EBOOK 6: SUSTAINABLE LIVING SERIES

HEALTHY HOMES

- Design for healthy homes
- Floors, paints and finishes
- Inside healthy homes
- Bedrooms, indoor plants and more

The best articles from *ReNew* and *Sanctuary* magazines

ATA'S GREEN CLEANING GUIDE INSIDE

ATA PUBLICATIONS

Healthy Homes
The Alternative Technology Association (ATA)

The Alternative Technology Association (ATA) is a not-for-profit organisation which has been promoting renewable energy, sustainable building and water conservation since 1980.

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WELCOME

The Healthy Homes ebook is a compilation of the best articles from *ReNew* and *Sanctuary* magazines on how to achieve a living environment that won't impact on your health.

FOR THOSE OF US WITH ALLERGIES or chemical sensitivities, considering the indoor air quality and toxin levels in our homes is routine. But even if you don't have sensitivities, it's worth doing; it's no secret that we are spending more of our lives than ever indoors.

Whether you're designing a new home or looking to improve your existing living environment, it makes sense to consider what makes a home "healthy" and what choices you can make to achieve it. Conveniently, what works for a healthy home is often also a more environmentally friendly choice.

In our design section, we bring you articles on ensuring the air in your home is fresh by avoiding condensation, using natural and mechanical ventilation and even by enlisting the help of carefully chosen indoor plants.

The materials and finishes you use in your home can also have a big impact on indoor air quality by "off-gassing" volatile organic compounds (VOCs) and other nasties. We've included articles on choosing more benign paints, oils and varnishes, and what to consider when choosing your flooring type.

We take a look inside three beautiful healthy homes, to see how the theory has worked in practice for these green home owners.

Plus pick up some tips for keeping your home, furniture and clothes clean with the ATA's ever-popular Green Cleaning Guide.

We hope this ebook helps you make design and material choices that promote a healthy home for you and your family.

The ATA team

Keep in touch

If you have feedback or questions about this publication contact anna@ata.org.au

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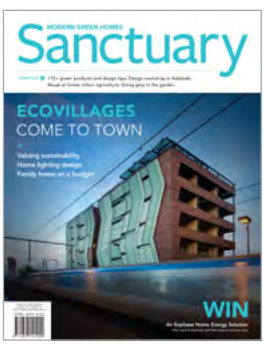
Published since 1980, *ReNew* is Australia's premier magazine on practical sustainable living, showing you how to have an environmentally-friendly home on a budget.
www.renew.org.au



Sanctuary is Australia's only dedicated sustainable house design magazine, providing inspiration and practical solutions for a sustainable home, without compromising on design.
www.sanctuarymagazine.org.au

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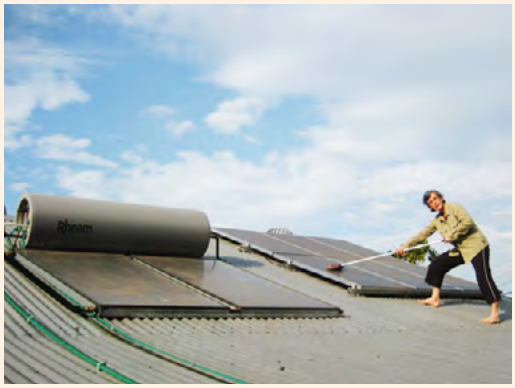

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Photo by Emma Byrnes

#1 DESIGN FOR HEALTHY HOMES

VENTILATION, INTERIORS AND LIVING HOMES

FIRST PUBLISHED IN SANCTUARY 13

VENTILATION & COOLING

DESIGN FOR CROSS VENTILATION

Keeping the facilitation of air flow in mind when designing your home is crucial for good ventilation and passive cooling, writes Paul Downton.

IF YOU HEAT THE END OF AN IRON bar, the heat moves from the source of the heat towards the cooler parts of the metal. Air doesn't behave like that: warm air doesn't move towards cool air. Warm air is less dense than cool air so it wants to rise; cool air wants to sink. That's how the atmosphere works, with rising warm air masses drawing in surrounding cooler air – as Bucky Fuller said, "Wind doesn't blow, it sucks!"

Passive heating is relatively easy because all you do, in essence, is trap heat. Cooling is more difficult because it involves losing heat – when it's already hot outside. Heat moves in three ways: for a building to lose heat it must either radiate away, be conducted away, or be carried off by convection.

Cooling by thermal mass typically uses masonry that radiates heat away at night and absorbs heat during the day. "Earth coupling" connects the building to the mass of the earth to achieve a similar effect.

Radiated heat can cross "empty" space and pass through air; convected heat is carried by the air; but conduction happens through solid materials when they are connected or touch each other (which is why having "thermal breaks" is important for aluminium window frames with double glazing).

The most practical and direct way to reduce the internal air temperature of a building is by convection, letting the warm air rise and escape. Provide a source from which to draw in the "coolth"

and you have passive cooling. Plants are natural evaporative air-conditioners, so shady courtyards or garden areas (think pergolas, green walls and layers of vegetation) can become sources of cooler air – ideally, using recycled water for irrigation.

Just like plants we feel cooler when air moves across our skin, so air movement is a vital part of energy efficient cooling. The numbers are less important in defining comfort than what we feel. Still air at 32˚C feels really muggy, but stir it gently with a ceiling fan and it can feel more like 28˚C – much cheaper than air-conditioning.

Air movement on still days is very important – develop a cool side and a warm side to your home and create air flow with the cooled, denser air flowing through the house to the warm side. Design for cross-ventilation – remembering that it can't take place if all you can do is open windows on one side of a room. You can't push the air without forcing it into pipes, which is exactly what we do with noisy mechanical air-conditioning systems and when we make musical instruments (if you want to make noise, force air through a constricted gap!). For good natural ventilation, ensure that the window or opening the air flows out of is bigger than the one where it comes in.

Capture cooling breezes. If you are near a large body of water, like a river or the sea, you'll have a major advantage in access to "coolth". In some environments, opening up your home to air movement can mean introducing unwanted dust and noise so careful design is vital. Insulation is as important to cooling as it is to heating and if you do have to seal the house up, a well insulated home will keep heat outside and need less air-conditioning.

Minimise the load by reducing ways your home can attract heat. Light coloured roofs, walls and paving absorb less radiation than dark colours. Shade structures have endless possibilities whilst solar panels or a deck raised above the level of the main roof (to allow air flow) can reduce the radiative heat load on the roof. Green walls, which can be as simple as a trellis and vine, help keep outside walls cool. ■

↑ Four kinds of controllable ventilation at Christie Walk use heat rising up stairwells to high level outlets. Clockwise from top left: openable skylight; vents in the peak of a roof; vents from attic; and openable louvres. Photo by Paul Downton

Dr Paul Downton's practice has always been exclusively about ecological architecture and design. His Christie Walk project in Adelaide (profiled in *Sanctuary* 1) is recognised internationally as a leading example of sustainable urbanism. He was editor of three editions of the best-selling *Your Home* and is one of its primary authors. Over the past twenty years Paul has written extensively about sustainability and earned a reputation as one of the world's leading thinkers on ecocities.

FIRST PUBLISHED IN RENEW 127

MECHANICAL VENTILATION

FRESH AIR WITHOUT THE HEAT LOSS (OR GAIN)

Clare Parry explains what mechanical ventilation is and why we might want to use it as our homes become better sealed.

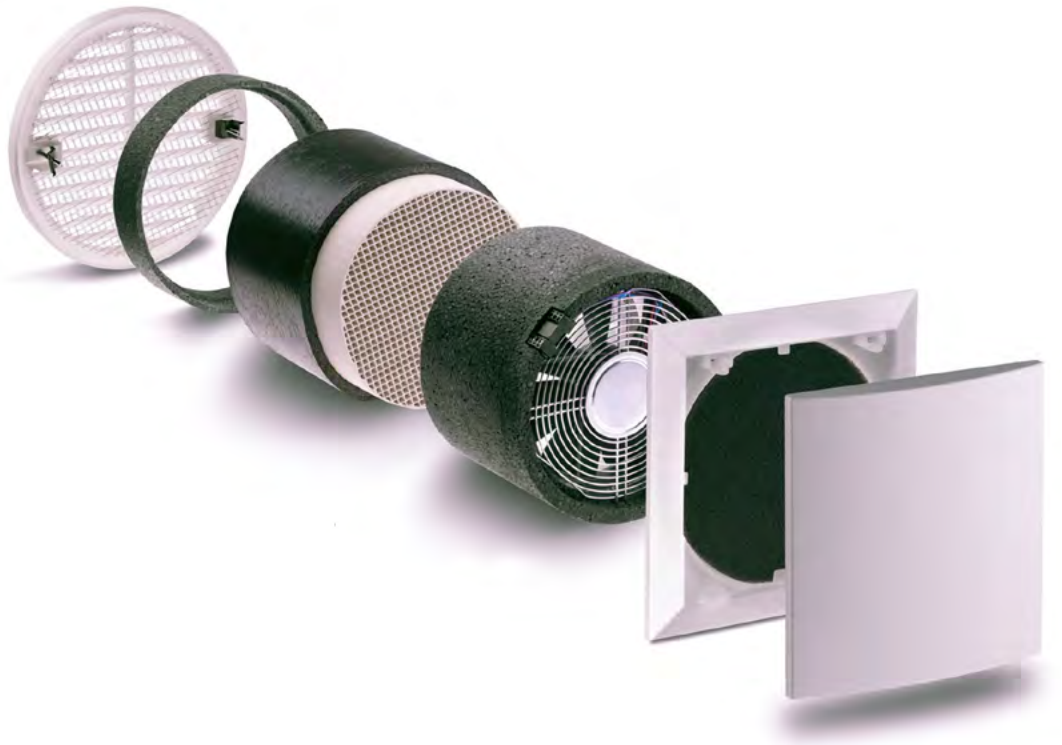
MECHANICAL VENTILATION IS NOT something many Australians would be familiar with in their homes, but it is something many would have experienced in other types of buildings, such as offices and hospitals. Mechanical systems are often regarded as unnecessary for dwellings, but, as our Star ratings encourage us towards better-sealed dwellings, these systems become important. Here I hope to outline the reasons why a truly comfortable and efficient home would include mechanical ventilation with heat recovery (MVHR, also called heat recovery ventilation, or HRV systems).

Air infiltration in homes can account for a significant component of the total heating and air conditioning loads in a building (around a third to a half), and this load can be particularly significant in low-energy buildings where all other loads have been reduced.

At a time when housing sustainability is on many householders' minds, the best way to increase energy efficiency is to take advantage of the basics of building physics by making improvements to the envelope. This involves using basic passive solar design principles in conjunction with insulation and building sealing.

One of the great things about sealing up a building is that you gain control over your internal environment—you can open the place up when you want, but when ambient conditions are not suitable the home can be closed up and the internal conditions will be more stable. Ideally, a well-designed home in most parts of Australia would not require heating or cooling at all.

However, sealing a building does mean you need to consider how the building is



↑ MVHR systems can be quite simple, such as the Lunos e2 systems which are installed in pairs. Outgoing air heats the integrated heat recovery ceramic core, which then heats the incoming air when the flow reverses—thus enacting the heat recovery.

then ventilated.

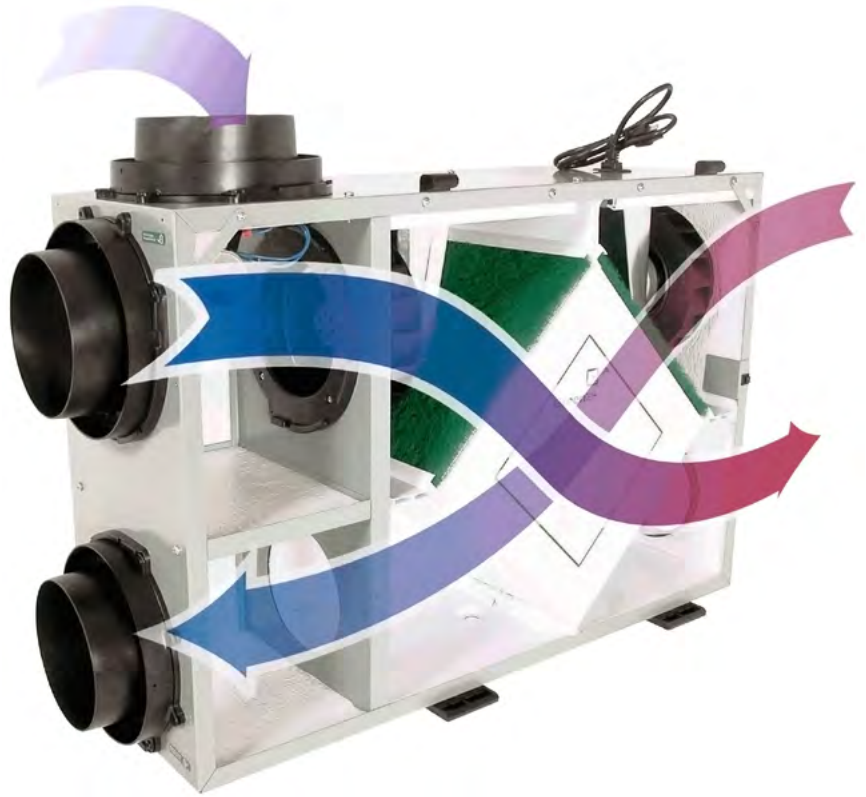
What we refer to as 'natural ventilation', and what the majority of Australian homes rely on for fresh air, is a combination of open windows and imperfections in construction (gaps and holes). This method of ventilation is largely imperfect[1]; good natural ventilation relies on natural variations in pressure and temperature, and the best designs use cross-flow and stack principles to induce air flow into and through a building.

