

# Surreal Estate

## SINGLE SUBURBAN FAMILY HOUSING



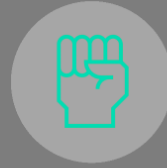
Sustainability

Resilience

Net Zero Energy

Affordability

Outline



Overview

Architecture

Sustainability

Resilience

Passive Energy

Affordability



# OUTLINE



Yue Wang



Srishty Varma



Sarah Yin



Ying Fai Fung

# *A Resilient Home for New Families*



Fire resistant



No compromise  
on comfort



Net zero energy



Affordable

# Team Information



“

*Ancora Imparo*

*I am still learning*

”



**9<sup>th</sup>** Materials Engineering program

*Academic Ranking of World Universities (2019)*

**21<sup>st</sup>** Civil Engineering program

*QS World University rankings (2020)*

**75<sup>th</sup>** University Worldwide

*Times Higher Education (THE) World University rankings (2020)*



# OUR TEAM



**Brandon Winfrey**  
Civil Engineering Lecturer



**Sarah Yin**  
Science and Materials Eng



**Alba Rivela**  
Resources Eng



**Ying Fai Fung**  
Mechanical Eng



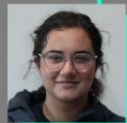
**Saad Nauman**  
Civil Eng



**Nathan Imperial**  
Civil Eng



**Yue Wang**  
Materials Eng



**Sandy Awad**  
Materials Eng



**Srishty Varma**  
Architecture



**Sarah Manning**  
Civil Eng

**JACOBS**<sup>®</sup>

**STIEBEL ELTRON**  
Technik zum Wohlfühlen

South East  
Water

**AQUAREVO**  
LYNDHURST

## Site details and House Layout

- Located in Tarneit, Victoria
- Climate similar to San Francisco
- Bushfire prone, Bushfire Attack Level (BAL) 12.5 is considered to protect against ember attacks and low radiant heat



| Landscaping                                         | House Exterior                                       | Roof                                                                                            | Doors and Windows                                                                                           | Other Measures                                              |
|-----------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Away from steep hillsides                           | External sprinkler system                            | Simple design (with minimal tilting and avoid roof valleys and skylights)                       | Protected by compliant bushfire shutters or screens                                                         | Smoke alarms                                                |
| Enough cleared lands between the house and the bush | Inbuilt water storage                                | Fully sealed<br>Gutter guards are installed (to help keep the gutters clear and free of debris) | Weather strips or draught excluders                                                                         | Attached evacuation plan                                    |
| Bushfire-resistant plant and tree species           | Firebreak between nearby vegetation and the house    |                                                                                                 | Toughened glass windows                                                                                     | Water and gas pipes are buried at least 300mm in the ground |
|                                                     | Use fire-resistant or fire-retardant treated timbers |                                                                                                 | Windows are built 400mm above an external surface<br>Cascade windows (can act as an escape route from fire) |                                                             |

house  
layout

## Map of Melbourne, Victoria



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## SINGLE SUBURBAN FAMILY HOUSING



Sustainability

Resilience

Net Zero Energy

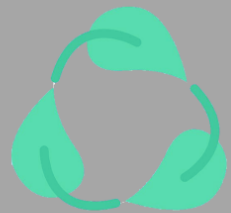
Affordability

Outline



Overview





# Sustainability

Embodied  
Environmental  
Energy

Architecture

# Embodied Environmental Impact

- From material selections to life cycle analysis
- Making the majority of the house timber, includes a suspended timber floor
- Trade-off: the use of polyethylene and spray foam

## Environmental analysis of two building material

Concluding the results of the analysis of 2 alternatives of the Slovak masonry family-houses, the reduction of the environmental impacts **was reached by up to 61.0 %** in particular structures and by up to 10.5 % overall, simply by the change of several building materials in structures. Thus, even relatively easy changes in material composition may lead to a reduction of environmental impacts.

**Acknowledgments** This research has been carried out within the project of Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences No. 1/0481/13 titled Study of building materials environmental impacts.

| Materials                                                | Intended use        | Service and comments                              | R-value (K·m <sup>2</sup> /W) | Embodied energy BTU/lb (primary) | CO <sub>2</sub> footprint lb/lb (primary) |
|----------------------------------------------------------|---------------------|---------------------------------------------------|-------------------------------|----------------------------------|-------------------------------------------|
| Terracotta roof tiles                                    | Exterior finish     | Excellent environmental resistance and durability | 0.05                          | 5.59 · 10 <sup>3</sup>           | 1.82                                      |
| Roof sarking                                             | Water & air control | Excellent environmental resistance and durability | 1.3                           | 499                              | 0.0698                                    |
| earth wool (made of 80% recycled glass) rigid insulation | Thermal control     | -                                                 | 6                             | 4.34·10 <sup>3</sup> (glass)     | 0.721 (glass)                             |
| Rockwool rigid insulation                                | Thermal control     | -                                                 | 2.1                           | -                                | -                                         |
| Recycled gypsum board                                    | Vapor control       | Limited durability                                | -                             | 2.24·10 <sup>3</sup>             | 0.317                                     |
| Polyethylene ground cover                                | Water & Air control | Excellent environmental resistance and durability | -                             | 3.25·10 <sup>4</sup>             | 2.96                                      |
| earth wool batts                                         | Thermal control     | -                                                 | 2.7                           | 4.34·10 <sup>3</sup> (glass)     | 0.721 (glass)                             |
| Timber floorboards                                       | Interior finish     | Limited durability                                | 0.7                           | 4.99·10 <sup>3</sup>             | 0.574                                     |
| Timber siding                                            | Exterior finish     | Good durability                                   | 0.53                          | 4.99·10 <sup>3</sup>             | 0.574                                     |

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# Architecture

Integrate form and function seamlessly through smaller features and materiality

Site Plan

Exterior  
Design

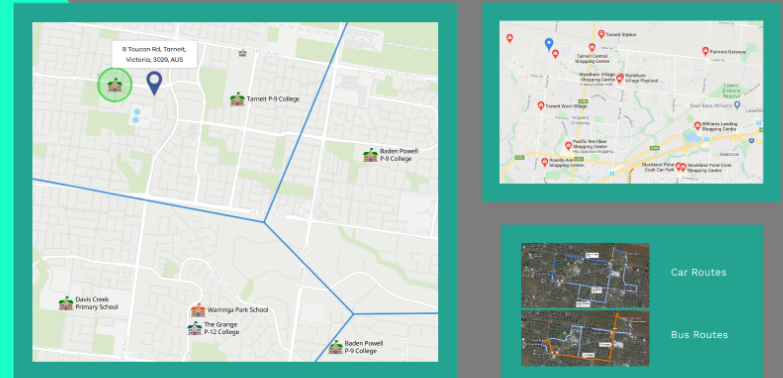
Floor Plan

Interior  
Design



# Site Plan

- Plant-life conserves water
- Optimises thermal and wind properties
- Aim to be as self-sustaining as possible
- Conveniently located
- Easy access to public transport



## Landscaping

- Designed for Australian culture
- Utilises mostly native Australian flora
- Conservation of water
- Edible native plants encourages promoting indigenous practices
- Aromatic lavender acts as a natural insect repellent
- Weeping grass and Dwarf Mondo grass is low maintenance
- Vegetable and herb gardens provide fresh produce

Central location on plot

- Reduces energy consumption
- Access to optimal wind direction for passive heating and cooling



