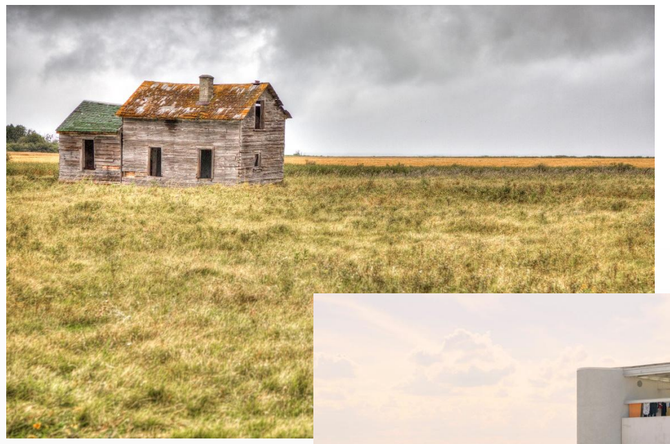
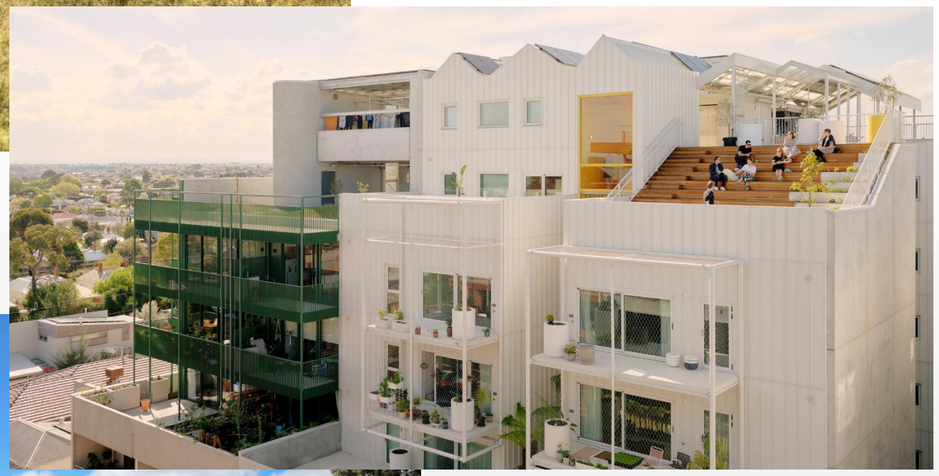
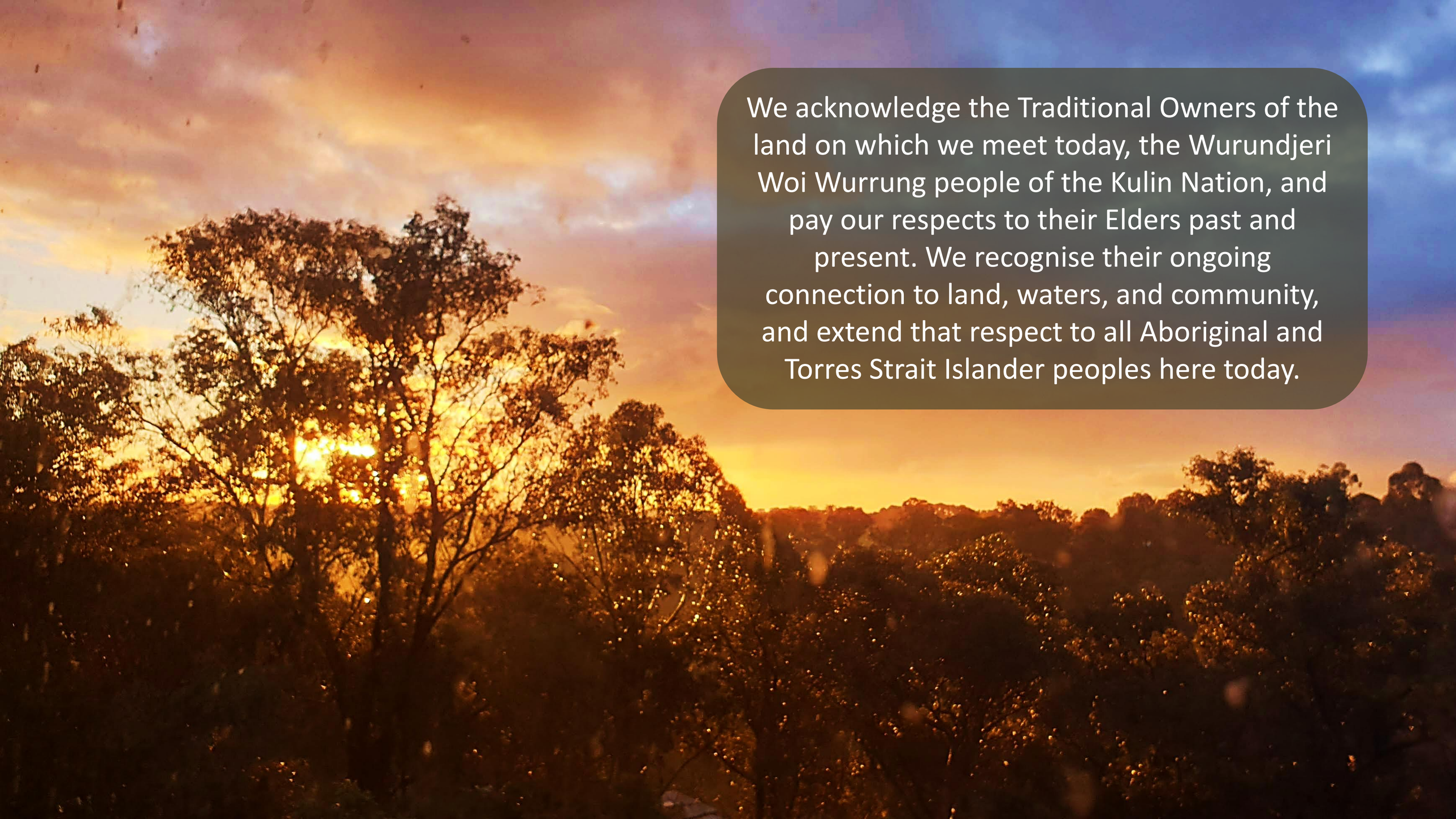
Operational energy | Embodied energy | End-of-life | Behaviour

Sustainable Housing

Using energy wisely across the whole life of a home






We acknowledge the Traditional Owners of the land on which we meet today, the Wurundjeri Woi Wurrung people of the Kulin Nation, and pay our respects to their Elders past and present. We recognise their ongoing connection to land, waters, and community, and extend that respect to all Aboriginal and Torres Strait Islander peoples here today.