Relying on natural ventilation to provide adequate conditions for good health, as well as comfort, is likely to be insufficient in a well-sealed home. This is because the amount of air infiltration relies on a number of factors, including the time windows are open, openable area and prevailing weather conditions. Table 1 shows typical air changes per hour

Level of home sealing/performance	Air changes per hour at atmospheric pressure (without building pressurisation)
Poor performing home (VIC) built pre-July 2005	5
Average home (VIC) built pre-July 2005	2.25
Poor performing home (VIC) built post-July 2005	1.9
Average home (VIC) built post July 2005	1
High performing home (VIC) built post-July 2005	0.5
British ATTMA standard for 'best practice' in homes	0.15
Passivhaus standard	0.03

↑ Table 1. Air changes per hour for different home types (study by Victorian Building Commission, 2011). As homes become better sealed, the number of air changes per hour without ventilation goes down. Mechanical ventilation is likely required to maintain indoor air quality where the air changes per hour are below 0.15.

Note: In July 2005, the mandatory Star ratings for homes were introduced, changing the approach of energy efficiency in housing, though no requirements for building sealing were included.



← In MVHR systems, heat is transferred between the air flows in and out to greatly reduce thermal flows while allowing high levels of ventilation.

Image: www.imperialgroup.ca

(a measure of air infiltration) without ventilation as building sealing improves.

Mechanical ventilation provides a way to address this, using fans to move air into and/or around a building. A number of studies[2] have also shown that the use of MVHR can be more efficient, in terms of reduced energy use and the resultant carbon emissions, than relying on natural ventilation. As with any system, appropriate system selection and design is key.

Why is adequate ventilation so important?

Adequate ventilation within a building ensures good air quality, by removing toxins and CO2, and also helps to control humidity, thus reducing the risk of condensation. Energy efficiency and thermal comfort can also be enhanced.

Air quality can be affected by a number of impurities, such as low-level irritants (dust, pollen) right through to radon and volatile organic compounds. In humid or colder areas, and particularly in uninsulated buildings, there is also a significant potential for condensation when humidity levels are too high, and this can result in mould growth and various health issues. As one example, asthma rates in Australia are high by world trends[3,4], and homes with insufficient ventilation have been shown to have real and significant impacts on respiratory health[5].

Building fabric can also be affected by moisture and deteriorate, reducing the life of a building and adding to life-cycle costs.

In addition, anecdotally, many people who've come to Australia from cold climates comment on how their homes in Australia are so cold when compared to those they experienced back home.

Why use mechanical ventilation?

A mechanical ventilation system can:

- remove stale air and introduce fresh air into a building
- assist with reducing indoor humidity levels
- reduce incoming pollutants, when effective filtration is included
- remove indoor pollutants, including CO_2 and VOCs from off-gassing of materials such as those used in furniture and finishes.

Recovering heat from outside

There are alternative solutions on the market that recover heat or coolth from outside the building (e.g. from the roof cavity) and circulate it into the home. They work on the principle that the home is not well sealed, and they are less effective than the systems described in this article.

Studies show that to ensure adequate ventilation by natural means, the windows in a reasonably well-sealed home would have to be opened at least four to six times a day for a reasonable amount of time (around 10 to 20 minutes, depending on the size of the home, openable window area, prevailing ambient conditions, etc)[1].

Who does it work for?

One of the most important things to get right before introducing a MVHR system is your building sealing—for what is the point in controlling the ventilation and attempting heat recovery when your building leaks like a sieve anyway? It's similar to turning on the heater while you have all the

↓ The Lunos f-go slimline unit can be fitted next to windows for a minimalist look.

windows open—fighting the classic 'losing battle'.

In order to be successful, ultra-low energy buildings require a very good level of airtightness. Once a building is airtight, it then becomes necessary to introduce ventilation in order to make the building habitable.

An example of an ultra-low energy standard is the Passivhaus standard, a standard based around energy and thermal comfort that has so far been applied in over 40,000 buildings worldwide. Passivhaus buildings are dependent on their MVHR systems to ensure good indoor air quality, and are characterised by year-round excellent indoor comfort and significant reductions in energy use. The application of the standard has been so successful that the EU is considering its adoption as the minimum residential building standard throughout Europe.

Like everything, the adoption of 'new' technology comes with its pitfalls; however, we have the advantage here of using an approach that has been well and truly tested.

Types of systems

The simplest mechanical ventilation system uses exhaust fans only, with fixed inlets to provide makeup air. There is no heat exchange on this system, so incoming air is the same temperature as ambient. Exhaust points would likely be provided in areas such as bathrooms and kitchens.

Another simple system is a two-way ventilator, which operates on a push-pull basis to generate a flow of supply and exhaust. Examples of this type of product include the Lunos e2 and f-go units and the Stiebel Eltron LA30WRG. These units are installed in pairs and, depending on the size of the dwelling, there may be a number of pairs, e.g. a two-bedroom apartment might require two pairs. These systems are simplified by their absence of ductwork—they are installed directly in a wall or window frame and simply wired into a central control panel.

These ventilators operate alternately, with one unit exhausting and the other supplying air, then after 90 seconds they switch modes. Running continuously, they provide filtration and heat recovery. An integrated heat recovery sink, such as a ceramic core, is used to transfer heat between exhaust and supply air streams, and they are a terrific, simple version of more complex systems, suiting basic, compact layouts.

At the other end of the scale, a fully-ducted ventilation system is the most effective solution, and utilises fully controlled and balanced ventilation. This type of system is most effective when applied in a well-sealed building, where other infiltration sources are reduced (note: this does not preclude openable windows!). These systems supply fresh, filtered air to the living areas of the building (bedrooms, lounge), where it then flows through to exhaust areas (e.g. kitchen, bathrooms), thereby removing hot or humid air. The air volume supplied is balanced with the exhaust. The most efficient way to operate such a system is to include heat exchange, whereby thermal energy is transferred between the outgoing and incoming air streams, keeping the internal conditions stable and retaining that energy where we have fought to keep it—inside! Bypass arrangements are possible on these heat exchangers, to take advantage of times when outdoor conditions are good enough for direct air supply.

Heating and/or cooling coils can be added to the more complex MVHR systems, and radiant or refrigerant systems (split systems or radiant panels) can be located internally to provide any additional heating or cooling requirements.

Highly efficient homes, such as those built to the Passivhaus standard, will be among the first to use these types of system in conjunction with an excellent building fabric.

What to look for

Like everything, it's about selecting the system that's right for the application. There is reduced benefit from installing a heat recovery system if the issue of building sealing first hasn't been addressed, as uncontrolled air infiltration will negate the effectiveness of your mechanical system.

Units should be selected based on predicted ventilation requirements (a function of occupancy and heat loads) and then size.

The unit should be selected for high thermal exchanger efficiency. A good unit will have a sensible (related to temperature) heat exchange efficiency of greater than 80% (it can be up to 93%). However, a reasonable efficiency could be around 75% and such units will typically be more affordable.

Electrical efficiency should also be considered (energy consumption per m^3 air delivery—less than 0.45 Wh/m^3 is excellent).

Controls can be as complex or simple as desired. Most would operate sufficiently with three simple settings (low, standard and 'boost'/high), catering for times of low occupancy, standard operation and when extra exhaust is required (e.g. during parties or to eliminate cooking odours).

While not a typical product offering for local air conditioning suppliers, some suppliers have MVHR units available as overseas models or for large-scale

projects. For example, Mitsubishi and Stiebel Eltron have a presence in Australia for various domestic product offerings, but their MVHR units have not been locally marketed due to low demand. Local design expertise may also require international support. Air Design offers large units, typically used in community, education or commercial buildings.

Well-designed systems

Long-term studies of the use of MVHR systems in Europe have raised a small number of potential issues, which can generally be managed with good design. Systems should be carefully designed and installed to ensure they work effectively for a specific house; for example, the question of noise from the system should be addressed in the design. This may be an issue if local expertise is lacking.

Users should be given information on how to operate the system and the conditions under which optimal operation is achieved. It's also important to set up maintenance schedules. Ideally, systems should be monitored across one full year and serviced and recalibrated 12 months after installation to help ensure that the system is operating as efficiently as possible.

Occupant education is key. Where issues have been noted in studies, they generally related to adapting to a new system or incorrect operation; satisfaction increased over time as occupants became used to MVHR in their homes. ■

Clare Parry is a senior sustainability consultant at Umow Lai, and founding chair of the Australian Passive House Association. She is currently experiencing the trials and tribulations of a Passivhaus retrofit on her own home.

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FIRST PUBLISHED IN SANCTUARY 18

CONDENSATION?

LET YOUR BUILDING BREATHE

Tighter building standards have given rise to condensation issues, but there are ways to minimise moisture build-up in your home: ventilation is key. By Michael Green.

AS WE IMPROVE THE AIR-TIGHTNESS of our homes and fatten our insulation, we need less energy for heating and cooling. But there's another side effect to consider: condensation.

Condensation occurs where humid air hits a cooler surface, like the way droplets appear on the outside of a chilled glass of beer. In a house, it tends to form when warm internal air meets the building envelope that's been cooled by exposure to the outside air.

Steve King from the Built Environment faculty at the University of New South Wales says Australian homes have always been draughty – until recently. "Traditionally, while there may have been condensation in homes, it dried out very easily because of the ventilation, so there weren't any cumulative effects."

In recent years, however, he says New Zealand, Canada and the UK have witnessed widespread condensation troubles after tightening their building standards.

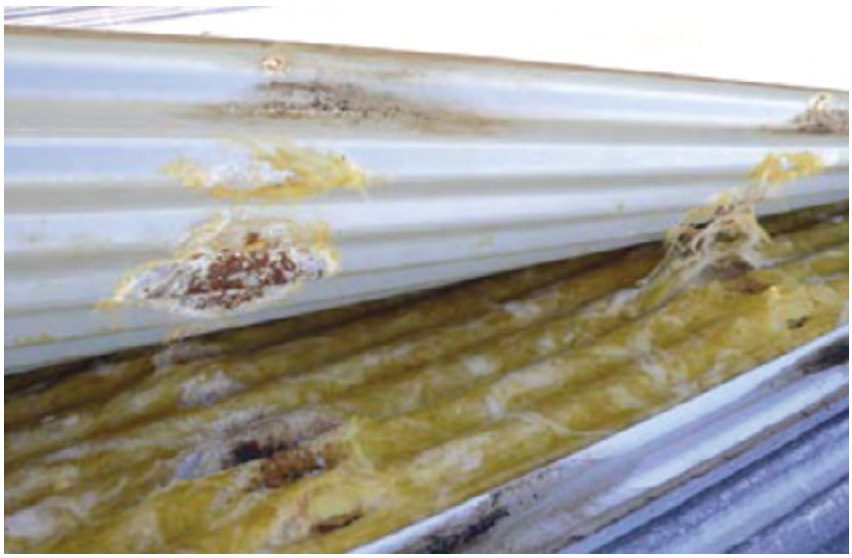
The Australian industry is beginning to take notice of the issue too. Earlier this year, the Australian Building Codes Board released a guide on condensation for designers and builders.

Andy Russell from Proctor Group Australia was one of the contributors to the handbook.

He says that where condensation forms regularly and doesn't dry out, it not only causes mould, but can also decay the framing and lining of the house. In some cases, residents will experience the symptoms of "sick building syndrome", including asthma, itchy eyes and nasal allergies.

Environmental building consultant Jan Brandjes says householders must understand where moisture comes from. First, there's the way we operate our homes – things like showering, cooking and drying clothes all produce humid air, especially if we don't use exhaust fans. Secondly, in new houses, the building materials themselves contain a lot of moisture.

↑ When a frame is filled with bulk insulation and wrapped externally with insufficiently breathable sarking, there is a high risk of condensation forming on the inside of the wrap during winter. This can lead to loss of insulation effectiveness, mould growth and structural damage. Photo courtesy Andy Russell



↑ Different climates require different strategies to avoid condensation problems. Here, in a tropical environment, moisture has caused damage to roofing and insulation due to the absence of an appropriately located vapour barrier. Photo courtesy BlueScope Steel

"Canadian research has shown that a new building will release roughly 1000 litres of water in its first year," Brandjes says. "If you're moving into a brand new house, try to do it in spring, because it allows you to flush the building out before winter."

In temperate or cool climate regions, condensation mainly occurs in the colder months, when there's a bigger difference between inside and outside temperatures. In more tropical areas, the condensation problem can work in reverse: humid air from the outside can form droplets where it strikes a wall cooled by air conditioning.

Either way, the answer is to pay close attention to ventilation. "How do you get rid of moisture? You need to exhaust air," Brandjes says.

If you're exhausting air from a well-sealed building, you must also think about where the replacement air will come from. He suggests householders research mechanical ventilation techniques – local businesses in the field include Air Change and Air2Energy. Recently, Brandjes has been working on condensation issues in apartment blocks, together with a Melbourne builder. "In a tight building, when you turn the exhaust fan on, it's like trying to suck air out of a plastic bag," he says. "And the fan just doesn't work – there's no way for fresh air to come back into the house or apartment."

Russell advises householders to watch for water stains or mould spots around cornices or skirting boards. "Stick your head up in the loft first thing on a cold morning," he says. "That way you'll see whether it's a leak in the roof or if it's condensation forming on the underside of the building wrap."

To reduce the risk of damp, the condensation handbook suggests using breathable building wraps in cooler climates, rather than the impermeable

products most commonly used. Another smart move, says Russell, is to make sure roof spaces have adequate ventilation that draws replacement air through vents in your eaves or gables, rather than up through the ceiling.

The same principles apply under your floor – a product such as polyurethane foam spray has the double benefit of sealing draughts and providing insulation, but you have to make sure that vents to the outside are free from leaves and debris.

The best strategies for avoiding too much moisture will depend on your climate zone, building materials and the construction method. But there are some general principles to bear in mind.

In cooler climates, seal gaps and cracks to stop moisture seeping into the wall and roof cavities, insulate thoroughly to avoid the cold spots where condensation forms, and provide controlled ventilation to let moist air escape.