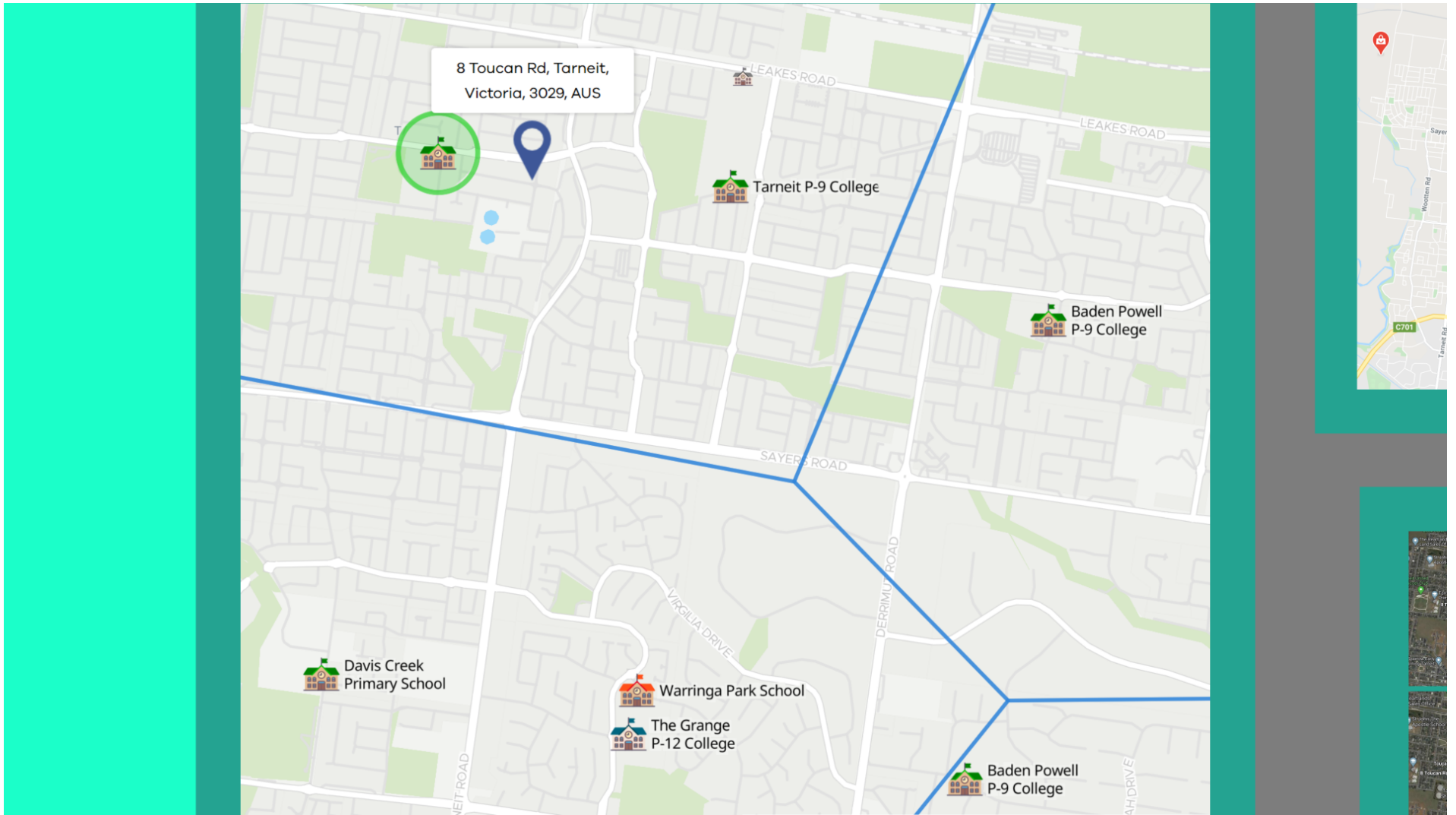
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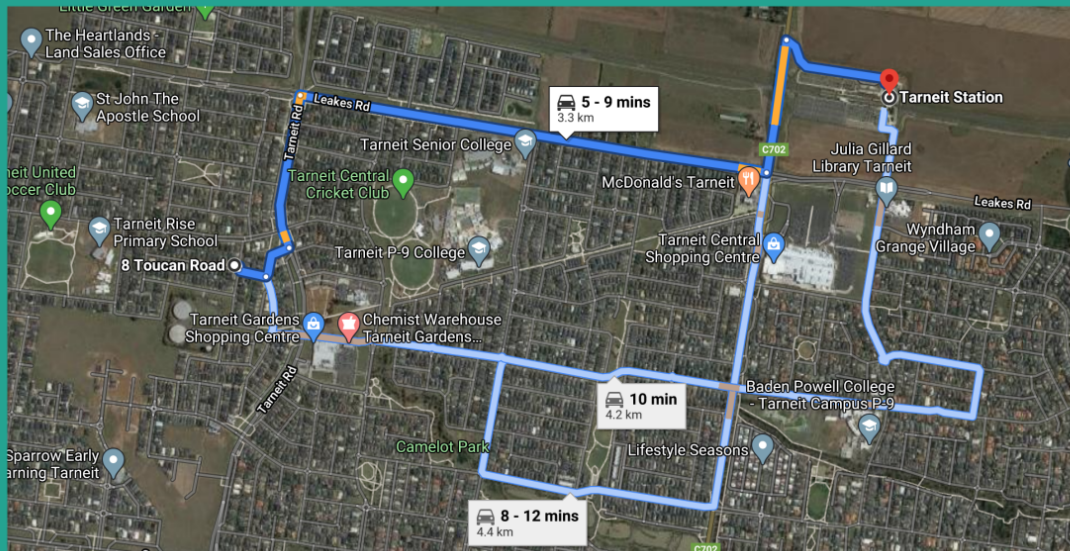
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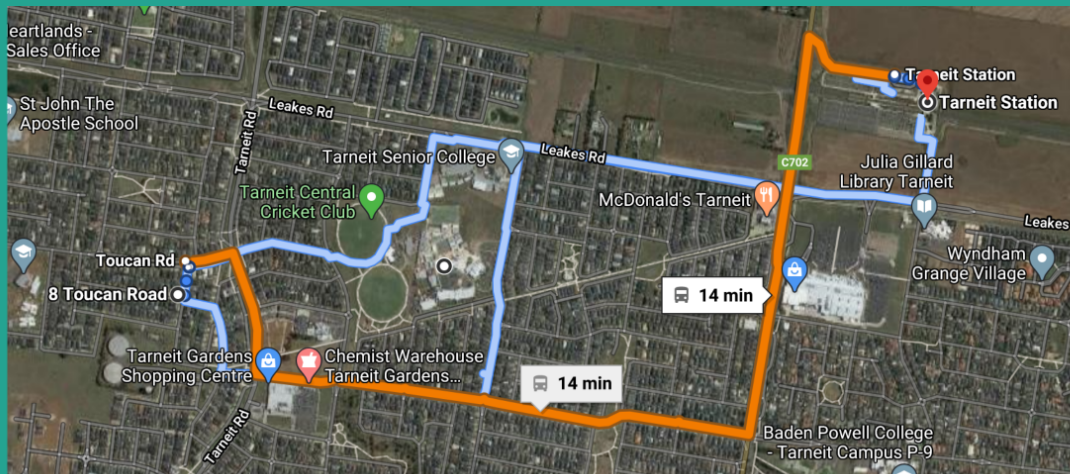








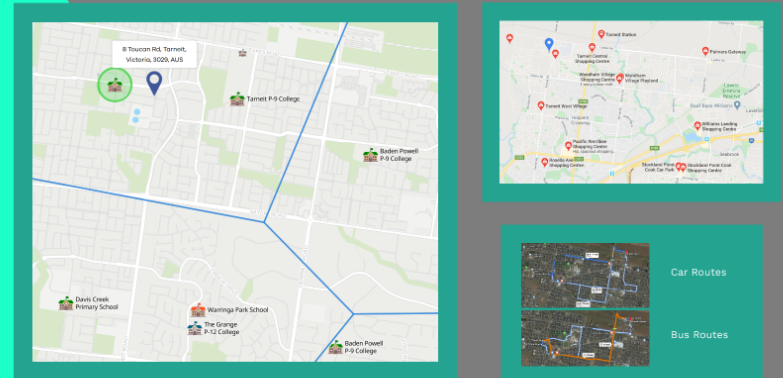
# Car Routes



# Bus Routes

# Site Plan

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# Exterior Design

- Materiality
- Orientation of external features

## Materials

Locally sourced

- High insulating capabilities
- Withstand a wide range of weather conditions
- Low maintenance
- Cost-effective

TERRACOTTA ROOF TILES



SPOTTED GUM CLADDING



- Perfect for bushfire prone areas
- Strong hardwood
- Thermal insulation
- Stable long-term

## External Features

Accommodates larger scale entertainment

Vegetable gardens close to kitchen

Water tank close to water heating system



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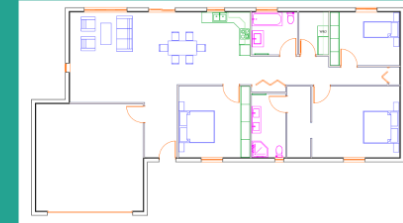


# Floor Plan

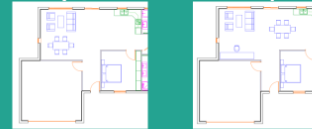
- Open floor plan
- Orientation-based design
- Multi-functional
- Optimises passive design principles