Overview

- Why think about energy?
- Sources of energy consumption in a home
- Embodied energy
- Operational energy
- End of life outcomes
- Our behavioural impact
- Taking action

Why does energy matter?

- Energy is required for all action
- Desire for more action = need to unlock energy stores
- By-products of accessing that energy
- Energy scarcity

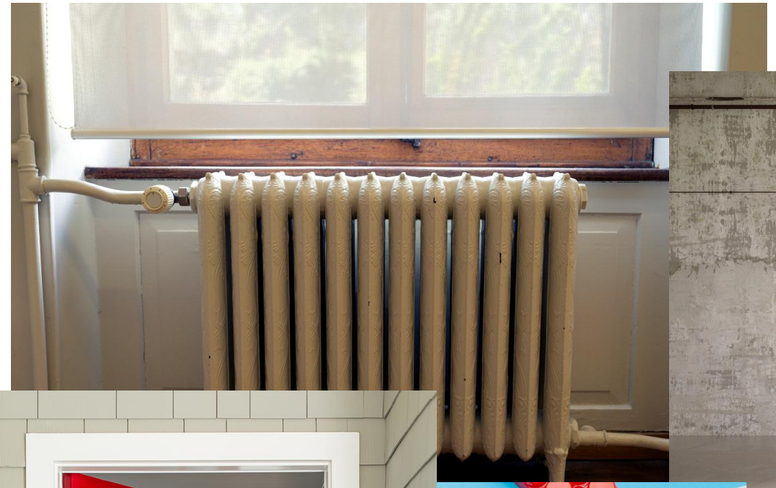
“Energy is the capacity to do work or cause change”

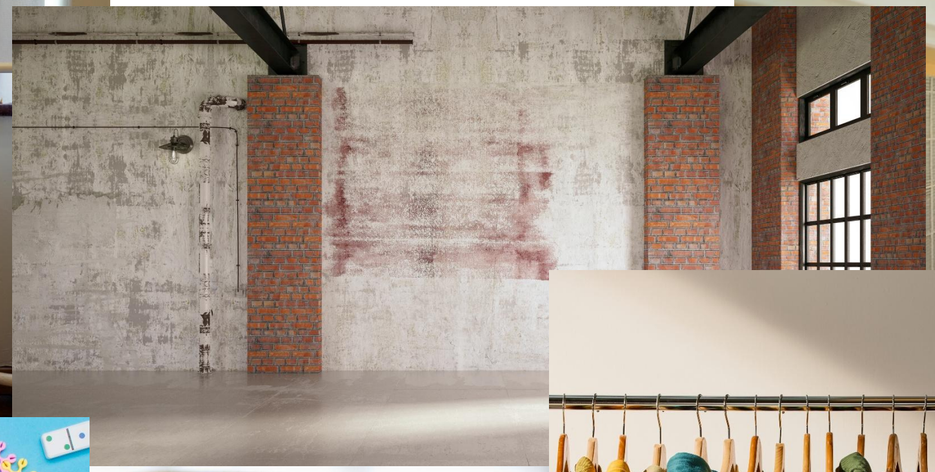
- Is energy consumption bad?
- When is it bad?

1/3rd of Australia’s emissions are from building activities

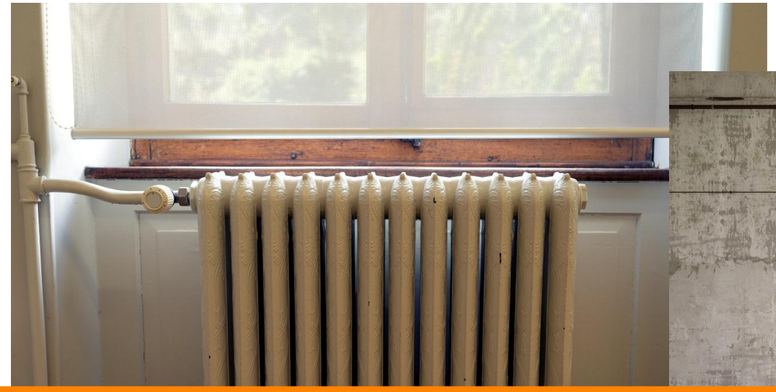
Source: Infrastructure Australia

What are the sources of energy consumption in a home?





Operational energy



“Energy used to run a home in day-to-day use”

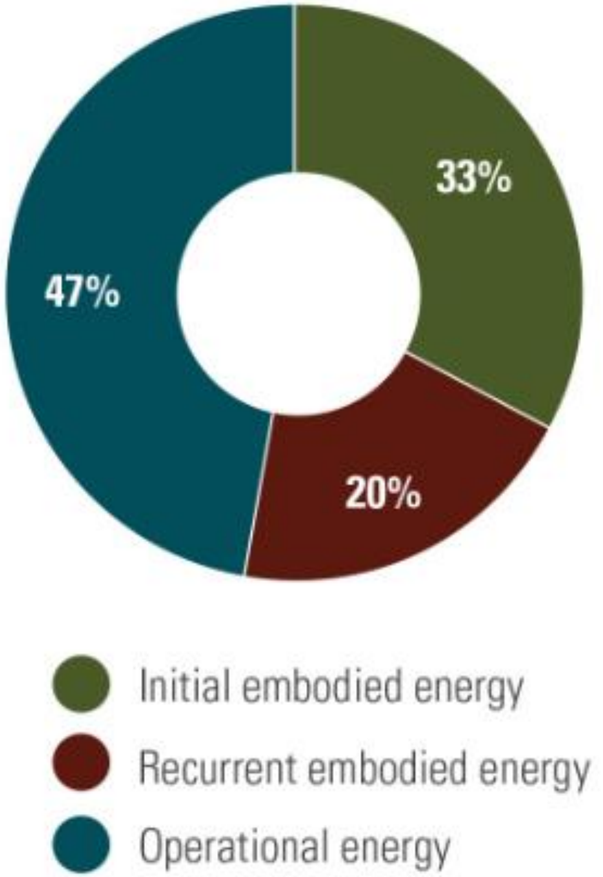
Embodied energy

“Energy used to produce an item from raw materials through to delivery, maintenance and end-of-life”

What matters most? Embodied or operational?

