glazed IGU (Insulated Glass Units).

Information source: Green Star Council of Australia

Thank you!

Questions?

"The first thing I noticed when entering the apartment was how fresh and clean the air inside was, far better than any apartment I'd ever been in before."

"The other thing I picked straight away was the quiet. You can hear the busy four-lane motorway on the street below, but it's a hum rather than a roar."

"It was an unseasonably warm evening, considering it's only the first week in September (eek), but the interior of the apartment remained a very comfortable 20-24 degrees Celcius the whole time."

Imagery source: Tirachard Kumtanom from Pexels, quotes from www.thefifthestate.com.au – First night in a PH in Sydney