## Living Arrangements

- Maximises flexibility
- Living and bedroom spaces can be altered
- Creates a more open and modular space



LIVING SPACES ARRANGEMENT



ALTERNATIVE BEDROOM ARRANGEMENT



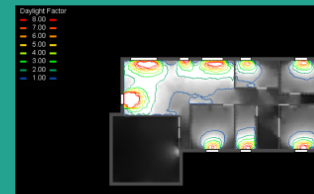
## Passive Design

- Encourages passive air-flow
- Sunlight penetration is maximised

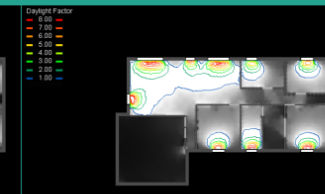
CROSS-VENTILATION THROUGH HOUSE



WINTER SOLAR PENETRATION

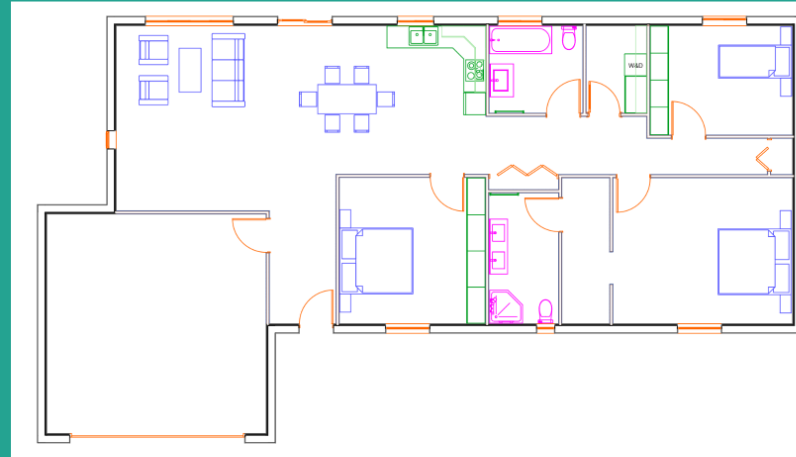


SUMMER SOLAR PENETRATION

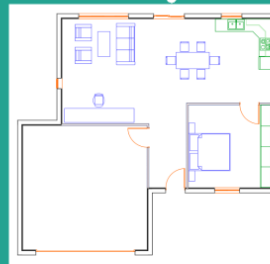
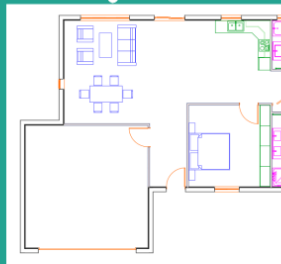


# Living Arrangements

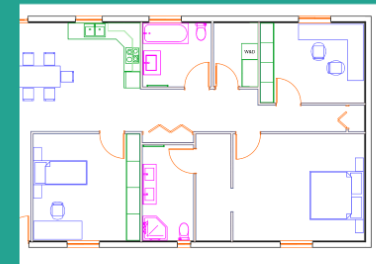
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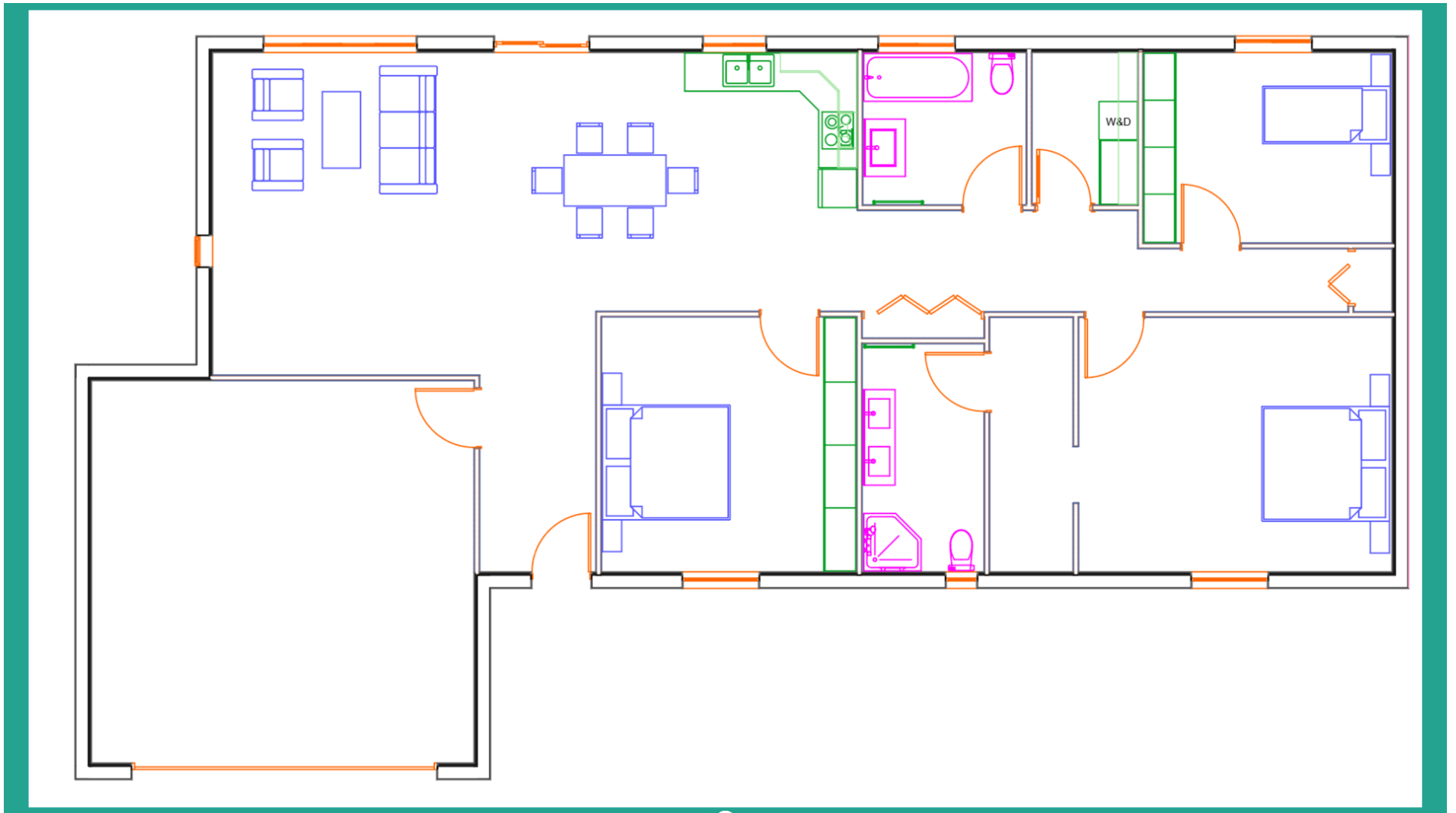