In tropical regions, the best bet is to open up your home to natural airflow by designing for good cross-ventilation.

Whatever the situation, condensation is much easier to avoid upfront than solve after you've built, especially in your walls – it's very expensive to remove plasterboard or cladding if you think there's a problem.

King's key advice is to be aware of the issues. "Don't be shy," he says. "Ask your builder quite specifically whether or not there's a condensation risk with the particular methods being proposed. Ask separately about the systems for the ceiling, walls and the floor." ■

MORE INFO:

Australian Building Codes Board:
www.abcb.gov.au
Condensation in Buildings Handbook:
bit.ly/CondensationHandbook
www.air-change.com
www.hrv.com.au

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MODERN GREEN HOMES

Sanctuary

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A GOOD NIGHT'S REST

HEALTHY BEDROOM DESIGN

How do you make your bedroom the most comfortable, restful and healthy room in your house? Interior designer Megan Norgate steps through the basics of good bedroom design and fitout.

IF YOU CONSIDER THE TOTAL AMOUNT of hours we spend in various parts of the home, bedrooms are by far our most frequently inhabited spaces.

Good bedroom design contributes to our psychological and physical health and wellbeing, and with careful planning need not be difficult or expensive to achieve.

The best-placed bedroom

Bedrooms can be spaces for rest, work, storage and play. But for all of their potential uses, they needn't be very large.

The location of bedrooms in your house is crucial. Upstairs bedrooms can be beneficial in cool climates as the home's interior heat will collect on the upper floor.

In warmer climates, placing bedrooms to the south and near thermal mass will help keep them cool.

Naturally lit and draught-free

East facing windows are ideal in a bedroom as morning sun and a view out a window from the bed are good for the spirit. Windows that can be locked securely open at night will help to passively ventilate the room and improve indoor air quality. A ceiling fan will circulate air and reduce your need for air-conditioning.

Thermally effective window treatments are especially important in bedrooms. North or west-facing windows will benefit from exterior shading in summer to keep a bedroom cool. Adjustable exterior blinds or deciduous plantings are ideal as they adapt to provide shade as needed. High performance windows with double or triple glazing and/or low-e coatings will also help to stabilise internal temperatures.

To keep bedrooms comfortable in

This master bedroom is free of toxins. A latex mattress and indigo dyed linen sheets are paired with a simple mid-century bedhead, lamps and ceramics. All images Megan Norgate.

winter, using heavy-lined curtains that have pelmets and run to the floor will effectively trap warm air inside. If curtains are impractical or your bedroom's heaters are under the window, recess-mounted honeycomb blinds or face-fixed heavy backed roman blinds are the best option. Roman blinds use less material than curtains and so can be a good opportunity to use organic and/or locally-printed fabrics. To further reduce winter draughts and summer heat, seal up old wall vents, fireplaces and other gaps. Insect screens are useful to keep mosquitoes and other bugs at bay.

Layout and fitout

Preserve limited floor space by running storage cupboards above head height and tuck a bed or desk into the alcove underneath. Capitalise on high ceilings by creating a sleeping loft, utilising the space underneath to fit a wardrobe, desk or another bed. Locating the bed so you are not looking out the doorway or directly out windows onto the street will increase your sense of privacy.

Wardrobes are a cost-intensive part of a renovation, so rather than using mass-produced storage solutions, look for creative ways to reuse secondhand cabinets, or hide shelves and racks behind a lightweight ceiling-mounted curtain.

Keeping furnishings simple will reduce dust build up, which can contribute to allergies and respiratory problems. Rugs are a warm and soft alternative to carpet that can be aired and cleaned regularly.

Leave new upholstery or furniture outside to offgas for a few days to get rid of the 'factory fresh' smell. Slatted bed bases provide good ventilation around a mattress that helps to reduce the occurrence of mould and dust mites.

Mattresses are commonly constructed and treated with chemicals that contain volatile organic compounds (VOCs), such as antibacterial agents, flame-retardants, PVCs, bleaches, pesticides and dyes.

These chemicals can contribute to allergies, respiratory problems and chemical sensitivities. Mattresses made of plant-based materials such as organic wool, cotton, hemp, natural latex and bamboo are an alternative option.

Bamboo and latex are naturally hypoallergenic and dust mite resistant. If you are replacing a mattress divert it from landfill by sending it for recycling.

Ideally, use natural fibre bed linens and covers made from organic and ethically produced sources of bamboo, linen, silk or cotton. Wash and line dry new bedding before using it to get rid of any chemical residues from production, or buy secondhand blankets. Try dying old or secondhand bedding and blankets to give them a new lease of life.

Also keep in mind that many painted surfaces and composite timber products off-gas VOCs into your indoor environment so choose VOC-free paints and oils for your bedroom walls and furniture, and EO rated timbers (products that have a formaldehyde emissions limit ≤ 0.041ppm) for your cabinetry.

If you are concerned about exposure to electromagnetic radiation, keep digital clocks, radios, baby monitors and phone chargers away from where you are sleeping and avoid positioning a bed on the other side of a wall to a smart meter, refrigerator or other appliance. [Ed note: The World Health Organisation states that current evidence does not confirm the existence of any health consequences from exposure to low-level electromagnetic fields, but says gaps in knowledge about biological effects exist and need further research. See www.who.int/peh-emf/en/ for more information.]

Poorly designed and furnished bedrooms can affect our wellbeing and ability to get a good night's sleep. By applying a few simple design and retrofitting ideas and carefully selecting the materials we bring inside our bedrooms, we can create healthy and restful spaces that are not only a place to sleep, but a retreat in which we can relax and rejuvenate. ■

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www.braveneweco.com.au

↑ This child's room was dark during the day so a double-glazed north-facing high-level window was installed to make it a pleasant place to play during the day. A heavy-backed roman blind in hand-printed linen helps regulate the temperature. Vintage furniture, toys, cushions and bedspreads decorate the space.

FIRST PUBLISHED IN SANCTUARY 30

LIVING WITH PLANTS

BETTER AIR QUALITY INSIDE

Indoor plants can help soften sterile environments and may have remarkable impacts on our health, as interior designer and healthy home consultant Megan Norgate explains.

PHOTOGRAPHY Emma Byrnes

IN AUSTRALIA, 80 PER CENT OF US live in urban areas, spending up to 90 per cent of our time indoors. As a result, many of us are looking for ways to bring the outdoors in.

As a design tool, plants are a multi-purpose, adaptable and easily retrofittable element for the home or office. Plant-scaping can be used not only for sculptural and aesthetic effect but to screen, buffer noise, filter light, purify the air and provide ambience. Recent studies also show that their place in indoor environments can have multiple benefits for our health and wellbeing.

Our survival is inextricably linked with that of the world's trees; 'the lungs of our planet' capture energy from the sun's rays and absorb carbon dioxide from the atmosphere to produce their own chemical energy, conveniently releasing the waste product of oxygen. It's no surprise then that photosynthesizing indoor plants are good for air quality.

But perhaps the most remarkable aspect of indoor plants is their capacity for air purification through phytoremediation. Plants can absorb and metabolise airborne contaminants such as particulate matter (fine dust), exhaust emissions and the volatile organic compounds (VOCs) released from our furnishings, paints, adhesives, building materials, paper, textiles and plastics, found in high concentrations in well-sealed indoor environments. These contaminants mean most of our indoor environments are more polluted than the outdoors.

'Dead space' such as circulation zones, passageways, staircases or entrances can be perfect places for your indoor plants.

← The UTS study into indoor plants and air quality showed that three to six plants in a standard-sized office designed for single occupancy kept VOC levels below 100 parts per billion (ppb), well below the Australian recommended maximum of 500 ppb.

A University of Technology Sydney (UTS) study on plants and indoor air quality found that plants' ability to remove VOCs works by a symbiotic relationship between soil and the plant; indoor contaminants are pulled into the root zone where soil micro-organisms convert them into food. The researchers also found that pot size, species and light and dark did not affect the rate of removal. Carbon dioxide levels were found to be reduced by between 10 to 25 per cent and carbon monoxide by up to 90 per cent.

Lead researcher of the project and plant scientist at UTS, Dr Margaret Burchett, has no doubt that greening the 'great indoors' with living plants could play an important part in enabling the sustainable urban communities of the future. She says that increasing our green space indoors could: improve energy efficiency through insulation and temperature control, reduce air pollution, raise spirits and work performance and improve concentration and attention span. The study also found significant improvements in stress and negative feelings with the introduction of plant life (up to 50 and 58 per cent respectively when testing for anxiety, depression, fatigue and confusion.) "They are also a great way to bring more nature to plant-scarce cities without taking up too much space."

How many plants?

The UTS study showed that three to six plants in a standard-sized office designed for single occupancy kept VOC levels below 100 parts per billion (ppb) – regarded as a negligible health risk (Australian standards recommend a maximum of 500 VOCs ppb). But it is likely that a single plant would suffice in most modern office-sized rooms.

Around 15 to 18 plants per 170 square metres of indoor space could make major improvements to indoor air quality, but even the presence of a single pot plant on a desk could improve someone's work day.

Caring for your indoor garden

Successfully growing indoor plants is about getting a few fundamentals right. With the following points nailed, you should find your indoor plants thrive with minimal attention.

↑ Indoor plants have a regulating effect on humidity in all climates, releasing 97 per cent of the water they absorb through transpiration. Clustering them in groups increases the surrounding humidity and creates an ideal climate for healthy plants.

Microclimates
The first rule of success with indoor plants is location, location, location. Different areas of a building may have specific microclimates that make them more suitable for certain species.

Light
Plants can be grouped into types that prefer low, partial and bright light. Low light or shade plants can survive with less than four hours of sunlight per day. Partial sun plants need at least four hours of sunlight per day, but not necessarily direct. Full sun plants need at least six hours of sunlight per day. Plants may need to be moved seasonally to avoid or reach the sun and rotated occasionally so that all sides grow evenly.

Temperature
Plants prefer stable temperatures, so avoid placing them close to heaters and air-conditioners that cause temperature fluctuations. Locating them near thermal mass can help even out the immediate temperature range the plant experiences.

Humidity
Indoor plants have a regulating effect on humidity in all climates, releasing 97 per cent of the water they absorb through transpiration. Plants will work to both raise and lower the humidity levels, maintaining an ideal level of between 30 and 60 per cent. Clustering plants in groups increases the surrounding humidity and creates an ideal climate for healthy plants.

Potting and nutrition
For optimum nutrition plants need high quality potting mix and occasional re-potting as they grow to avoid becoming root bound. Increasing the pot size by only 2 to 3 centimetres can prevent volumes of damp soil which cause rot. Repot, divide and propagate at the beginning of the growing season, placing broken crockery, pebbles or scoria at the base of pots for aeration and drainage. Add a slow release fertiliser or heavily diluted liquid fertiliser such as worm tea periodically.

Watering
Over-watering kills plants as often as under-watering so water with small amounts and often, and don't leave plants sitting in water. Plants will need less water in winter unless the heating is

↑ Indoor plants are susceptible to mould that can exacerbate allergic and respiratory conditions. Physically remove the mould and apply a good dusting of cinnamon over the soil as a natural fungicide.

running at high temperatures. Forming a habit of emptying leftover cups and water bottles into plants will help make the job incidental. Some plants like to dry out between waters.

Troubleshooting

Cleaning the leaves of your plants with a damp cloth removes dust that reduces the plant's ability to photosynthesize. Indoor plants are susceptible to mould that can exacerbate allergic and respiratory conditions. Physically remove the mould and apply a good dusting of cinnamon over the soil as a natural fungicide. Move the plant to a well-ventilated area of the house and let the soil dry out partially between watering to prevent the mould returning.

Where to plant?

Access to light and irrigation systems for indoor gardens is only just beginning to be considered at each stage of the design process. Here are some suggested ways to use plants indoors.

At a design and build level: Atriums, light wells, conservatories, vertical green walls, in-built garden beds, suspended gardens.

In large existing spaces: Anywhere there is dead space, e.g. circulation zones, passageways, under staircases, entrances, corners, as room dividers in open plan spaces, vertical spaces growing upwards against windows, under skylights.

In small existing spaces: On window sills, along tops of cupboards, hanging in rows and corners, on stands, wall-mounted shelves, chairs, tables and stools.

Using repurposed elements: Enamelware, ceramic teapots/bowls/cups, tins, crates, industrial metal bins and containers, pallets, aquariums and vases for terrariums.

↑ Indoor plants have been shown to make significant improvements to air quality, and to have a positive impact on physical and mental wellbeing.

Which plant where?

According to the UTS study, any green shoot will remove carbon dioxide and release equal amounts of oxygen with adequate light and water. However, different species may require different conditions to photosynthesise effectively. The more foliage, the better.

Low light: Snake plant, Janet Craig, hahnii, peace lily, cast iron plant.
Partial sun: Bamboo palm, kentia palm, pothos, happy plant, parlour palm, orchids.
Full sun: Yucca, bird of paradise, rubber plant, golden cane, dragon tree, bromeliads, lady palm, succulents.
To lower humidity: Boston fern, English ivy, maidenhair fern, snake plant.
To raise humidity: Lady palm, Boston fern, gerbera, peace lily, Kimberley queen, florist's mum, warneckei.
For air purification: Aloe vera, golden pothos, spider plant, peace lily, English ivy, gerbera, snake plant, heartleaf philodendron, weeping fig, warneckei, bamboo palm.
In bedrooms: Orchids, epiphytic bromeliads and succulents release oxygen at night.
Australian native plants for indoors: Umbrella tree, black bean, Davidson's plum, lilly-pilly, silky oak (when young), rasp fern, fishbone fern. ■

MORE INFO:
For more information on UTS' research into indoor plants and health see: www.uts.edu.au/about/faculty-science/what-we-do/our-research-areas/plants-and-indoor-environmental-quality-group

Megan Norgate is a sustainable design consultant and interior designer at Brave New Eco. Keep up to date with sustainable design topics on the Brave New Eco blog: www.braveneweco.com.au

Image courtesy Livos Australia

#2 FLOORS, PAINTS & FINISHES

HOW TO HAVE A LOW-TOXIN HOME

FIRST PUBLISHED IN SANCTUARY 5

A CLEAN SWEEP

THE RIGHT FLOOR FOR YOUR HOME

Environmentally-friendly floors can also provide the foundations for a healthy home.