- **The longer the asset lifetime, the less intense the embodied emissions**
- **Upfront emissions are locked in by construction, whereas operational energy emissions can reduce as renewable energy supply increases**
- **Reducing one may increase the other**

They both matter!



Proportion of operational and embodied energy over the 50-year life of a typical brick veneer house

Source: Operational energy based on Weterings and Tustin (2017) and initial and recurrent embodied energy based on Crawford (2014) (average initial embodied energy of 13.4GJ/m^2, average recurrent embodied energy of 8GJ/m^2 for 50 years) and average floor area based on ABS/CommSec (2018) (new detached housing of 230.8m^2).

Source: YourHome.gov.au

Reducing embodied energy/emissions

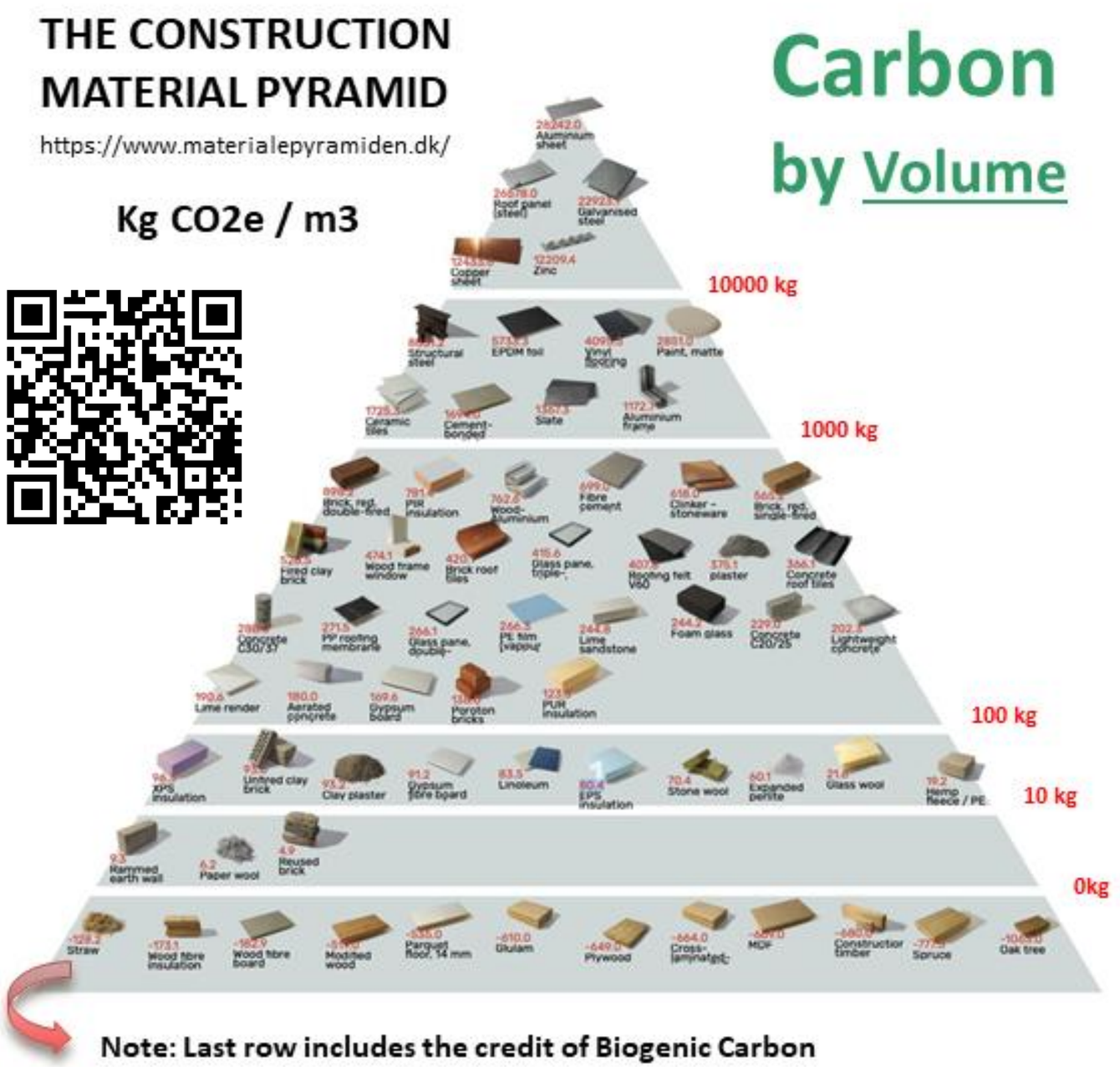
Understand material emissions intensity
- Emissions generated by volume
- How much material you need
- Consider longevity/quality
- Lifecycle assessment calculation / EPDs

Re-use materials – circular economy
- Reclaimed / repaired
- Recycled content*
- Waste product

Consider material transport
- Hyper-local supply
- Electric freight
- Avoid air-freight
- Intl sea-freight over long-distance road freight

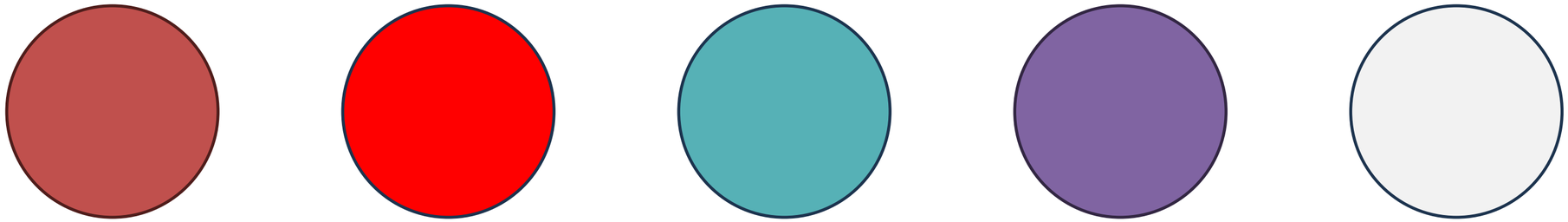
<u>Use less</u>
- Build smaller
- Retain/reuse/repair what you can

This is the #1 most impactful action



Source: thesba.com.au

What uses the most energy in a typical Vic home?