LIVING SPACES ARRANGEMENT



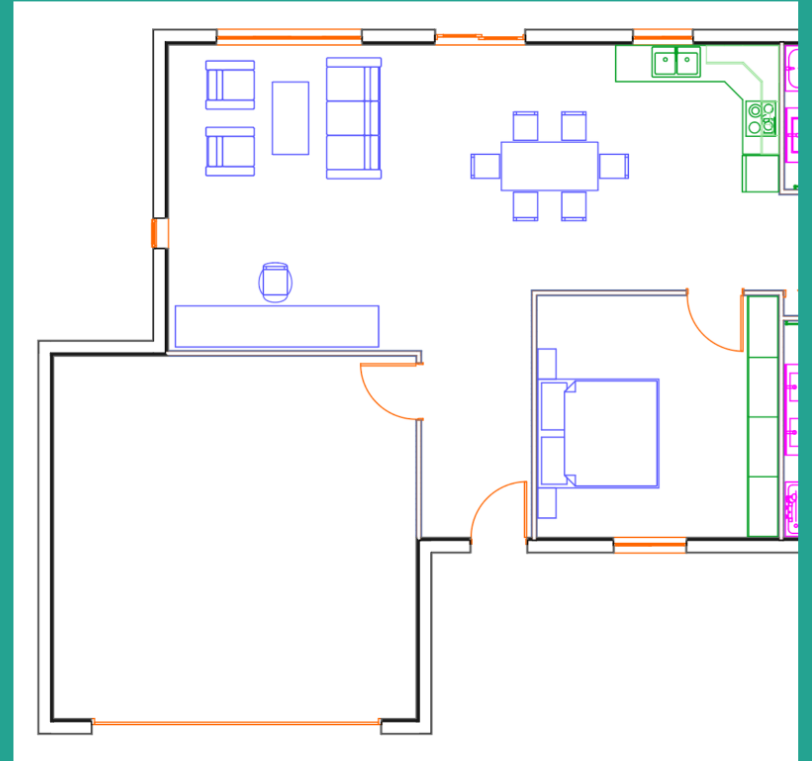
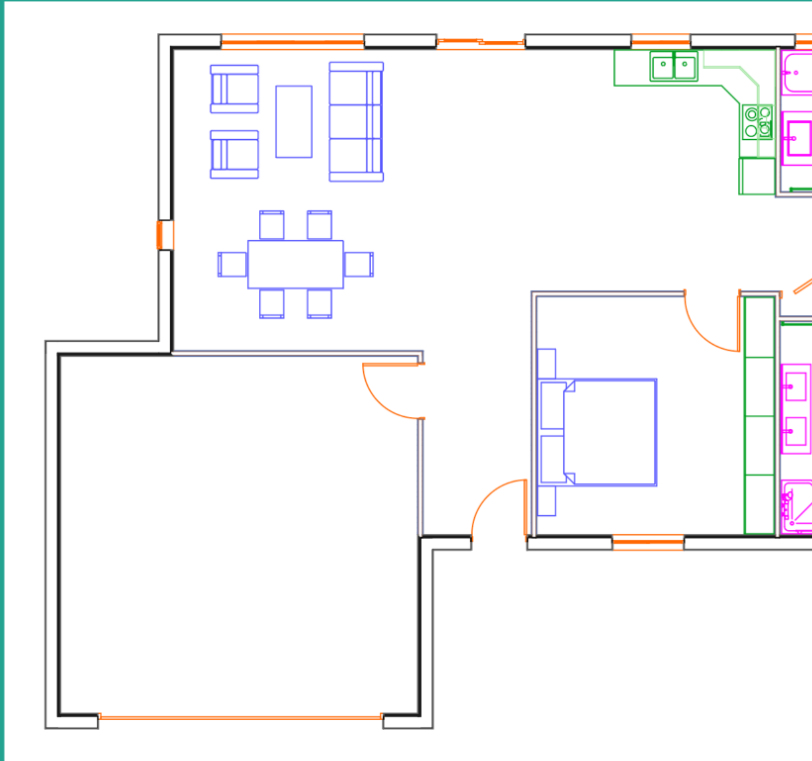
ALTERNATIVE BEDROOM ARRANGEMENT



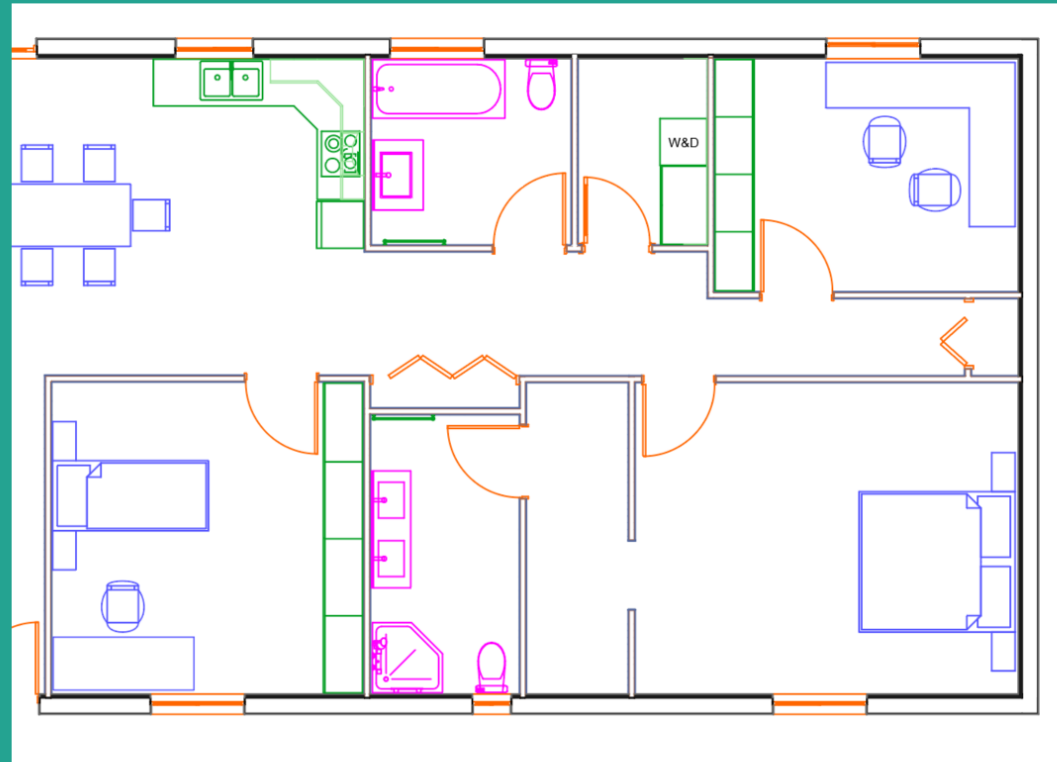




# LIVING SPACES ARRANGEMENT



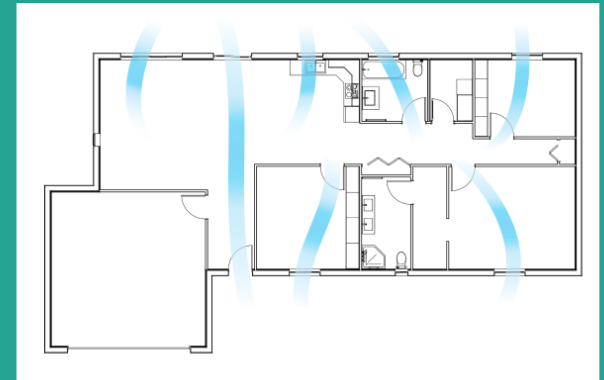
# ALTERNATIVE BEDROOM ARRANGEMENT



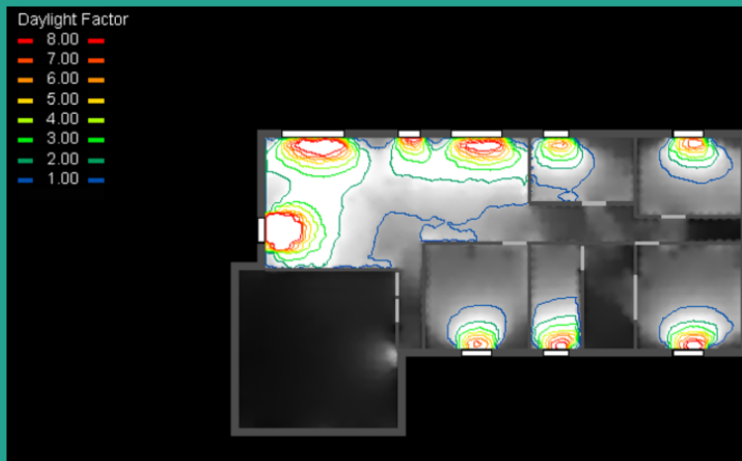
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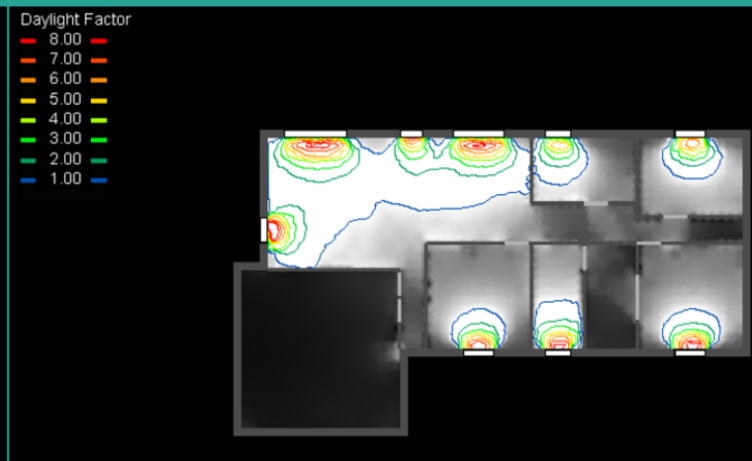
CROSS-VENTILATION THROUGH HOUSE