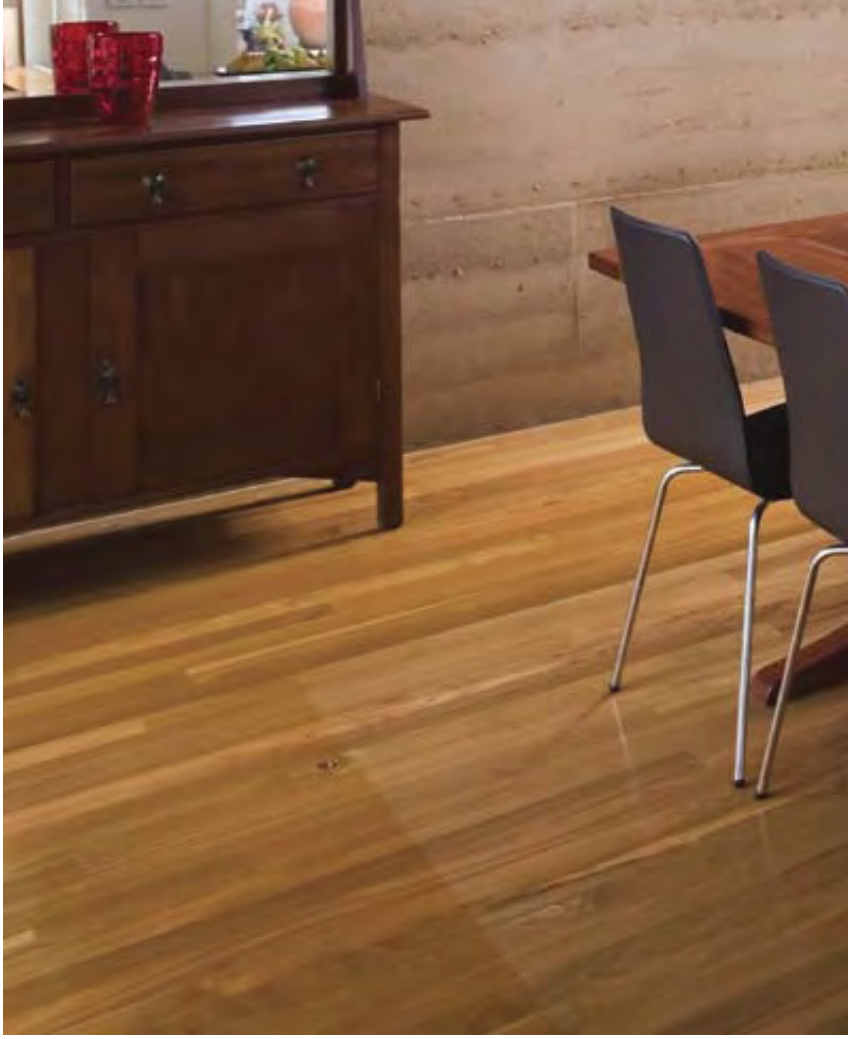
FLOORING AND FLOOR COVERING options are many and varied and so are the environmental considerations. From plush wool carpets to concrete floors, the right solution depends on your individual tastes and circumstances. Where you live, the purpose of the room, cleaning routine, ventilation and who uses the room are all factors. No one solution fits all.

Environmental factors

As the old adage goes, reduce, reuse, recycle. The first question you need to ask is do you need a floor covering at all? Polished concrete, wooden and bamboo floors can not only help with the environmental performance of a house concrete floors are excellent for trapping and releasing heat but can look spectacular. Whatever the surface is, it needs to be durable to reduce the need for replacement.

Can you buy secondhand materials or does the flooring product contain recycled content? Some enterprising companies now supply heavyduty wool carpets that are reclaimed from office renovations, cleaned and their condition graded. There is also a range of carpet underlays that are made from old carpets, textile off-cuts or even recycled plastic bottles.

The raw material that the flooring is made of needs to be considered. As with most products it is better if it is made from natural, renewable materials that can be replaced in a relatively short time. The actual manufacturing process also has an impact on the environment with some processes requiring large amounts of water and energy, contributing to greenhouse gas emissions. Also check whether the manufacturer participates



↑ Wooden flooring options are always popular and wood has a low embodied energy.

in recycling programs that reduce waste during the production process.

Health and toxicity

As we spend over 90 per cent of our lives indoors, our internal environments have a large impact on our health and wellbeing. Not only can floors contain toxic products such as volatile organic compounds (VOCs), which can 'offgas' into the surrounding air, but they can harbour dirt, mould and dust mites. Dust mites feed on skin flakes and produce airborne particles that can trigger allergic reactions or asthmatic episodes when inhaled by children or adults who are sensitive to them.

The best way to reduce dust levels and dust mites is to keep surfaces clean. Smooth floors such as ceramic tiles, linoleum or polished wood and bamboo are easy to clean. Look for carpets that are easy to clean and washable. Cleaning methods will vary depending on the type of carpet, its backing and any underlay present, and the level of traffic and use. Whatever the floor covering, care needs to be taken during installation as VOCs from glues and sealants may be released.

Natural flooring options: Natural carpets and fabrics

Carpets made from natural products such as wool, silk, cotton, coir, sisal or seagrass can look great and bring warmth to a room. They offer a rapid renewable and non-toxic alternative to synthetic carpets and are more likely to be recyclable or biodegradable. However, as with all carpets, care needs to be taken to ensure that they are well-maintained so they do not collect dust and dirt. They consume large amounts of water and energy during steam cleaning and toxic chemicals may be used to treat the carpet against moisture and insects.

Carpet tiles are a good option as they reduce the need to replace all of the carpet in a room. Even just one panel can be replaced and they reduce the amount of waste during installation.

Natural linoleum

Natural lino products are made of mostly linseed oil in conjunction with natural pigments, rosin from pine trees and wood flours. Lino is a durable, long-lasting floor covering made from a renewable resource that is biodegradable. It can be swept, reducing the need for water, power or chemicals for cleaning. Lino can be dried easily and is great for wet areas, preventing the build-up of mould and mildew.

Polished concrete floors

Concrete floors can be finished to create different visual effects and colours and are a strong, easy to clean, long-term floor option. They can also play a part in keeping the house at a comfortable temperature by storing and slowly releasing heat. Some sealants may contain toxic components but natural wax alternatives can be used that are safer for your health and the environment.

Ceramic tiles

Ceramic tiles are another tough and easy to clean option. Like concrete floors they have very good thermal qualities and the base product can be locally sourced, is easily recycled and contains no VOCs. However, as they are produced from clay fired at high temperatures they use a lot of energy during the manufacturing process.

Wood flooring

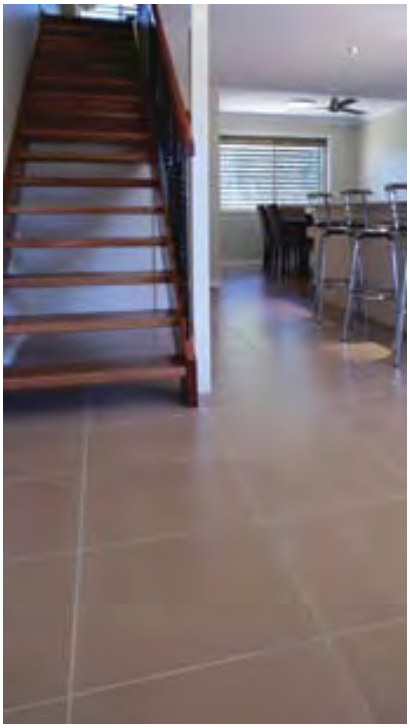
Wooden floors have been used and loved for many years. Compared to other building materials wood has a low embodied energy, is easily reused and recycled, and is completely biodegradable. However, to maintain its eco-credentials, wood needs to be recycled or sourced from sustainably-managed forest or plantations. Look out for independent labelling such as from the Forestry Stewardship Council (FSC). Once again check that no toxic sealants have been used during manufacturing or installation. While wood is renewable, it has a long growing period.

Bamboo flooring

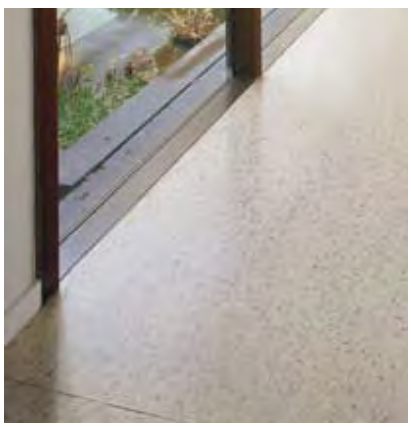
Bamboo is actually not a wood but a grass and is growing in popularity as a strong, durable flooring option. As bamboo is a fast-growing plant with a harvest time of three to five years, as opposed to 10 to 20 years for most timbers, it is a readily renewable resource. Check with your supplier to ensure that the bamboo is sourced from sustainably-managed plantations.

Backings and underlays

One of the main sources of VOCs that is often overlooked is carpet backings and underlays. Make sure that what you



↑ Ceramic tiles also have good thermal qualities.



↑ Concrete floors are great for storing heat.

↑ Lino is a durable, long-lasting floor covering made from a renewable resource that is biodegradable

have underneath your natural flooring option is also non-toxic and comes from a sustainable, renewable source.

Whatever flooring option you choose, what you do in the home can make the single biggest difference to the health of the indoor environment. Avoid smoking indoors, don't let dust build up, keep surfaces dry and well-ventilated and avoid cleaning products that use fragranced ingredients as they may include VOCs. There is variation not only between the flooring types but also products used within the flooring types, so make sure you do your homework and look for products that have been independently assessed and certified by an eco-label.

Floor advice

- Choose a flooring option suitable
- for your climate and needs.
- Check that any wood products are
- from a sustainably-managed source.
- Be careful of the off-gassing of VOCs from glues and adhesives and sealants during the installation of floor coverings and underlays.
- Check to see if the product has been independently certified with an eco-label.
- Avoid smoking indoors, don't let dust build-up, keep surfaces dry and well-ventilated and avoid cleaning products that may include VOCs.

FIRST PUBLISHED IN SANCTUARY 18

OILS AND VARNISHES

GREENER TIMBER AND CONCRETE FINISHES

Whether you have concrete or timber underfoot in your home, choosing the right finish for your floor, building materials and furniture is important to ensure that you protect the surface, your family's health, and the environment.

WORDS Sarah Robertson

WHEN IT COMES TO TIMBER AND concrete finishes, a growing range of environmental and health conscious products are now available. Some are greener than others, but a basic understanding of how different finishes work and the type of finish they deliver can help you tread carefully through the greenwash and choose the right finish to meet your needs in your home.

Types of finishes

There are two main types of finishes for timber and concrete surfaces. Film-forming finishes lay a water-repellent varnish over a surface. These finishes can be solvent/oil-based or water-based and are available in different gloss and sheen levels. Meanwhile, penetrating finishes, including oils and stains, penetrate into the concrete or timber surface. While some finishes are designed specifically for application on particular surface types, many finishes can be applied on a variety of surfaces.

Timber coatings and concrete finishes used around the world in the last 50 years have largely been petroleum-based solvent/oil polyurethane coatings that contain toxic solvents with high volatile organic compound (VOC) content. VOCs have been linked to air pollution and their deleterious effects on health in indoor environments – from headaches to respiratory problems in more extreme cases – have been recognised by government bodies such as CSIRO. The Green Building Council of Australia limits

↑ A timber floor with a Livos natural finish.

↑ An EpiMax professionally finished concrete floor. The finish is achieved with a combination of a solid base colour, a second coat applied intermittently by squeegee and then a clear, non-yellowing seal coat.

the total VOC content of timber finishes to 140 grams per litre for credits in the Green Star rating for buildings.

In the last ten years, lower VOC water-based polyurethanes have entered the Australian market as a less toxic, yet still durable alternative. More environmentally friendly and health conscious still are natural products made from naturally occurring and often non-toxic ingredients.

From low VOC to natural finishes

Looking for products with minimal VOC content is the first step on the path to greener and healthier finishes.

As Deb Preston of paint and timber finish supplier Painted Earth explains, however, it's important to be aware that choosing a water based or low VOC product doesn't mean it is entirely non-toxic, particularly for chemically sensitive people, as not all chemicals that are classed as hazardous are categorised as VOCs.

"Low VOC has become a measure of the eco-friendliness of a product because VOCs add to environmental air pollution and smog," she says. While low VOC means fewer chemical fumes emitted into the indoor environment, it doesn't say anything about the toxicity of the other ingredients in the product, she adds.

"Mostly the ingredients in a product, if not emitted, will remain in a stable form in the dried finish and not affect the inhabitants of a building. However this doesn't mean we can eat the product and it doesn't mean it's safe to dispose of in our soil or waterways."

Angela Petruzzi from Livos reiterates the point: "It's not the level of VOCs in a product, it's the types of solvents it has in it." She points to a comparison of two products, explaining that while one is a very low VOC product and one is high VOC, the higher VOC product is certified food safe, while the low VOC product isn't.

This is why natural finishes are generally considered to be a more people-friendly and eco-friendly option than synthetic finishes.

Whether you choose a low VOC synthetic product or a natural finish ultimately comes down to personal choice, however, and will depend on how much weight you give health issues, the desired look of a floor or other surface, the required durability of the finish, and environmental concerns.

Film-forming finishes

Film-forming finishes are available as two pack polyurethanes (made up of a finish and a hardener that must be mixed together before application), single pack urethanes, acrylics, epoxies, and combinations of these.