Highest energy user

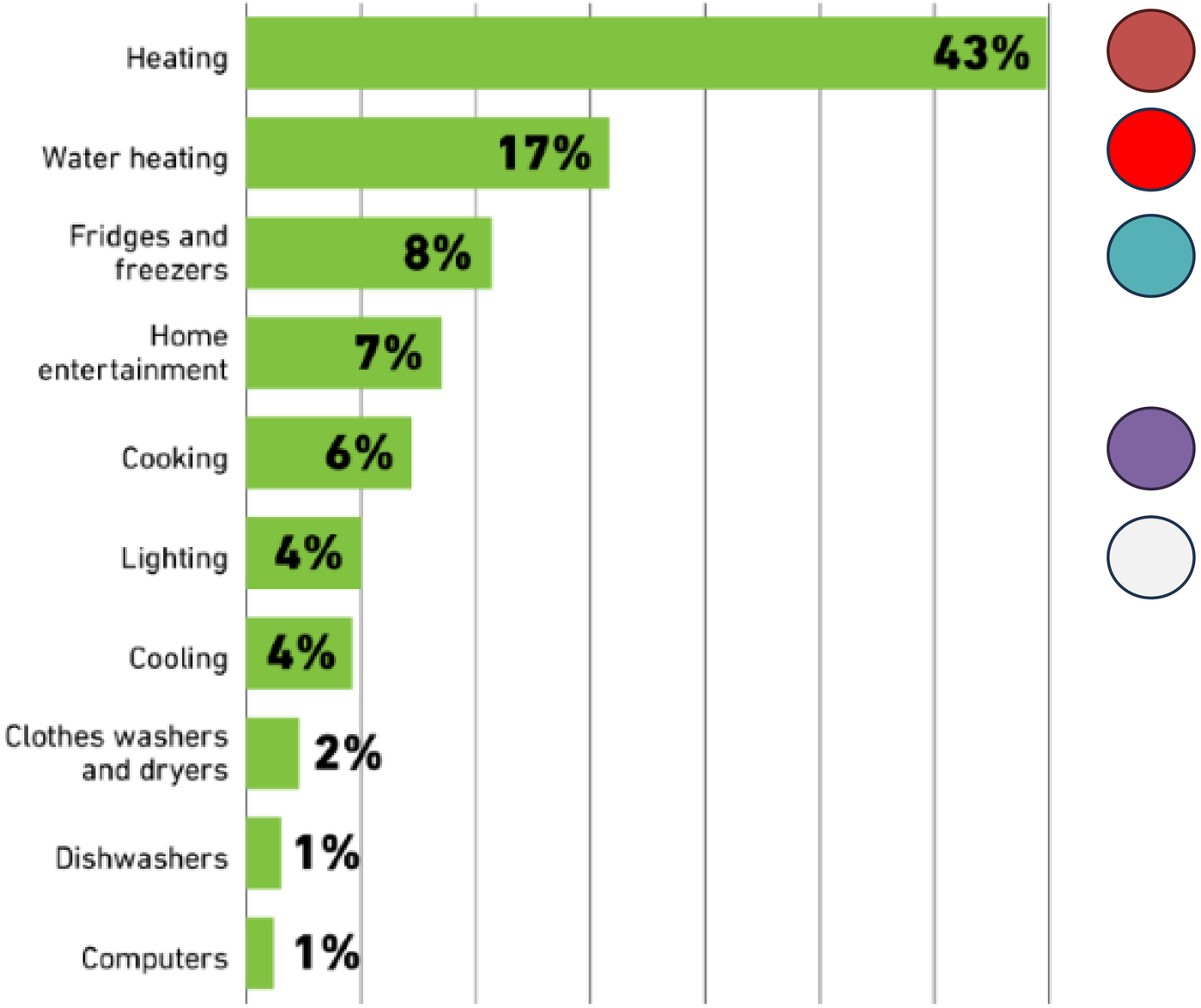
High

Moderate

Low

Lowest energy user

What uses the most energy in a typical Vic home?



Source: Sustainability Victoria

Reducing operational energy/emissions

Energy efficiency of the building

Reduce heating and cooling loads

- Air-tightness to prevent ingress/egress
- Insulation and thermal breaks isolate the inside of the home from outdoor temps
- Use natural systems to heat and cool

Energy efficiency of appliances

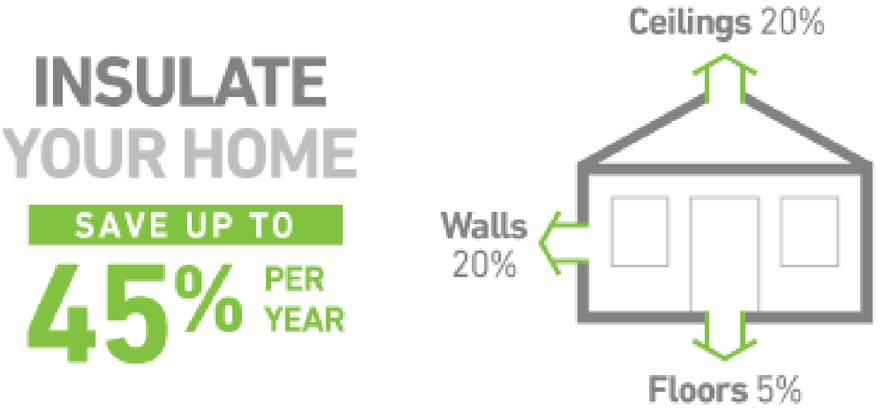
- Heating and cooling
- Hot water heating
- Fridges & freezers
- Washers & dryers
- Dishwashers
- Lighting
- Oven and Stove
- TV’s, screens etc.