WINTER SOLAR PENETRATION



SUMMER SOLAR PENETRATION



# Interior Design

INTERNAL TIMBER CLADDING AND FLOORING



BEDROOM STORAGE

LINEN CUPBOARD

Internal Storage



# Surreal Estate

## SINGLE SUBURBAN FAMILY HOUSING



Sustainability

Resilience

Net Zero Energy

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Overview



# Engineering



# Bushfire Resistance



Building  
Enclosure



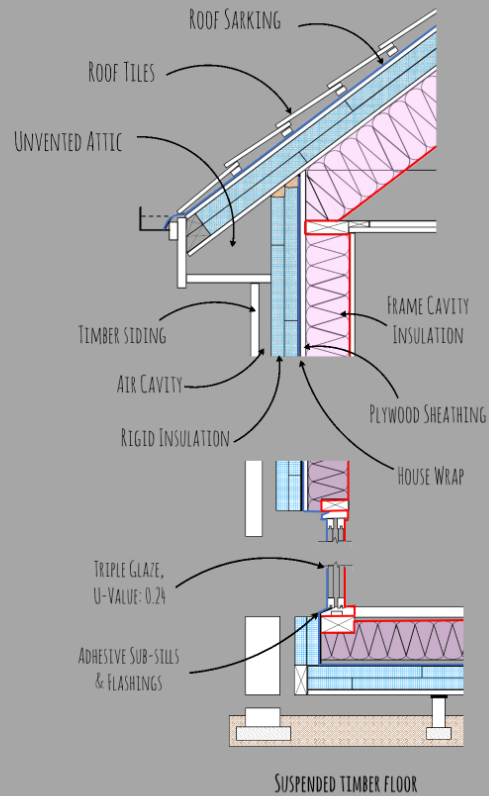
Building  
Systems

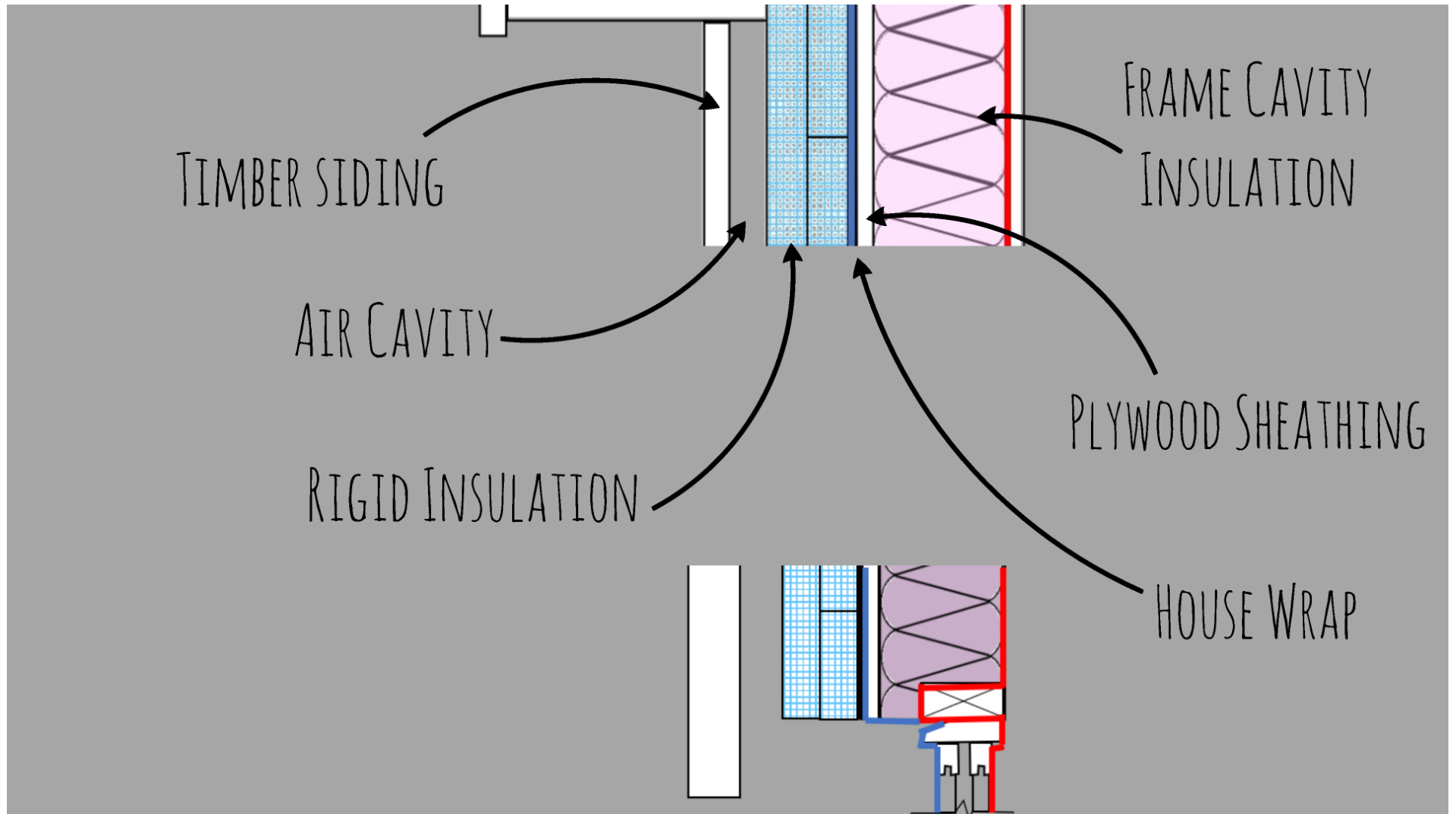


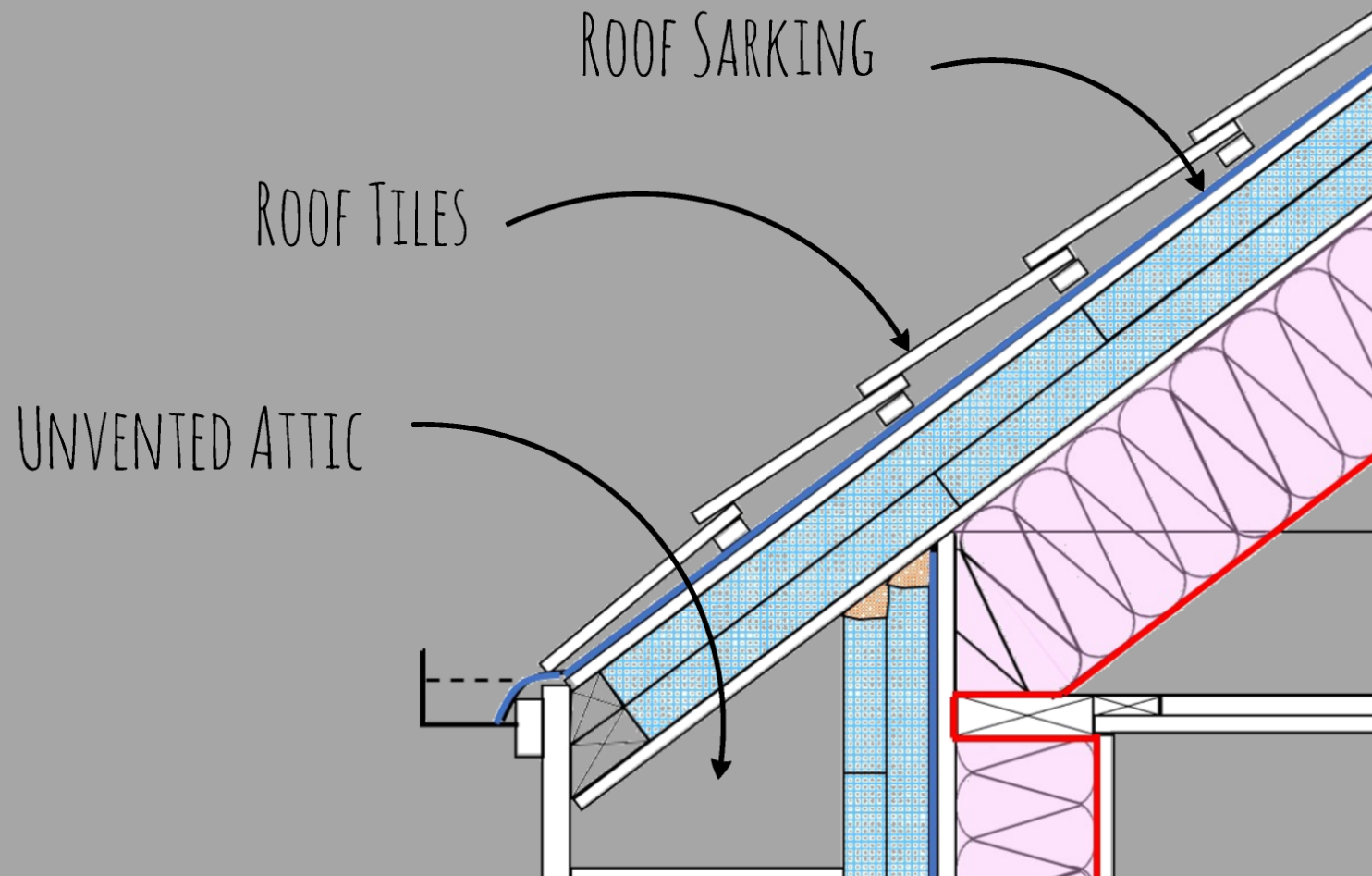
Resilience  
Measures



# Building Enclosure

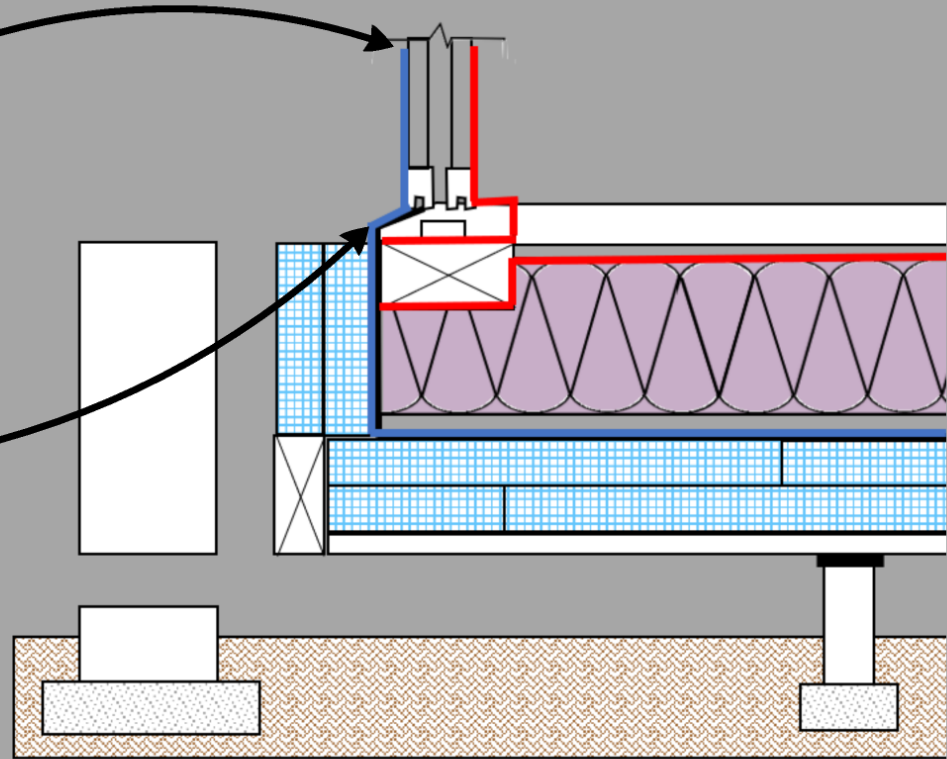