Low VOC water-based polyurethanes are the most common and environmentally and health conscious film-forming alternative to traditional polyurethane finishes. These coatings are hard wearing and contain less of the nasty solvents and chemicals, such as free isocyanates and formaldehyde, than their solvent-based predecessors.

Moreover, improvements in toxicity standards in Europe have seen an increasing range of non-toxic classified polyurethane finishes become available in Australia. All commonly available DIY polyurethanes, however, do still contain some form of cross-linking agent/hardener that enables them to cure.

Co-founder and Technical Director of Ecospecifier and GreenTag Program Director David Baggs says: "Water-based polyurethanes still contain toxic components. In fact some contain products known to cause birth defects in their liquid state and when freshly applied. Bisophenol A (BPA) is one organic compound used in some epoxy resins that can migrate from within the base polymer via direct contact and has raised concerns amongst health experts, particularly in the context of floors where infants or toddlers may play."

He adds that factory applied prefinished "UV catalysed polyurethanes" (PURs) are another healthier film-forming option as they have very low to

no VOC emissions. As Baggs explains, UV catalysed PURs are typically only available for in-factory application and so have to be purchased already applied to products. Almost all bamboo flooring comes finished with UV cured PURs, and so do many floating or laminated timber flooring options.

"The technology is not unlike that used by dentists for white polymer fillings, although mostly a different polymer base is used," he says. "The benefits are that the products contain no solvents at all and fewer toxins, so overall they are a healthier alternative."

Natural oils

Natural wood oils are a good choice for those looking for a health and environmentally conscious product, and they often highlight the natural beauty of timber surfaces. By soaking timber floors or furniture in an oil-wax-resin mixture, they work to repel water while maintaining the vapour permeability of the floor or other surface.

For concrete, Preston advises using oil finishes only on fairly dense smooth floors, as oil can be over-absorbed when used on very porous concrete. She adds that this can make application expensive and result in a matt rather than a lustred finish.

Tony Palmer from Palmer Constructions uses tung oil finishes on timber and concrete floors alike. He explains that most concrete floors have some sort of finish on them as it makes them easier to clean.

It is important, however, to be aware of greenwash when choosing a "natural" product. Environmental labels such as GECA and Global GreenTag and online knowledge bases such as Ecospecifier Global can help to sort the good from the bad, but not all "good" products will have an eco-label or be in product databases of verified and certified products such as Ecospecifier. In the end, Preston's advice is to check the ingredients.

"Some products are called Natural Oils but are in fact synthetic oils or oils with added synthetic chemicals," says Preston. "There are a number of these on the market and their names can be misleading to a person wanting a truly natural product on their floor."

Durability and performance

When applying a finish to any concrete or timber floor, it is imperative to prepare the surface properly and follow the manufacturer's application directions. Petruzzi explains that this applies whether you are getting your floor professionally finished or doing it yourself. "As with all products, if you don't follow instructions, you can get into a mess," she says.

Polyurethane finishes are considered to be the most hardwearing and are therefore often used in commercial situations. However, scratches can show up more clearly on these high gloss and satin finishes. As Petruzzi explains, protection against scratches and scuffmarks doesn't depend only on the product chosen, but also on the nature of the floor itself. Soft timbers, for example, are likely to scratch more easily than hard timber floors, regardless of the type of finish.

Maintenance is also an important point to consider. While natural oil-finished surfaces can be spot rejuvenated, a floor with a film-forming coating needs to be entirely sanded back to the raw timber or concrete surface and recoated from scratch.

Choosing the right product

Choosing the right product for your floors and furniture comes down to personal choice, your values and whether the finish is fit-for-purpose. You may have to compromise on some qualities to fulfil other requirements, but it's important to do your research and speak to your architect, builder and supplier about products they have used successfully.

"There are a variety of natural oils on the market and a variety of good water-based film forming products as well," says Preston. "Each person will have their own requirements so it is good to compare the qualities of several different finishes in each category and see what suits you best." ■

MORE INFO:
GreenPainters:
www.greenpainters.org.au
GECA certified floor coverings:
www.geca.org.au/products/standards/17
GECA certified paints and coatings:
www.geca.org.au/products/standards/47
Ecospecifier Global:
www.ecospecifier.com.au
Global GreenTag:
www.globalgreentag.com

Please see the original article in *Sanctuary* 18 for a table giving specific product information for a variety of concrete and timber finishes.

↑ This floor in Auckland, New Zealand, features a coat of Bona Prime Intense and two coats of Bona Mega Extra Matt finish.

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MODERN GREEN HOMES Sanctuary ATA

FIRST PUBLISHED IN SANCTUARY 31

CARPET CHOICES

TREADING THE WOVEN PATH

While rustic floorboards and polished concrete have long been the mainstays of sustainable design, carpets are still often used in bedrooms for their softness and insulating qualities. Interior designer and healthy home expert Melissa Wittig helps you tread the woven path.

Environmental impact

While thermally massive materials such as concrete and tiles are often preferred for living spaces to help moderate temperatures, carpet does have benefits in the right space, offering warmth underfoot, noise reduction and insulation. However, the environmental impact of carpets varies widely. One of the primary issues is the relatively short life cycle of some carpets when compared with hard flooring materials.

Agriculturally sourced fibres have wide ranging impacts depending on the intensity of production, land and water use and the related outputs of the farm. Life Cycle Assessments (LCAs) aim to cover all of these aspects, but for agricultural commodities this is inherently complicated and not all assessments will cover farm processes.

The need to regularly vacuum carpets to lengthen life, maintain appearance and reduce dust should also be considered alongside the embodied energy – that is, all the energy required to produce and distribute the product for use. a

Carpets are recyclable, but current rates of recycling or reuse in Australia are low. When carpets are recycled, only one reuse is generally possible, with around 25 per cent of the carpet likely able to be reused as carpet, a further 25 per cent could be retained for carpet backing and half the carpet sent to landfill where it could take up to 50 years to break down, releasing greenhouse gases in the process. And of course some components of nylon and synthetic materials from petrochemical origins will never completely break down.

Some manufacturers operate their own recycling programs and will collect your old carpet for reuse as part of the

↑ Cavalier Bremworth's Kennedy Point 100% New Zealand wool carpet has a ECS Level 4 rating. The company has a recovery and recycling program for commercial carpets when replacing with their product.

installation agreement, though this is more common for commercial properties. Meanwhile, innovative programs such as one at Deakin University are working to reuse carpet and textile polymer waste in concrete.

What's in my carpet?

The components of carpet are cushion or underlay, adhesive and carpet.

There are generally two categories of materials that can be used on their own or blended to create carpets, natural or synthetic. However, more recently we have begun to see the production of alternative composite material carpets, such as those made with recycled plastics or even fishing nets.

Synthetic fibres are man-made materials such as nylon (polyamide), polyester (PET) and polypropylene (olefin) and are most commonly used in carpet production. Alternative, natural fibres such as sisal, jute, coir and seagrass are growing in popularity, partly because they can be grown without chemical input and are naturally antimicrobial. However, natural fibres such as these can be susceptible to moisture so may not be suitable for humid climates.

Wool has strong insulative potential and is also naturally antibacterial. The practices and environmental impacts of sheep farming in different countries vary greatly, depending on the climate and what else the farm is producing. Land and water use, methane pollution, and soil degradation through acidification and eutrophication are also potential issues.

Both natural and synthetic materials can require energy intensive manufacturing processes, and all fibres will vary in grade and quality. Though natural fibre products can be more environmentally friendly than synthetics they can also be less durable, and obviously frequent replacement of flooring defeats the environmental objective. A true comparison on material type would need to be context-specific based on an LCA of materials, production, use and replacement and end-of-life considerations. The type of fibre used in a carpet will contribute to its durability, flammability, pile retention, colour fastness, stain resistance and pest resistance.

While some fibres such as wool have inherent characteristics like high UV protection and ignition thresholds, making them fire resistant, other fibres require additives. Chemicals are often used on carpets to provide or improve dust, mould, stain, flame and insect resistance. The 'new carpet' smell we're all familiar with is essentially volatile organic compounds (VOCs) being emitted (but it is also important to note that VOCs do not always have an odour). While wool fibre has been reported as being able to absorb and trap VOCs this is not the case for most synthetic fibres.

Carpet backing and underlay

Carpet backing is placed underneath the carpet to provide longer life, additional comfort, insulation, and noise reduction. In some cases a cushioned secondary backing is integral to the carpet backing. The backing material of a carpet also contributes to its sustainability and VOC emissions. For example, rubber backing, while a good insulator, tends to have higher VOC emissions than jute fibre. PVC backing with 100 per cent recycled material is available and used by some manufacturers, but is not yet standard. Foam backing is also popular and is cheaper but less hardwearing. Felt backing, produced from plant fibres, which is also insulating and soft underfoot could be a good option. Fibre treatments listed above also have the potential to release emissions into indoor air over time.

Chemical adhesive used during installation is often toxic and can off-gas. It is also a key inhibitor to sustainability as it limits carpet removal and reuse. Non-toxic adhesives and adhesive-free pressure application systems are available, but may not be offered by all manufacturers.

Certification programs

There are no specific import standards for carpets in Australia, and while the general requirement under Australian Consumer Law is that products must be

durable, safe and fit for their intended purpose, in reality laws do not require carpet imports to be accompanied by full documentation. a

Ingredients of concern in carpets made to inferior standards may include banned dyestuffs such as AZO dyes that have been found to be toxic, or fibre chemical treatments not accepted or tested as safe in Australia.

Independent certification programs can assist with navigating product choices. The Carpet Institute of Australia runs a voluntary grading system, the Australian Carpet Classification Scheme (ACCS), available to all companies local and abroad as well as the voluntary Environmental Certification Scheme for Carpets. All participating companies must meet performance standards for raw materials, manufacturing, installation, use and final disposal and recycling or reuse. The Environmental Certification is a four-level program, with producers certified above level 2 able to contribute to Green Star building ratings.

Other certifications that carpets can carry include the Woolmark/ Woolblendmark label and New Zealand's Fernmark label for wool content.

There are many certification programs around the world that assess products to varying standards.

↑ The Carpet Institute of Australia administers the voluntary Environmental Certification Scheme for carpets, measuring cradle to grave impacts of the product.

To avoid greenwashing, read the certification criteria to understand what characteristics have been assessed. If a product has a 'green certification', this does not necessarily mean it is a healthy product option. For example, a product may be made with renewable materials in a resource-efficient way yet still have high VOC emission levels. The Environmental Certification Scheme for Carpets mentioned above does consider total volatile organic compounds, and the Carpet Institute of Australia provides a list of certified carpets and suppliers at their website. Other organisations in Australia that certify environmentally friendly carpets and floor coverings are Good Environmental Choice Australia (GECA) and Eco Specifier.

Unfortunately the current voluntary nature of product assessment leaves many consumers in a vulnerable position. It would be great to see industry product assessment in this sector become mandatory so that consumers can make informed decisions about a product's materials, quality, sustainability and health credentials based on testing outcomes displayed on labels. ■

MORE INFO
www.carpetinstitute.com.au
www.geca.org.au
www.ecospecifier.com.au

Melissa Wittig is a health-focused interior design consultant, Principal of Healthy Interiors and Relish designs, and author of The Smart Living Handbook, creator of The Healthy Home App and Healthy Interiors Resource Hub.
www.healthyinteriors.com.au

Melissa is currently developing a range of low toxic bedding solutions; for further information please contact melissa@healthyinteriors.com.au

← Havan Esperanza sisal carpet by Interfloor. Sisal fibres are from the agave sisalana, a native of Mexico. The hardy plant grows well without chemicals all year round in hot climate and arid regions which are often unsuitable for other crops. Both coir and sisal contain tannins which repel dust mites and are non-static.

← Tretford produces a blended goat hair carpet which is also available in custom rug format such as this design by Fiona Lynch, which has GreenTag's Silver Plus and GreenRate Level A ratings.

Tips for buying and owning carpet

- Ask questions about: where and how the carpet was made; transportation required; raw material use and sourcing; additives and treatments used; VOC emissions testing; independent certification; installation requirements; maintenance and warranty period; end of product life programs
- Choose colours, textures and patterns that will transcend fashion
- Opt for manual installation or fixing methods rather than adhesives to avoid pollutants and VOCs
- Keep a record of the manufacturer, carpet name or code (batch code if possible, as colours can vary), grading registration number, retailer details, type of underlay used, date of purchase, installation date and purchase receipt in case of warranty or insurance issues in the future
- Consider UV protective window glazing, curtains, blinds or awnings to protect carpet from prolonged periods of direct sunlight – this will help minimise colour fade and deterioration
- Keep windows and doors open for as long as possible at installation to air the carpet and reduce VOC pollution
- Use furniture cups to protect carpet from compression under furniture legs
- For people with allergies or chemical sensitivities, investigate individual products, fibre characteristics and maintenance needs before purchase.

PAINTING GREENER

...INSIDE AND OUT

In *Sanctuary* 16, in 2011, we looked at the choices available for those wanting their next paint job to be kinder on their family's health and on the environment; what had changed by 2013? Anna Cumming discovered that it was cheaper and easier than ever to paint green.

SUSTAINABLE PRODUCT technology is improving all the time, and paints are no exception. The highest profile issue with conventional paints is their incorporation of volatile organic compounds (VOCs), which are released as the paint dries and often for a long time after. VOCs have been linked to a range of health problems, and also contribute to atmospheric air pollution. (For more information, see *Sanctuary 16*, p71.)

According to Daniel Wurm, managing director of GreenPainters, in the last two years acrylic paints reformulated to be zero VOC have become more readily available, and low VOC modified paints are more affordable. "The Green Building Council of Australia's definition of 'low VOC' is unchanged at up to 75 grams per litre," he says, "but the Australian Paint Approval Scheme [APAS, administered by CSIRO] now considers 'low' to be up to just five grams per litre" Good Environmental Choice Australia (GECA) also tightened its standards for low VOC in 2012.