Building efficiency

Create an efficient ‘thermal shell’

- Insulation
- Double-glazed windows with thermally broken frames*
- Draught-proofing
- Reduce ‘thermal bridging’ - conductive materials that span outside to inside
- Reduce external wall and glazing ratios
- Avoid windows on the west and south
- locate living spaces and windows to the north

Image credit: Clean Energy Nillumbik, Rosie & Grant’s House



Source: Sustainability Victoria

Source: © Beaumont Building Design, via YourHome

All homes should try to achieve these goals

*for retrofits, consider ‘secondary’ double glazing (no frame upgrade) as a more cost-effective option

Building efficiency

Use of natural systems

- Cross flow ventilation
- Passive solar heating
- External shading in summer
- Thermal mass banks

These will depend on your site / orientation / shading and ultimate design approach

A PassivHaus creates a highly efficient thermal shell and may not utilize natural systems – good for sites with poor orientation or heavy shading.

All performance measures are verified to achieve certification - confirming you are getting what you paid for!

Image credit: Clean Energy Nillumbik: Trevor & Maureen's House

"Build it tight, ventilate right"

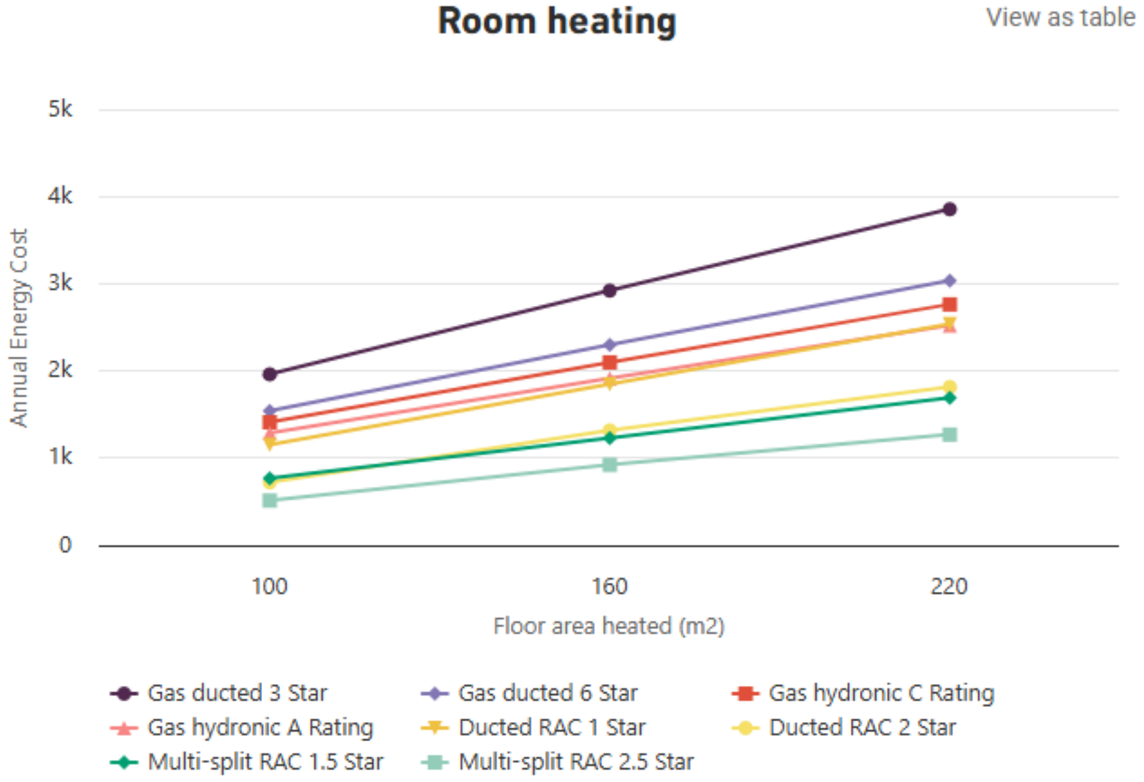
Increasing air-tightness traps moisture – ventilation is a must

- Typically achieved using ventilated cavity construction (wall and roof) with vapour permeable membranes, and
- Mechanical heat recovery ventilation -> efficient transfer of heat from expelled air to constant fresh air intake

Appliance efficiency

Go-electric

- Heat pump heating and water heating are 3-5x more efficient than gas and conventional electric
- Can be powered by renewable energy
- Electric cars are more efficient than combustion engines
- + health and pollution benefits, and they cost less to run!

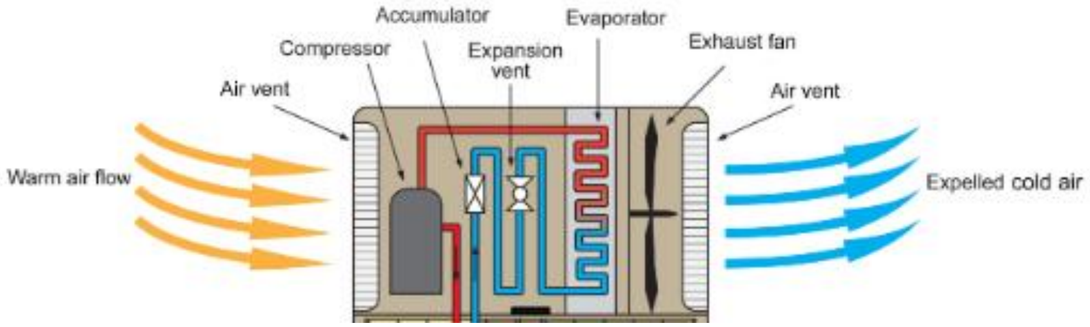


Source: Sustainability Victoria

Tip: Insulate and draught-proof before installing RCAC – this is the best bang for buck!