TRIPLE GLAZE,  
U-VALUE: 0.24

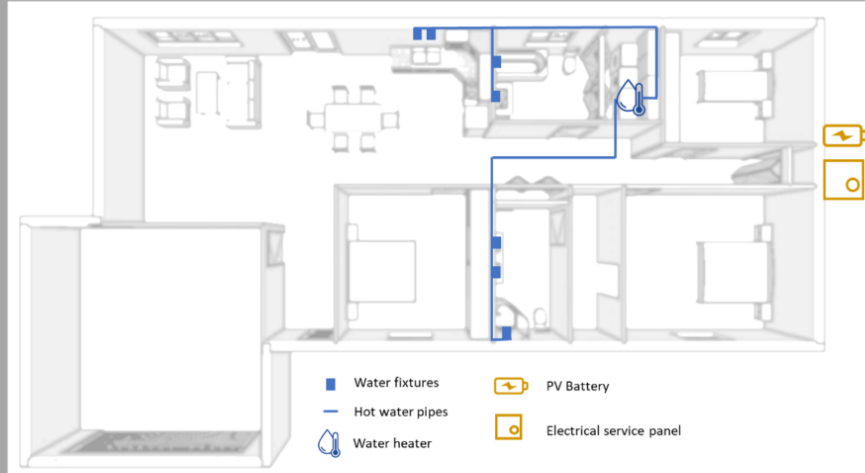
ADHESIVE SUB-SILLS  
& FLASHINGS



SUSPENDED TIMBER FLOOR

# Building Systems

- Centralize utilities
- Maximize efficiency
- Optimize maintenance

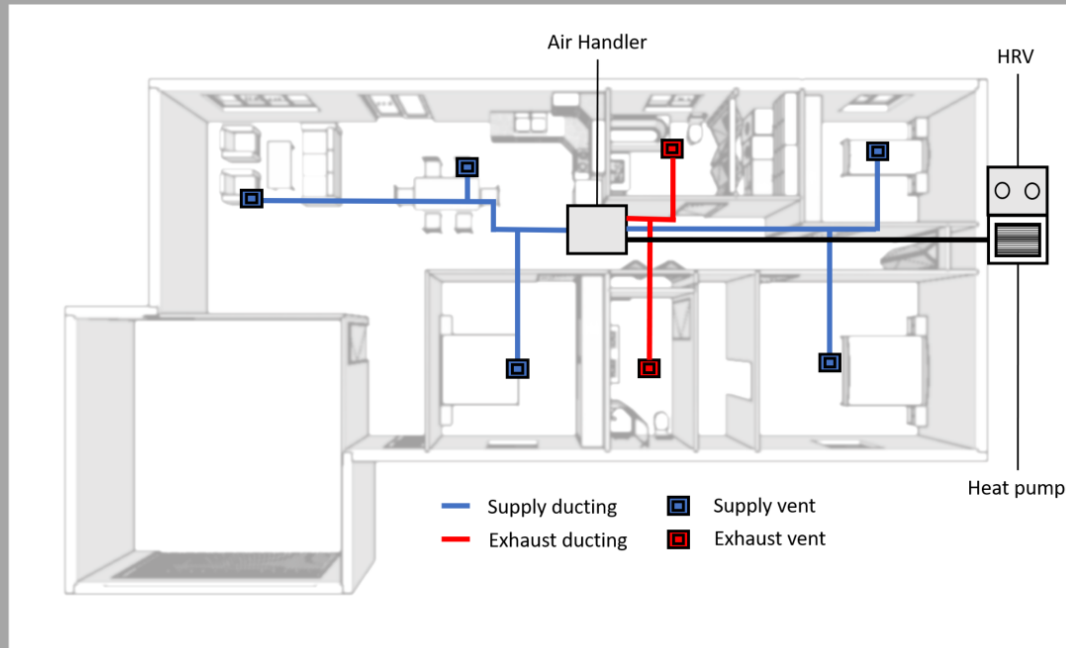


HVAC



Water  
systems

# HVAC



- Air-source heat pump
- Central air handler
- Ceiling mounted ducting
- Supply duct sizing: 20"
- Exhaust duct sizing: 12"
- HSPF: 9.5
- Heat Recovery Ventilator



# Water systems



- Centralized water fixtures
- Minimize heat loss
- 1,850 gal rainwater tank next to garden