However, Angela Petruzzi of natural paint supplier Livos Australia cautions that when talking VOCs, it's not just about the number on the tin. She would like to see a requirement for the full disclosure of paint ingredients. "People need to be aware that the term [VOCs] covers a wide range of chemicals, and not all of them are regulated, especially if each is present in very small amounts," she explains. "Even with low VOC paints, people with chemical sensitivities should delve into the precise ingredients before buying."

Of course, the environmental impact of paint is about more than VOCs, with ingredients made from non-renewable petrochemicals and manufacturing processes with heavy environmental

footprints. Natural paints, made largely from plant-derived or highly abundant and often renewable raw materials, generally have a low impact on health and on the environment in regard to their production, application and disposal. Natural paint ranges are expanding, and although they are still more expensive than conventional paints, the gap is narrowing.

These improvements in green paint technology and availability are being pushed along by increased customer awareness and demand at the commercial and residential levels. "People are definitely asking about these eco-friendly paints more, and wanting to use them," says Wurm. "The need now is for painters and builders to be better trained and aware of green options." He recommends that if your painter claims going green will be too hard or much more expensive, find a new one.

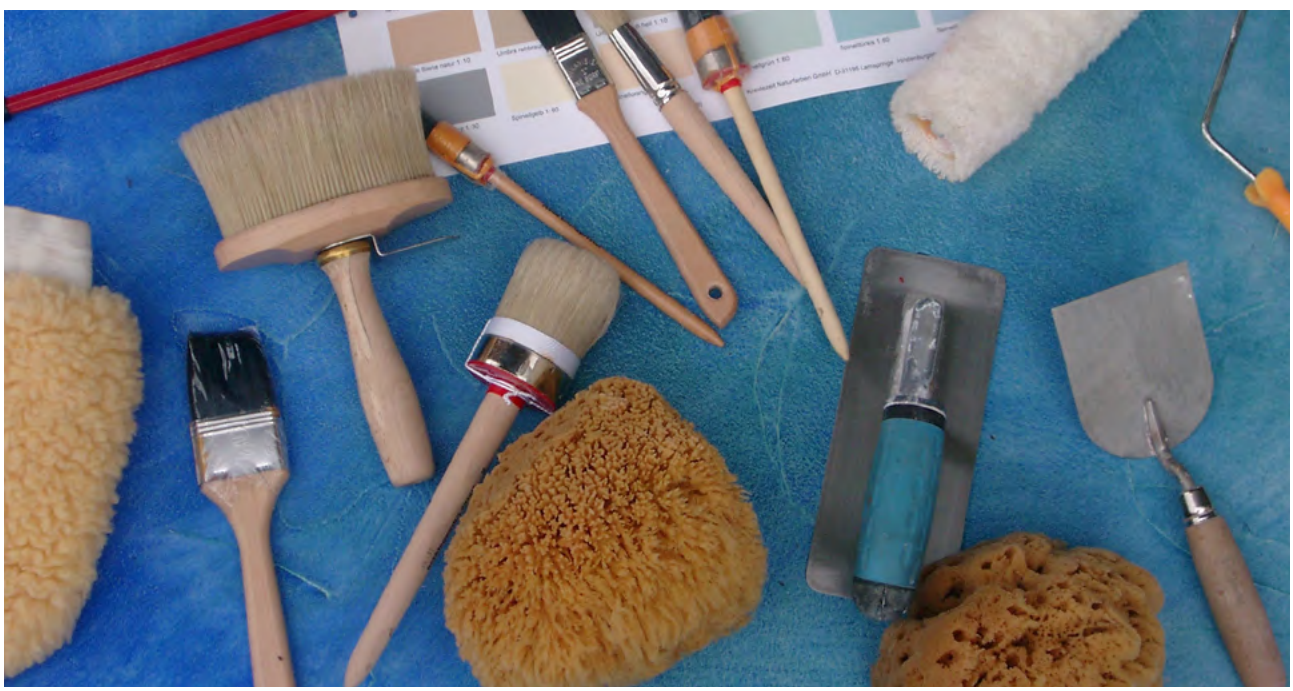
Exterior paints

Without synthetic stabilisers and film coatings, many natural paints are best suited to interior applications. However there are natural options for painting the outside of your home. David Baggs, CEO of Global GreenTag, endorses them: "The benefits of natural paints are that they go on easily, they are long-lived and the building takes on a really interesting patina over time."

Some exterior natural paints are based on technology that's been around for generations. Mineral-based paints such as lime washes and cement paints bond with the substrate and are vapour permeable (they allow the wall to breathe). They also naturally discourage mould growth. However they are generally not as stain resistant as acrylic paints. Mineral paints are rough to the touch and made from raw materials that are generally abundant and non-toxic, such as clays, lime and crushed marble. Best suited for mineral surfaces such as render, brick, stone and mudbrick, mineral paints are not suitable for timber or metal.

Silicate paints are made from a liquid compound of quartz sand and potash, mixed just before application with sodium silicate (known as waterglass). Hartmut Kiehn of the Natural Paint Company explains that the drying process is facilitated by the binding of carbon dioxide from the air as well as evaporation. "The product silicifies, forming a microcrystalline bond with the substrate, resulting in a very durable surface," he says. Pure silicate paint (as distinct from 'dispersion' silicate paint, which contains acrylic binders) is naturally free of VOCs. It is not appropriate for use on gypsum, wood or metal surfaces, but can be used on lime or cement renders, stone and concrete. In addition, Kiehn says "pure silicate paints are particularly good for finishing mud brick and strawbale, because those surfaces are mostly rendered for adhesion and demand a finish that is open to exchange of air and moisture."

Natural oil-based paints, or eco enamels, replace traditional petroleum-derived solvents with citrus or linseed oil. "These paints are made from renewable resources and can be considered better for the environment. However, they often contain high levels of natural VOCs (citrus oil is a VOC) that some people may be allergic to, or find irritating," says Wurm. He says accredited GreenPainters will recommend people with allergies



↑ Image: The Natural Paint Company

choose natural enamels with low VOCs, water-based enamels or another suitable product. "It's a matter of finding the balance between being sustainable and protecting your health," he says.

If you'd prefer to stick to an acrylic coating, it's still important to consider low or zero VOC. The off-gassing of conventional paints outdoors may not affect your health as much in an exterior application but VOCs are significant contributors to air pollution. There are now low and zero VOC acrylic paint ranges suitable for exterior use that Wurm considers to perform as well as their conventional cousins. "If you choose your product carefully, greener paints have no specific extra maintenance requirements," he says. "The majority of problems with paint failing are to do with the application – an underlying problem with the surface, or preparation that's not done properly."

Baggs notes that the acrylic exterior paints of today have much longer lifespans than the paints of the past. "In the past, you had to recoat every five to seven years. Now most paints are guaranteed for at least 15 years. This greatly helps their overall life cycle impact."

The next big thing?

Wurm and Baggs both advise keeping an eye on the development of heat-reflective paints, which contribute to a building's overall energy footprint by reducing the need for heating and cooling. Visit the GreenPainters website for more information. ■

MORE INFO:
Sanctuary 16, p71, 'Greener Paint'
GreenPainters: www.greenpainters.org.au
Australian Paint Approval Scheme (APAS): www.apas.gov.au
Green Building Council of Australia (GBCA): www.gbca.org.au
Ecospecifier's Eco Priority Guide - Paints: www.ecospecifier.com.au
Global GreenTag: www.globalgreentag.com
Good Environmental Choice Australia (GECA): www.geca.org.au

Please see the original article in *Sanctuary* 23 for a table giving specific product information for a variety of greener paints.

Preparation and paint removal

With any kind of paint, getting a great finish that lasts depends largely on the preparation of the surface. Particularly when renovating, using some sort of paint stripper may be unavoidable. Traditional strippers contain solvents such as methylene chloride that are often toxic and nasty to work with, but there are now some less-toxic alternatives such as Livos's Taketi or Let's Clean Heritage No 1.

Removing paint from older homes can be an issue due to concerns about the paint's potential lead content. "Twenty-five per cent of Australia's housing stock was built before 1971 when manufacturers were required to stop using lead in their paints," says Wurm. He advises having any paint to be removed tested first and if it does contain lead, removed correctly.

↓ The Natural Paint Company supplies paint pigments (in the glass jars) with white paint powder. The user combines these with water before painting.

→ Porter's Zero VOC Eggshell acrylic paint on a hallway wall.

Cleaning up

David Baggs stresses that it's important not to wash any paints down the drain, as they typically contain materials that can be high-level toxins for marine and waterway ecosystems. So what can DIY painters do to clean up?

Firstly, choose a paint that is as environmentally benign as possible while still being suitable for your task. See the tables in *Sanctuary* 16 p72 and *Sanctuary* 23 p77 for options. The Australian Paint Approval Scheme (APAS) also recommends:

- Buy only the paint you need. Use an online paint calculator such as GreenPainters' to help: www.bit.ly/gppaintcalc
- Don't rinse brushes and equipment between coats. If using water-based paint, brushes can be wrapped in plastic to prevent them drying out; for oil-based jobs, store your brush in water and then brush out well on paper to remove the water before starting again.
- After cleaning brushes and equipment, allow the cleaning solution or water to sit for a few days. Once the pigment particles have settled, decant the liquid (reuse if it's a solvent; dispose of it in the garden if it's water) and dry the solids before disposal in your household garbage.
- For small amounts of leftover paint, pour it onto shredded paper or kitty litter, let it dry and put it in your garbage.

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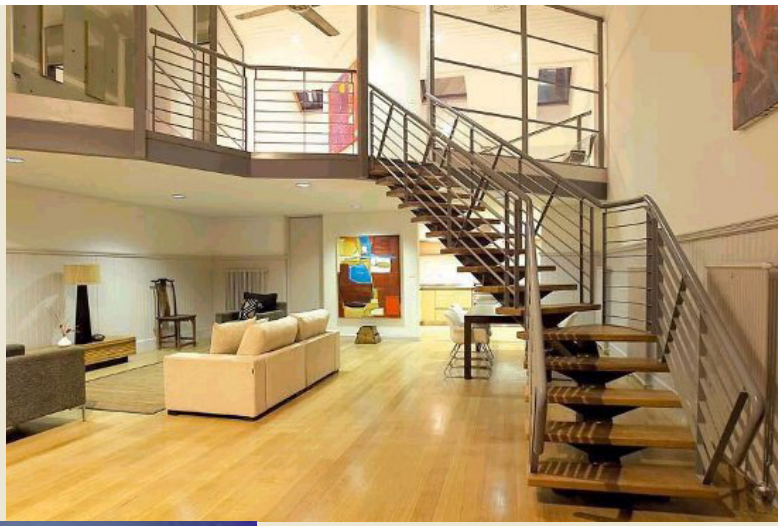

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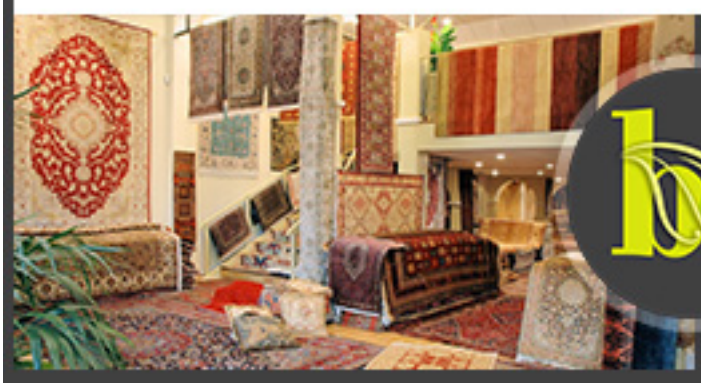

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#3 INSIDE HEALTHY HOMES

MODERN HOMES THAT ARE GOOD TO LIVE IN

A spacious hall leads through the home past two courtyards to the north-facing living, kitchen and dining rooms. Both hallway walls are 300mm-thick hempcrete and timber-frame construction, providing excellent acoustic insulation. The wall to the right has been finished with a lime-based render, while the wall on the left has been left exposed and unfinished.

FIRST PUBLISHED IN SANCTUARY 25

EARTHY MODERN LIVING

A Melbourne hempcrete and rammed earth home takes bold steps in environmentally sustainable family living.

WORDS Sarah Robertson
PHOTOGRAPHY Rhiannon Slatter

BEYOND ITS PARED BACK STREET façade, Michelle and Chris' home is impressive. The modern design incorporates clean lines, generous and smart spaces, high ceilings, double glazing and classy furnishings. Though first and foremost a family dwelling, it's also an 8 Star home designed with environmentally responsible living firmly in mind.

Stepping through the front door, your eyes are immediately drawn along the hallway to the north-facing open plan kitchen, dining and living area, beyond which are the deck and garden. Contrasting yet complementary textures – industrial and earthy – cut through the modern exterior and sleek fit-out. A polished concrete floor and white walls greet the floating timber staircase and rich timber window frames. In the living area, rammed earth walls are warm and inviting.

As you walk through, you can't miss the unusual textures of the hempcrete wall to your left. Unlike its counterpart on the other side of the hall, this wall has been left unrendered, exposing the fibrous hemp that progressively stores more carbon dioxide and becomes stronger.

There's no doubt that hemp and rammed earth are environmentally impressive, but architect Steffen Welsch believes materials should also be aesthetically pleasing. "If [a material is] not beautiful you won't use it just because it stores carbon dioxide."

Steffen is a convert to rammed earth. "We have worked with rammed earth before and it has very good acoustic qualities," he says. "It softens the sound within the space." Because the porous wall has more surface area, it can also absorb more heat. And it's a local material: "It comes from quarries within Victoria,

← The south-facing front façades of these two hempcrete and rammed earth homes in Northcote are designed to be small and compact to limit heat loss and gain.

so I would consider it a very contextual material."