Add solar

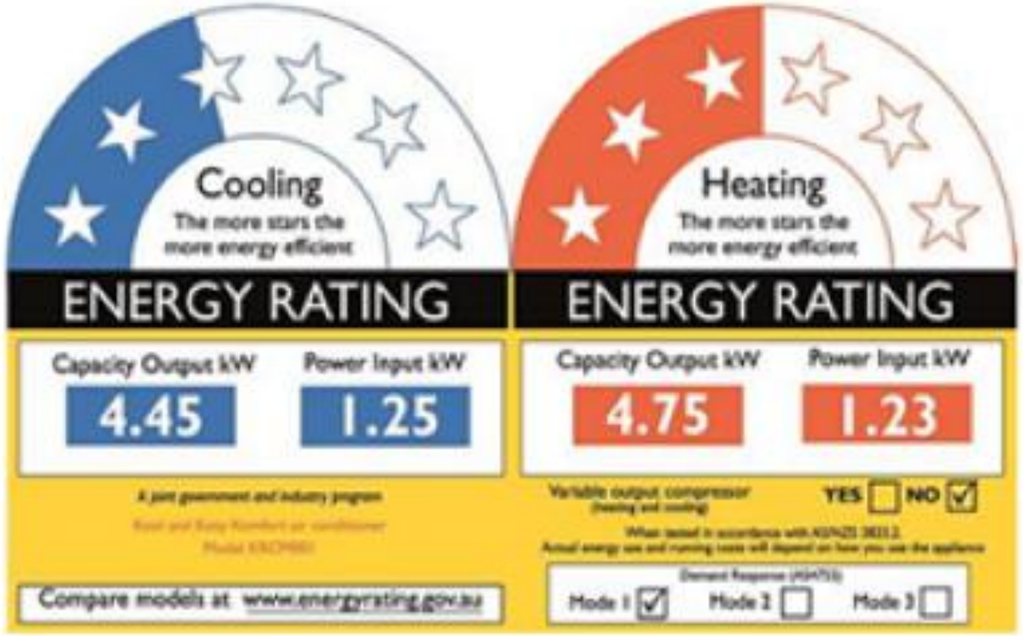
- Enables electric equipment to run off solar
- Consider a battery to continue powering the home after dark

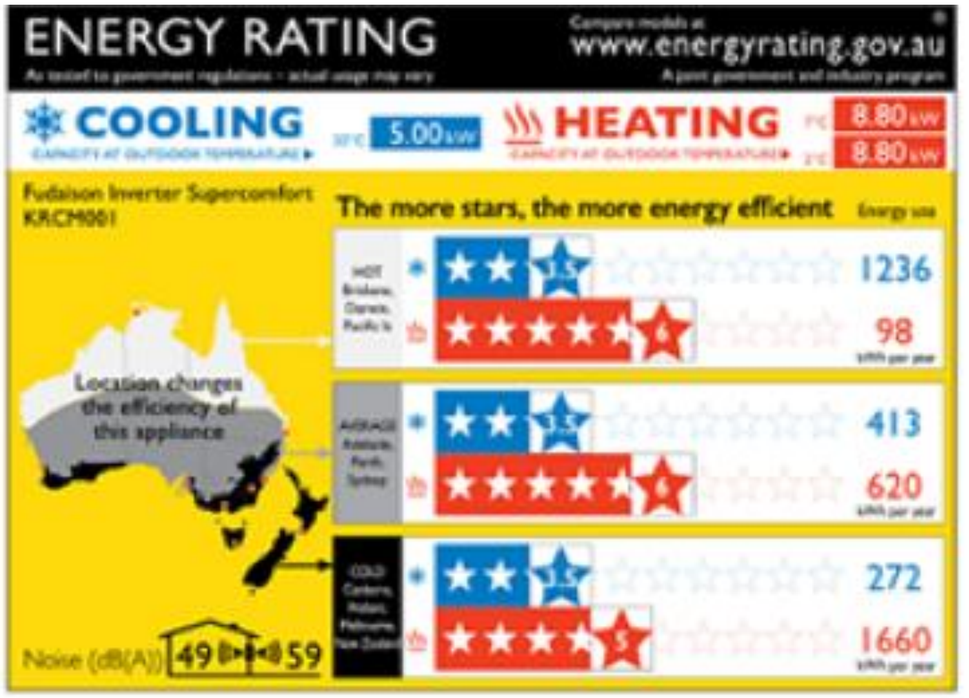


Appliance efficiency

Use the energy-star rating to choose appliances

- Only compare models of the same capacity / size
- Look at both heating and cooling for reverse-cycle air-conditioners and a the ‘cold’ climate zone
- Buy the right size
  - Make sure air-conditioners are powerful enough
  - Fridges are most efficient when they are well-stocked but not chock-a-block
- The more stars the better