# MAIN APPROACHES

- Standard-accordance
- Removal of areas that may catch fire



LANDSCAPING



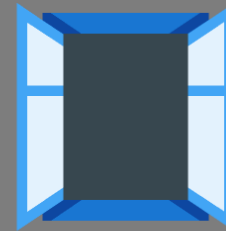
WATER TANK



SPRINKLER SYSTEM



FIREBREAK



CASCADE WINDOWS



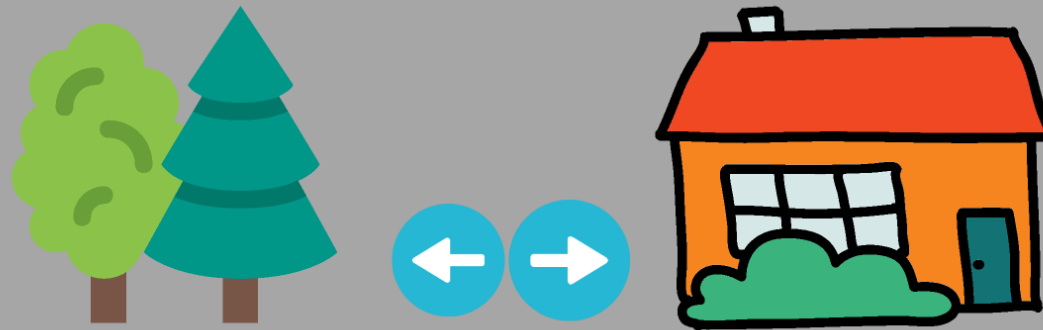
GUTTER GUARDS



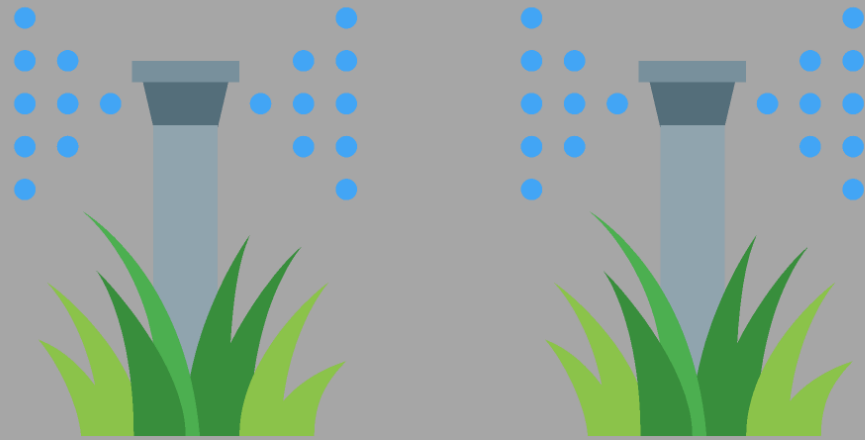
EVACUATION APP

# MAIN APPROACHES

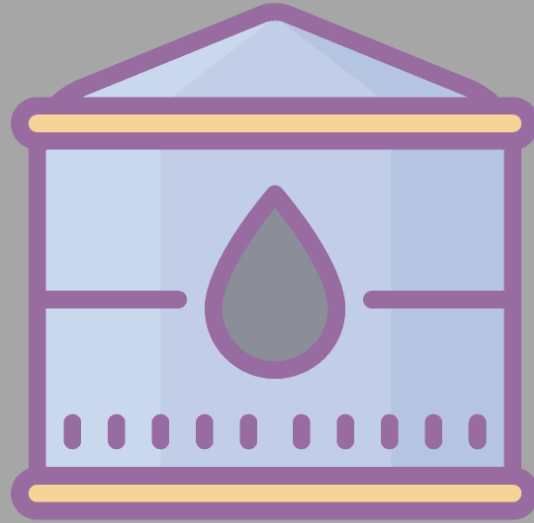
- Standard-accordance
- Removal of areas that may catch fire



# LANDSCAPING



# SPRINKLER SYSTEM



WATER TANK

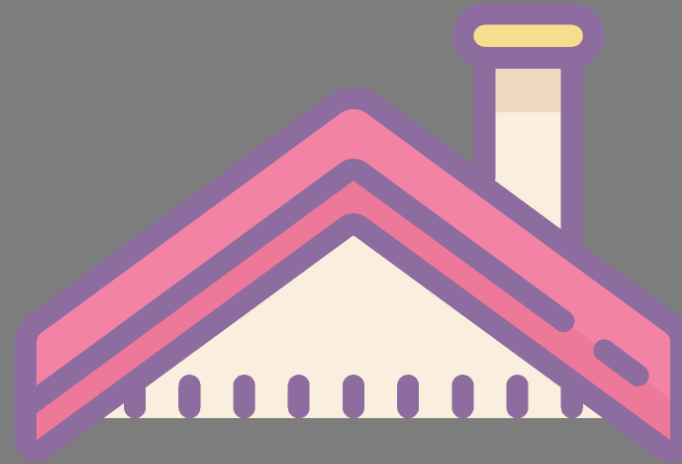




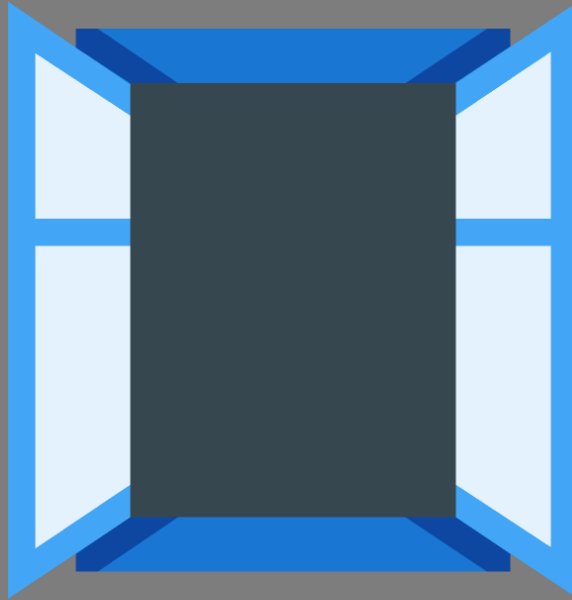
FIREBREAK



REAK

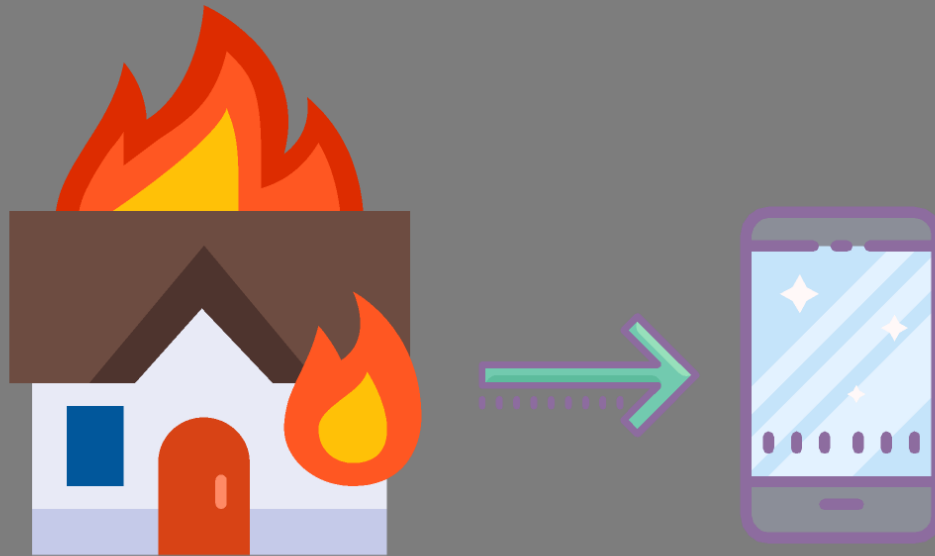


GUTTER GUARDS



CASCADE WINDOWS

DOWNS



EVACUATION APP

# Surreal Estate

## SINGLE SUBURBAN FAMILY HOUSING



Sustainability

Resilience

Net Zero Energy

Affordability

Outline



Overview

# Energy Performance

## Annual Energy Consumption

8323  
kWh

5.87  
kWh/sq ft

30%  
heating

## HERS Index

35  
without PV

-25  
with PV

CLICK TO KNOW  
MORE!