Hempcrete is a newer material for Steffen. Although he hasn't undertaken a life cycle analysis, he says hemp's ability to make a wall carbon neutral makes sense. "To us it looked like it had very similar qualities to the rammed earth." In the original plans for the house, the walls were to be built entirely of hempcrete or rammed earth but the hempcrete proved difficult to build with during Melbourne's winter when construction took place and so was ruled out for external walls. Despite this, Steffen is keen to work with hempcrete again. Now all he needs is another adventurous client who is prepared to take a risk, he adds.

There's much more than hempcrete and rammed earth that give this house its environmental credentials, however. Several years ago Michelle, Chris, their two kids and their dogs had outgrown their Edwardian terrace. They needed more space inside and outside. At the same time, Michelle's parents wanted to downsize from the large family home they had built in the 1980s. Michelle and Chris found a 900-square-metre block in Northcote and approached Steffen to design two homes, complete with a shared backyard.

Steffen says he was initially intrigued that Michelle and her family were trying to do something outside the box. "It was three generations and they wanted to build a house [each] and explore co-housing, which seems to be very sensible but it's not practised and hasn't been realised to the extent that it should," he says.

Working to their requests for a home that maximised passive solar design and incorporated renewable energy and water saving technologies, natural light, generous living spaces and a large backyard, Steffen designed two double-storey homes centred around internal courtyards.

"I find generally that the courtyard house is a very suitable model for Melbourne's environment," Steffen says. "You can increase the number of rooms that are north facing, you can improve cross-ventilation ... You achieve separation as well as connection within the family."

A west-facing courtyard aids cross-ventilation, making the most of cooling south-westerly breezes in summer. Michelle has added exterior blinds to the double-glazed windows to block unwanted sun. Bamboo will be planted along the western fence to further reduce unwanted sun.

↑ A large north-facing living area is light and bright thanks to significant areas of double glazing, a void above the kitchen and a high ceiling.

← Homeowner Michelle had an additional joist built into the ceiling to ensure this swing could be installed. Security flyscreens are installed in the double-glazed windows.

The design makes the most of air flow within and through a double-storey house: hot air rises and can vent out through clerestory windows in summer, while in winter heat rises up the stairs to the bedrooms. The design is proving itself in practice. "Since the hot February we had, the temperature [inside] has been beautiful," says Michelle. With in-slab hydronic heating, double glazing and its highly insulated walls and roof, the house is warm and peaceful in winter. Upstairs, the hottest days of summer were too warm for the family, however, and they are considering installing an evaporative cooling system.

To further improve the home's passive cooling, the couple have added blinds to the courtyard windows and are planning to plant bamboo and other natural shading. Also on the cards are a pond for the eastern courtyard and hosting a Permablitz to get the garden into shape.

After a lengthy design and build phase, including a frustrating year for Steffen waiting for planning approval from the local council and then the Victorian Civil and Administrative Tribunal, Michelle and Chris and Michelle's parents next door are very happy with their new homes.

They were about 10 per cent over their budget of around $700,000. Surprisingly, Steffen says that as building materials, hempcrete and rammed earth aren't necessarily more expensive than highly insulated conventional walls.

Michelle and Chris are still making final touches to their home, but they are clearly very happy with it. Steffen is also pleased with the result: "By the time we landscape the front yard, [the house] will disappear. I quite like that. It was never meant to be a statement – it's supposed to be two comfortable family homes."

↓ The stairs lead to three bedrooms and a bathroom. Windows that open automatically at the top of the stair void help vent warm air in summer before it reaches the bedrooms. A pond is planned for the eastern courtyard.

FIRST PUBLISHED IN SANCTUARY 30

JEWELLERY BOX

LIGHT, LIGHT AND MORE LIGHT

A modest extension to a suburban 1950s weatherboard maximises natural light and air for a tranquil retreat in a classic setting.

WORDS Emma Scragg
PHOTOGRAPHY Jon Linkins

LIGHT, LIGHT AND MORE LIGHT WAS the brief for a new parents' retreat for Louisa and Martin in their 1954 low-set timber home in Brisbane. Having lived in the house for eight years and carried out their own minor, necessary renovations for the growing family of five, an extra bedroom and bathroom was finally needed. In contrast to the dark, inward-focused house, they wanted the new spaces to be filled with natural daylight and fresh air.

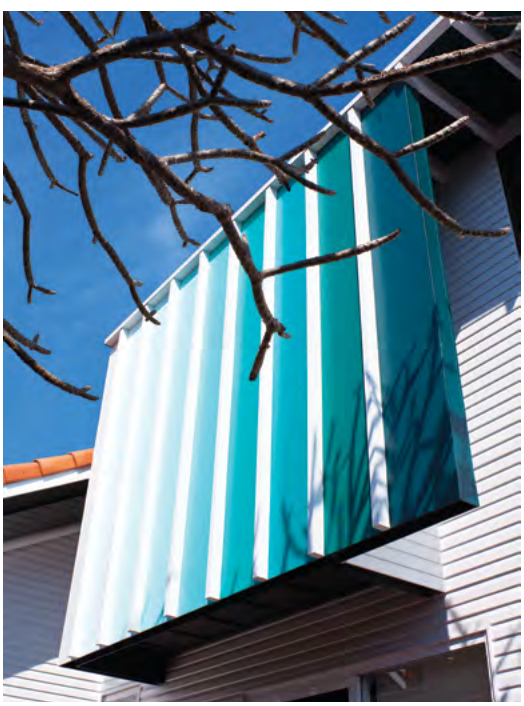
Green thumb Louisa had already transformed the backyard by removing heat-reflecting paving and establishing dense plantings of natives between deciduous 60-year-old frangipanis and a pecan, to encourage bird life. Reddog Architects created the missing connection between the house and garden. Sliding glass doors were added to the existing rear rumpus and the new wing above opens into the canopy to cool incoming breezes, compensating for the south-west orientation.

The owners were keen to leave the existing house undisturbed. The new bedroom, walk-in-robe, ensuite and office sit over the rumpus room at the top of a long plywood stair, which also serves as a thermal chimney and lightwell. The ground floor footprint remained unchanged, but the ceiling of the rumpus room was raised for more natural daylight.

Beneath the new raking ceilings of the upper level, clerestory windows let in warm northern winter sun and abundant daylight the rest of the year. Most other windows are louvres to optimise cross-ventilation, carefully placed and glazed to provide privacy without the need for blinds.

Architects Paul Worroll and Emma Healy didn't want to add air-conditioning –

↑→ Materials were kept simple, in line with the home's original 50s aesthetic; its original terracotta-tiled roof is offset with sun-shading fins in graduated shades of teal and blue beneath. "The exterior was perceived as a jewellery box", Paul says, "with a humble exterior palette but a more luxurious, contemporary experience inside".



→ A base palette of light-coloured plywood and warm white was complemented by soaring skylights, geometric ceiling forms which reflect and refract the light. The colour palette was a crucial factor in achieving the owner's brief for tranquil private retreat within the family home, says architect Paul Worroll.

↑ The ensuite is the only room with full-height internal walls. All other partitions and the two large sliding doors stop short of the ceiling to maximise airflow between the spaces. Ceiling fans provide additional cooling circulation on still or the hottest days.

→ Beneath the new raking ceilings of the upper level, clerestory windows let in warm northern winter sun and abundant daylight the rest of the year. Most other windows are louvres to optimise cross-ventilation, carefully placed and glazed to provide privacy without the need for blinds.

"good architecture shouldn't need it". The ensuite is the only room with full-height internal walls. All other partitions and the two large sliding doors stop short of the ceiling to maximise airflow between the spaces. Ceiling fans provide additional cooling on still or the hottest days.

Materials were kept simple, in line with the home's original 50s aesthetic; its original terracotta-tiled roof is offset with sun-shading fins in graduated shades of teal and blue beneath. "The last thing I wanted was a really stark contrast to the rest of the house, but then I didn't want to spend all that money and have it look just the same either", says Louisa. The tranquil colour palette is extended indoors, to the sliding doors and a stripe of bathroom tiles.

Its occupants are delighted with the result. "Paul really won me over," says Louisa."He came up with something different that was still going to be practical and I didn't have to change any of the existing house, and I love the light."

FIRST PUBLISHED IN RENEW 123

URBAN STRAWBALE

THE UPS AND DOWNS OF A DIY HOME

Owner-builder Nikki McCoy shares her home, building experiences and lunch with Beth Askham from *ReNew*.

THERE HAS BEEN NO SHORTAGE of vision and hard work poured into this lovely strawbale house built on a suburban block in Melbourne's west.

Built with non-toxic materials to be energy-efficient, long lasting and with a small footprint, it was a pleasure to visit and take a look at this home over lunch.

The house has the beautiful feeling inside that is characteristic of strawbale houses. It's a settled quiet that puts you at ease. "The straw was chosen for its insulation quality and also for its beauty. Straw also creates such a melodic ambience in the house," says owner-builder Nikki.

The first thing I noticed is how the house enables the many social and creative visions of its makers. Designed to feel and function a little like a small town hall, the central space of their urban strawbale home includes a stage (complete with power and AV concealed in the floor) and a commercial kitchen where Nikki plans future cooking classes, drawing inspiration from their abundant edible garden.

The house is the product of two years visioning, planning and designing and one year of hard work by a committed team led by Nikki. The core building team was made up of Nikki and her son, his friend and two building apprentices in the process of retraining from chefs (is this why the kitchen is so great?), with skilled tradespeople coming in and out as needed.

They ended up spending $340,000 instead of their budget of $270,000, but still feel like it was economically worth it, especially as their suburban block cost them only $100,000.

Nikki says, "We chose the vacant lot (500 m^2) as the land was close to main

↑ This cool cupboard is kept at a lower temperature, around 16°C in summer and 12°C in winter, with air drawn from an underground tube.

↑ It took a year of construction to make this lovely liveable space. You can see the strawbale walls before the lime render, and after (next page, top). On the north-facing wndows, both inside and outside shades keep out the summer sun.

street shops, ten minutes walk to the railway station and most importantly, right next to the beautiful, magnificent Werribee river."

They did the design themselves, and included a lot of what they wanted in their three-room house. It has two-storey high ceilings, storage cupboards that stretch almost to the roof (accessed by a ladder), a 19,000 litre galvanised water tank, a Wattworks greywater treatment system and solar hot water. In summer it keeps them cool with fans, insulation, moveable outside shades and semi-transparent inside blinds. As they plan to stay for a while, they also designed the single-storey house for wheelchair access.

It's more like a sculpture than a house, and indeed Nikki spent six months placing the render onto the straw walls. "We used strawbale walls with render made up of hydraulic lime, sand and water and a mineral silicate finish which makes it both breathable and waterproof." Three layers of render later and the walls are a beautiful white with each window nook sculpted by Nikki into different forms; some are curved and some have straight edges.

It's worth mentioning that in the building of the house, no toxic glues, paints or sealants were used. Nikki says, "A lovely thing about working with non-toxic paints and glues and with straw and lime render is that there were no strong chemical smells when working. Everything was non-toxic and if you got some lime render on your skin you would just wash it off with some vinegar."

← From the street, the house certainly stands out, with neighbours watching the build with interest and, in some cases, scepticism. Most plants in the garden are edible.

Earth tube

Nikki said that looking at what others had done was really helpful. She drew ideas and inspiration, what to do and what not to do, from other strawbale houses.

The earth tube, or cooling tube, was one of the ideas that Nikki saw and was inspired to give it a go. The tube runs a metre and a half underground from the back corner of the yard over the ten metres or so to the kitchen, where it leads to a vent at the base of a cool cupboard where Nikki stores grains and vegies. A small extraction fan at the top of the cupboard helps to move the air through the cooling tube. The theory is that the earth cools the air as it moves through the tube, keeping the cupboard cool with very low energy input.

At the moment, the earth tube manages to keep the cupboard at 16 degrees in summer and 12 degrees in winter—Nikki thinks it could do better and is troubleshooting possible problems.

Heat exchange system

Halfway through the build they dreamed of having an air exchange system, and after deliberating on the cost, found a way to make it happen. They now have a Venmar heat recovery air exchanger and when it's switched on, the air inside the house is replaced every four hours. Being a heat exchanger, it keeps the air temperature inside the house constant, neither gaining nor losing heat from inside the house.

More tech specs

There is roof space for solar panels and the wiring is ready for the house to run off a 3kW solar system—they are just waiting as they save the money for the system.

The house is heated by gas-fired hydronic heating, with radiator panels in each room. In hindsight Nikki thinks it would have been a good idea to have installed an electric system, given their plans to go solar. A small panel sits in a drying cupboard where washing is hung to dry. Underneath sit two big drawers for both clean and dirty washing—another great design aspect to keep Nikki's sense of order.

They have made sure the house is well insulated. Nikki loves the airlock between the front door and the lounge room, with a double-glazed door separating the two. "We also have R3 recycled polyester/polypropylene batts in both the ceiling and the walls that are not straw. The floor is also insulated with recycled plastic."

After some deliberation they built the floor from recycled timber salvaged from Echuca primary school. "The issue was the extra cost of secondhand timber in price and the extra labour stripping it back and cleaning it up. In the end we decided it was worth it both for reasons of recycling and how beautiful it was, as well as the fact it was very hard wearing, probably 300 years old," shared Nikki.

Of the kitchen Nikki says, "I designed the kitchen myself and got a cabinetmaker to build to my design. I used slabs of granite. After much research and costing this seemed the most viable and durable, but probably not the most environmentally sound. I used jute flooring for my kitchen." The floor is a lovely black that is waterproof and easy to clean.

All lights in the house are LEDs.

North-facing windows look out to a back garden that is full to the brim with food producing plants. There are around 25 fruit trees not to mention the delicious tomatoes and pumpkins that were stretched out in the summer sun.

The garden is completely edible with wicking beds built from recycled 44 gallon drums and recycled pallets (supplied by Nikki's son's business, Be Herbitual).