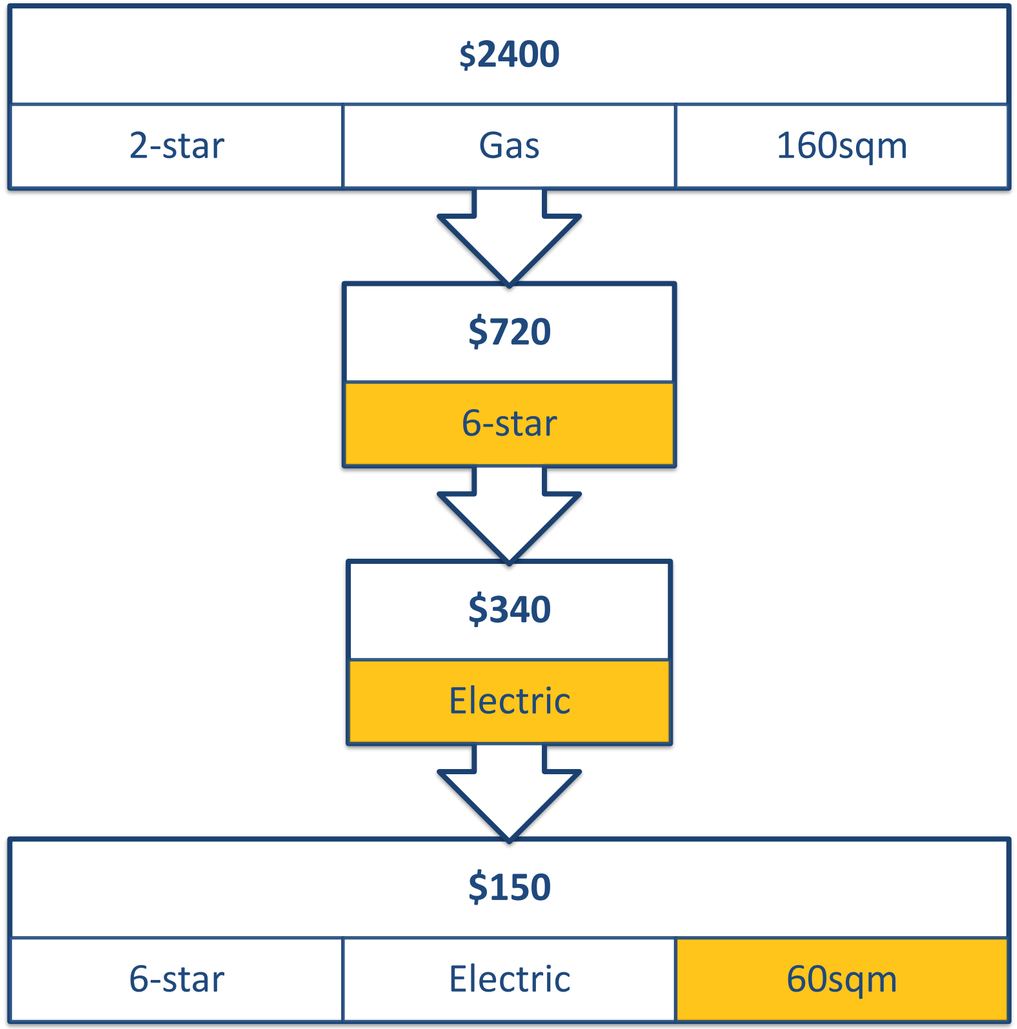


Combined effect of efficiency measures

Approx. 93% saving on heating and cooling:

- **6 star home**
- **Efficient reverse-cycle for heating and cooling**
- **60 sqm (small second dwelling)**

Example: Annual cost of heating and cooling



Adapted from Sustainability Victoria data rounded to nearest $10

End of life outcomes & the circular economy

Problem

- Construction waste is roughly 40% of Australia’s waste
  - material separation
  - cleanliness
- Energy trapped in landfill
- Market for recycled products

Solutions

- Design for disassembly / reuse / recycle On-site recycling solutions
- Look for energy-efficient products that also support the circular economy

Everything uses energy for growth / manufacturing / transport. Anything saved from landfill prevent new energy use and ‘wasted energy’

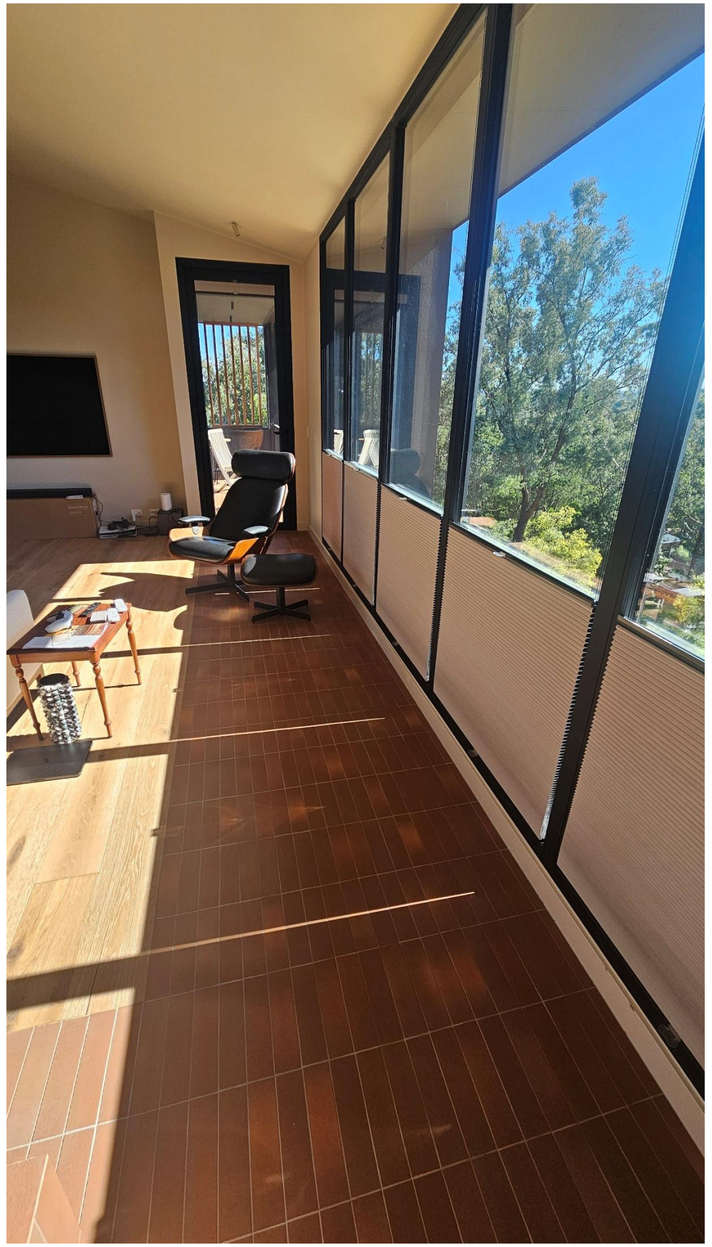
- Leftovers from other builds (marketplace)
- Second hand items
- Liquidation etc. auctions