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Design 10% more

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- Efficient appliances & lightings (ENERGY STAR)  
and passive heat design



Energy

S & Green Star)

ings (ENERGY STAR)

Energy

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ings (ENERGY STAR)



15% window-to-wall ratio  
North-facing



Cross-flow ventilation



Thermal zoning

# Strategies to Net Zero Energy

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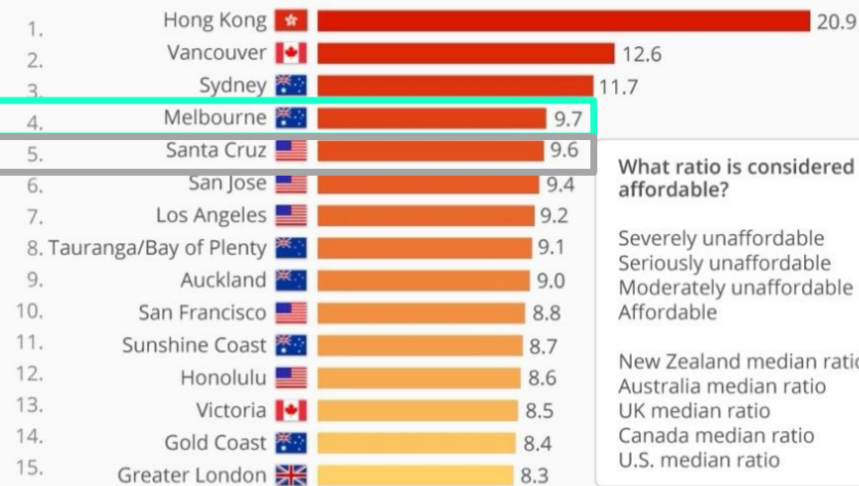


Overview



## Where it is Hardest to Afford a Home

Least affordable international housing markets ranked by house price to income ratio\*



What ratio is considered affordable?

|                          |         |
|--------------------------|---------|
| Severely unaffordable    | ≥5.1    |
| Seriously unaffordable   | 4.1–5.0 |
| Moderately unaffordable  | 3.1–4.0 |
| Affordable               | ≤3.0    |
| New Zealand median ratio | 6.5     |
| Australia median ratio   | 5.7     |
| UK median ratio          | 4.8     |
| Canada median ratio      | 4.0     |
| U.S. median ratio        | 3.5     |

\* median house price divided by median annual gross household income  
@StatistaCharts Source: Demographia International Housing Affordability Survey 2019

statista

# Affordability

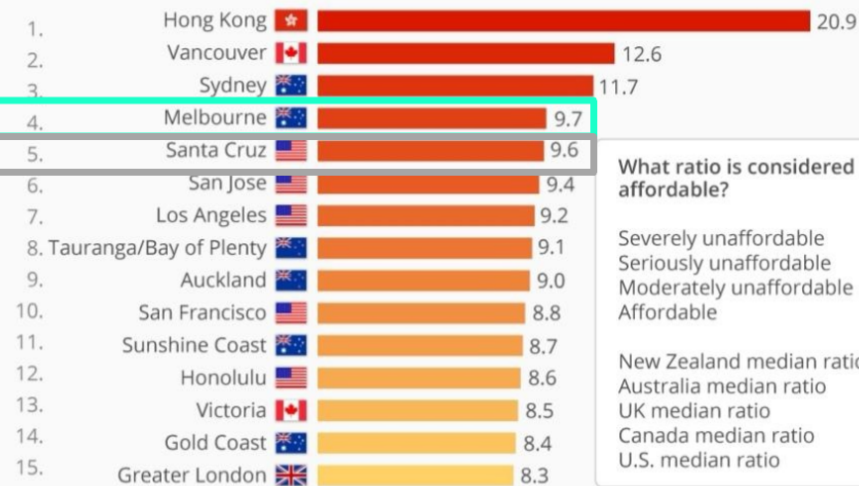
SUBURBS TIPPED TO ENJOY ABOVE AVERAGE GROWTH IN NEXT 12 MONTHS



“ Tarneit is an affordable, burgeoning outer-west suburb ”

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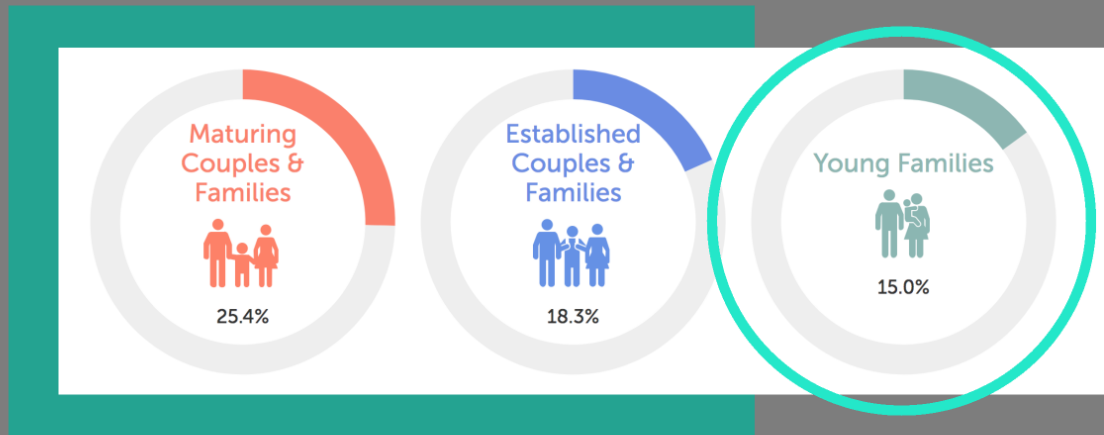
SUBURBS TIPPED TO ENJOY ABOVE AVERAGE GROWTH IN NEXT 12 MONTHS



“ Tarnait is an affordable, burgeoning outer-west suburb ”

# Target Market

*The average working Australian family*



**15%**  
more affordable  
than Melbourne city

*Average home in Tarneit*  
**\$ 277,800 USD**

*Realestate.com.au 2020*

*Mean household income*  
**\$ 72,282 USD**

*Australian Bureau of Statistics (ABS) 2017-18*

*Low bracket cost to build  
a home in Victoria*  
**\$ 185,128 USD**

*Budget Direct 2019*

*\*AUS TO USD EXCHANGE RATE (1:0.62)*

# Financial Feasibility

- *Tesla solar battery Powerwall*

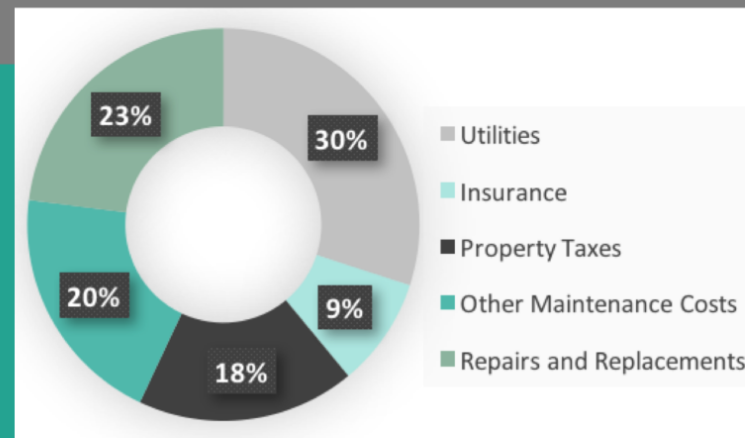
**\$7,120 USD**

- *Total Construction Costs*

**\$190,611 USD**

- 80% of expenses are incurred during usage

## *The 1% Rule*



# Surreal Estate

## SINGLE SUBURBAN FAMILY HOUSING



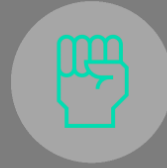
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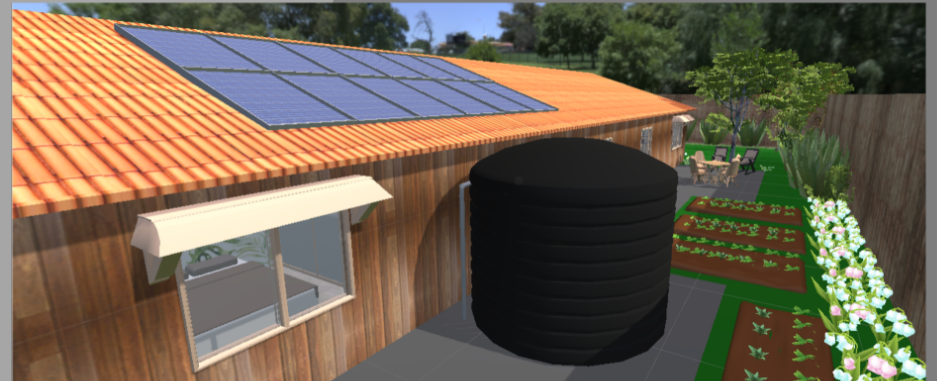
Outline



Overview

# Overview

- Focus on bushfire resistance
- Highlight affordability
- Sustainable
- Encourage passive energy design





# Surreal Estate

## SINGLE SUBURBAN FAMILY HOUSING



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Overview