Behavioural impact

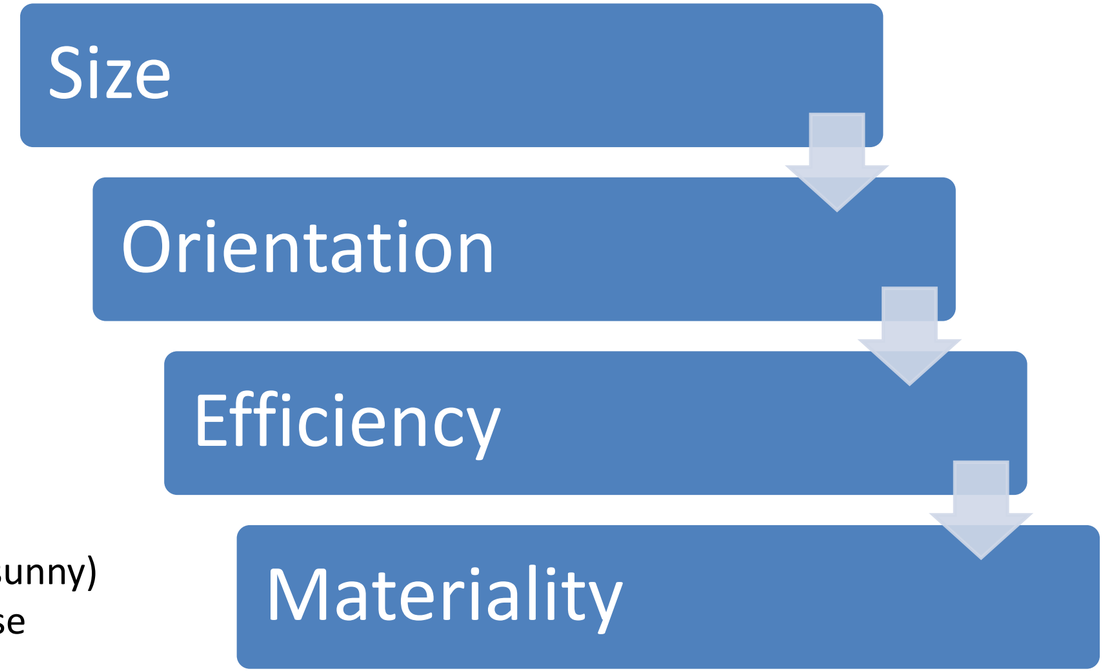
Efficient appliances aren’t the end of the story – Education is key

- Use **passive feature first** – cross flow ventilation, blinds and awnings
- Use **low-energy features second**, like ceiling fans or the AC on ‘dry’
- Set heating and cooling to the right temperatures
  - 18-20 for heating
  - 24-26 for cooling
  - Every **1° cooler adds ≈ 10% energy** (and cost!)
  - Every **1° warmer adds ≈ 15% energy** (and cost!)
- Use an **efficient shower head (at least 5-stars)** and keep showers short
- Keep **mixer taps on full cold** – unless you will wait around for the hot!

- **Be solar aware** – use electric appliances during solar production
  - Schedule hot water heating, dishwashers and washers/dryers
  - Cool the house during hot days, before sunset



Take action



Don’t try to do it all.
There are inherent trade-offs

- Strengths & weaknesses – leverage & focus
- Rank your ambitions
- Whole-of-life material impact

Have good solar?– worry less about cooling efficiency as when it’s hot (and sunny)
Poor solar capacity? – prioritise efficiency, thermal shell + natural systems use
Good orientation? – prioritise natural systems use
Poor orientation? - Acknowledge heating and cooling will be required. Focus on efficiency + thermal shell. Consider Passive House / EnerPHit

Smaller home upgrades

- Draught-proofing & insulation, heating + water heating, solar
- Second-hand / leftover building items

In renovations/extensions

- Leftover material sourcing
- Orientation, thermal shell of new areas separated from old

In new builds – Passive solar or Passive House approach? Natural materials or design for deconstruction?

My top tip for building:

The project team knowledge and priorities matter most

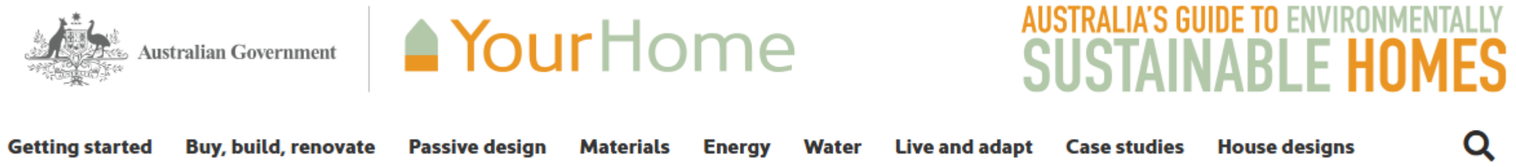
- Choose a builder first with strong values alignment
  They need to have the expertise and the passion to technically and logistically implement your goals

- Choose your designer second.
  Again, look for values alignment

- Consider selecting a builder and architect team that are committed to working together throughout the design

Resources

The bible for homeowners
www.yourhome.gov.au



Construction/materials focus
www.thesba.com.au

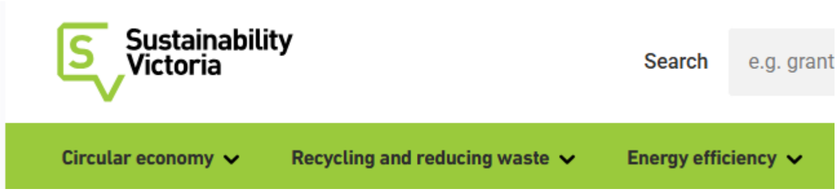
Sustainable Builders Alliance

- Podcast
- Webinars
- Builder list
- Factory visits
- Site tours
- Net Zero Roadmap

Operational energy
Facebook group: My Efficient Electric Home (MEEH)

- Industry experts
- Product reviews
- Knowledge sharing
- Quote sharing
- Real experiences
- Caution: Salespeople

Victoria-specific facts
Sustainability Victoria*



- Heating & cooling costs
- Insulation installation videos
- Buy Circular directory

Upcoming events

Sustainable House Day

The Nillumbik Trail 2026

Sunday
17 May
9:30AM - 3:30PM

Visit local homes and hear from homeowners about their sustainable house improvements and what they have learned.
Ask questions, get inspired, and explore practical ways to make your home more comfortable, cheaper to run, and better for the environment.

Want FREE expert advice?

Come to our second event on 30 May at Edendale Farm - **Electrification Speed Date**
www.cleanenergynillumbik.org.au/events

Book your entry now:
www.cleanenergynillumbik.org.au/events

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