The hard parts

The building process was not without drama. The drought broke just as they dug their first stump hole and the rain didn't stop falling after that moment. They ended up building the house under a plastic cover to stop the straw from becoming damp and mouldy.

There was also a lot of conflicting advice and they never felt confident in their building knowledge. It felt like they could never know enough and that they were working in the dark most of the time.

Looking back, there are things that they would do differently. Nikki thinks that the windows are too big because if they gain or lose heat, it is through the windows.

They also found it difficult to find like-minded tradies sympathetic to their vision. One example of this was their wish to use non-toxic glues. Even with clear communication of their wish for non-toxic glues, Nikki would still find toxic glues being used by tradies that they would have to confiscate! "On a few occasions I had to raid the tradies trucks and chuck them out but after about two months I got the message through." ■

↑ At the front of the house you can see the external shades, rainwater tank, rendered walls and the airlock entry to the right. The driveway gravel is made from crushed, reused concrete and bricks.

Nikki has the final word on being an owner-builder

There is no doubt that DIY house building is really, really hard work: 7 days a week, 15 hours a day, making 60,000 decisions each day. Many of the decisions I made were based on very little knowledge of the consequences. Despite lots of research, asking lots of experts, visiting lots of other strawbale houses and strawbale house builders, in the end, only I could make that final choice. I would suggest that it's only worth doing if you already have some expertise in house building (and a very strong relationship with your partner!) I had my son, Louis McCoy, and his business partner, Michael Murphy, both carpenters, with me the whole build, but ultimately I had to make decisions I knew very little about.

I really wanted my house to be 'green', i.e. energy efficient, with low energy use, low-VOC adhesives, low-VOC building materials, green plumbing and effective use of sun. I had a clear and determined goal, but when I started sourcing building materials most products that met my criteria didn't even exist in Australia and if they did, they cost a fortune. A good example was 'plyboo', a plywood made out of bamboo: sounds great, only available in the USA. Another, insulation made from recycled denim jeans! Only available in the USA.

Most building materials I sourced were recycled or low-VOC and I made a decision to pay extra for such things. For example, we used recycled floorboards from Echuca Primary School at a cost of $2000 more than if I bought them new (that's excluding my labour to clean them). In some cases, my budget forced me to make some decisions that didn't fit my criteria, but in the end my philosophy was that at least I was making each decision consciously.

#4 GREEN CLEANING GUIDE

ENVIRONMENTALLY FRIENDLY CLEANING AT HOME

ATA'S GREEN CLEANING GUIDE

RECIPES FOR SAFE AND INEXPENSIVE CLEANING

Discover tried and effective recipes for a clean home. The original version of *Green Cleaning* was an article by Sarah Berry in *ReNew*'s precursor *Soft Technology* magazine issue 41, and it has been one of the ATA's most popular guides ever since.

Green cleaning recipes: a different approach

Australians spend millions of dollars each year on manufactured household cleaning products, and detergents are among the most highly advertised products in everyday use. We are constantly encouraged to clean better and deodorise and perfume every room and surface. The recipes for alternative cleaners suggested here are not only cheaper than their commercial counterparts, but are also softer on the environment.

There are some products that will never be what most people would call 'environmentally friendly', such as traditional disposable nappies, dry cleaning products and aerosols, to name a few, and we should try to avoid them. In particular, it's probably best to avoid using antibacterial cleaning products. They are no better at preventing infection in the home than good hygiene practices using warm water and soap, and there's evidence to suggest that overuse of these cleaning products may be contributing to

the development of antibiotic-resistant bacteria.

Despite the best efforts of regulatory authorities, voluntary programs and industry self-regulation, it is still often difficult for consumers to tell from the bottle just what effect the product in the bottle will have on the environment.

As consumers of cleaning products, we are faced with two alternatives: we either buy cleaning products as sensibly as we are able, or we use effective, alternative recipes to make our own cleaning products. The recipes and suggestions for alternative cleaning products on these pages are simple, cheap to buy in quantity and relatively safe to use. Most of the recipes use soap, lemon juice, vinegar, sodium bicarbonate (baking soda), washing soda, glycerine and eucalyptus oil.

Although borax and ammonia are often cited as good alternatives for disinfectants and laundry cleaners, they will not be recommended here. Borax is widely available in other countries, but in Australia it can only be purchased from chemists at high cost. Even though borax biodegrades quickly, it is toxic to humans and many plants.

Ammonia is a highly toxic, strong alkaline and should not be used by people with respiratory problems, as it is a severe irritant. Ammonia must be used in a well-ventilated area and spills on the skin must be counteracted with large quantities of water, or a weak acid such as vinegar.

Finally, there are some general points of common sense and safety to remember, whether using synthetic cleaning products or any other chemical, such as a glue, pesticide or home maintenance product:

- Use the minimum amount of the product.
- Buy in bulk to avoid packaging, except when buying a product for a one-off use, then buy as small a quantity as possible.
- The recipes given here are tried and tested. In general, never mix chemicals unless following instructions carefully.

Dispose of chemicals safely

Disposing of chemicals may involve giving the excess to a friend or contacting your local council for advice on the safe disposal of waste products. Rinse empty containers before disposal, as the residue can still be dangerous.

You will find that many household spills can be cleaned easily, simply by using a damp cloth if they are dealt with immediately. And never underestimate the effectiveness of the powerful cleaner—elbow grease.

Multi-purpose cleaner/laundry detergent/shampoo/dishwashing detergent/wool wash

Grate a 125 gram bar of laundry soap in a saucepan. Cover with one litre of water and boil gently. In a separate container, dissolve one cup of washing soda in one litre of hot water. Add the dissolved laundry soap to the washing soda and seal in a container. One cup is sufficient per wash, but it must be diluted in three cups of hot water. Hot washes give a better result. The recipe is enough for around eight washes. Do not dilute when using as a shampoo.

Bathroom

Deodorising the bathroom
Ensure there is a through draught. Put a bowl of pot-pourri or eau de cologne in the bathroom, or leave a bunch of lavender stems by the toilet. Pieces can be broken off and squeezed as necessary.

Air freshener
In a spray bottle or atomiser, mix 2 cups of water, half a teaspoon of vodka and a quarter of a teaspoon of eucalyptus oil (or any essential oil that takes your fancy).

Removing mould
Scrub mould with sodium bicarbonate. To prevent it regrowing, make sure the bathroom is well ventilated, and spray your tiles with an equal mix of white vinegar and water after your shower.

For areas with persistent mould problems, use tea tree oil instead of vinegar, combining two drops with one cup of water in a spray bottle. A natural antiseptic and fungicide, tea tree oil costs more than vinegar but will kill most types of mould and help prevent new growth.

Cleaning the toilet, bath, sink and tiles
Use sodium bicarbonate and soap. To give surfaces a shine, wipe them with vinegar.

Bathroom floors
Wipe with a solution of vanilla essence and water.

Shower curtains
Scrub with vinegar.

Baths and sinks
Rub with vinegar to remove water marks.

Polishes

Floors
Melt 1/8 cup of paraffin wax in a double boiler. Add one litre of mineral oil and a few drops of lemon essence. Apply with a rag, allow to dry and then polish.

Copper
Polish with a mixture of lemon juice and salt, or equal parts of flour, hot vinegar and salt. Wash in soapy water and dry thoroughly.

Chrome
Polish with white flour on a dry rag or apple cider vinegar.

Brass
Rub with a mixture of equal parts of salt and flour plus a little vinegar. Lacquered brass should be dusted or wiped with a damp sponge.

Silver
Mix together one litre of water, a tablespoon of salt, one tablespoon of bicarbonate of soda, and bring to boil in a large saucepan. Drop the silver into the pan and allow the mixture to boil for three minutes. Remove the object and polish it with a soft cloth.

Stainless steel
Stainless steel can be cleaned with a cloth dampened with vinegar. Rinse thoroughly and dry well.

You can also use neat eucalyptus oil on a cloth to remove annoying streaks on stainless steel appliances.

Furniture
Dissolve a tablespoon of lemon oil in 1/2 litre of paraffin oil. Apply with a rag.

Clothing

General stain removal
Most spots are likely to be quickly removed by rubbing with soda water, glycerine or eucalyptus oil.

Ink
Rub with a mixture of lemon and salt before washing.

Blood, milk and chocolate
Soak in cold water.

Tea, coffee and grease
Pour boiling water through the stains before washing.

Egg
Soak in cold salty water before washing.

Oil
Cover in a paste of lemon juice and salt. Allow to dry and then wash.

Fruit
Sponge or rinse immediately with cold water, then a solution of warm water and white vinegar. For old fruit stains, rub in glycerine and leave for three to four hours before rubbing off and washing.

Grass, perspiration and curry
Cover with glycerine do not rub and then wash.

Rust stains
Saturate with sour milk or lemon juice and rub with salt. Place in direct sunlight until dry, and then wash.

Lipstick
Rub with cold cream and wash with washing soda.

Soiled nappies
Pre-soak in three tablespoons of bicarbonate soda dissolved in warm water.

Chewing gum and wax
Rub with ice and the chewing gum or wax will flake off. A dab of eucalyptus oil should remove any residues.

Mildew
Pour a strong solution of soap and water, or lemon juice and water, on mildew spots and allow to dry in direct sunlight. Repeat as often as necessary.

Wine
Put a generous amount of salt on the spillage immediately. Rinse in cold water before washing.

Hand washing clothes
Use a combination of soap and washing soda.

Laundry bleach
Half a teaspoonful of sodium hexametaphosphate to two litres of water, or a cup of lemon juice to half a bucket of water. This recipe also freshens laundry.

Suede articles
Steam the article over a boiling kettle or saucepan and brush with a wire brush to loosen the nap of 'tired' suede.

Hankerchiefs
Soak in cold salty water before washing.

Shoes
Sprinkle inside smelly shoes with sodium bicarbonate and leave overnight. Canvas sneakers can be washed in the washing machine.

Woolens
Wash by hand in pure soap or in the following mixture:

- 4 cups soap flakes
- 1 cup methylated spirits
- 1 cup eucalyptus oil

Mix together and store for future use. When required, disolve a small amount in hot water, add cool water and wash by hand.

Upholstery and carpets

To remove odours, sprinkle with cornflour and then vacuum. To clean, rub small areas with cloths soaked in a solution of half a cup of vinegar to a bucket of warm water. Soda water can remove many stains quickly. Sodium bicarbonate is useful for soaking up liquids.

Burn marks

Trim burn marks carefully with scissors and rub them with vinegar.

To take grease or oil out of a carpet

Put plenty of flour or talcum powder over the spill as soon as possible to prevent the oil spreading. Leave overnight, then sweep up the flour, add some whitening and rub the spots with a clean rag dipped in turpentine.

Wine

Cover the spill with salt. Leave to dry overnight and vacuum up the next day.

Moth repellents

Cedar chips, bunches of dried herbs or lavender are all good alternatives to mothballs.

Heat marks on wood

Rub in a mixture of one teaspoonful of salt and a dessert spoonful of olive oil.

Scratches on wood

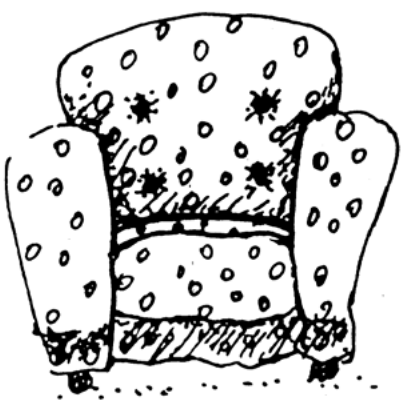
Rub in a mixture of one table spoonful of olive oil and two tea spoonsful of vinegar.

Water marks on dark leather

Rub olive oil over the area with a damp cloth. Check the effect on a small area first.

Alternative cleaning materials

Common name	Chemical name/ composition	Warnings
baking soda (bicarb soda)	sodium bicarbonate	–
caustic soda	sodium hydroxide	poison, irritates eyes
citronella oil	–	moderately toxic
eucalyptus oil	–	moderately toxic
Fuller's Earth	(dried clay; mainly alumina and silica)	–
glycerine	glycerol	–
linseed oil/flax seed oil	–	slightly toxic
olive oil	–	–
paraffin, liquid	–	burns
plaster of Paris (gypsum)	calcium sulphate	–
talcum powder	magnesium silicate	dangerous to inhale
washing soda	sodium carbonate	moderately poisonous
whiting/chalk	calcium carbonate	–



Kitchen

Laminated kitchen bench tops and stainless steel items (sinks and cutlery)
Scrub with a plastic scourer using soap or sodium bicarbonate.

Oven and stove top
Cover surfaces with a paste of sodium bicarbonate and wipe off. Sprinkle new stains with salt and wipe off when the oven has cooled. Line the grill and the bottom of the oven with foil to catch spills.

Burnt saucepans
Coat the burnt area/s with a thick paste of bicarbonate of soda and water. Leave for several hours before washing.

Enamel saucepans
Rub with coarse salt and wash in hot soda water.

Washing dishes
Use soap in soft water areas and soap and washing soda in hard water areas. Add lemon juice for a pleasant scent.

A dash of vinegar or a few drops of tea-tree oil may be added for tough grease.

Stained vases and bottles
Shake small pieces of steel wool inside the container in a solution of vinegar and sand or salt. An alternative method is use potato peels and soapy water.

Removing labels or anything sticky
Eucalyptus oil is great at removing glue from old labels and stickers, and other waxy residues.

Deodorising bottles and vacuum flasks
Soak the bottle in a solution of one teaspoon of sodium bicarbonate.

Stained crockery
Rub with salt or sodium bicarbonate on a damp cloth.

Deodorising the fridge
Rub over the surfaces with vanilla essence or sodium bicarbonate on a damp cloth. A small container of sodium bicarbonate in the fridge can help reduce odours at their sources.

Floors
Mop floor using half a cup of vinegar in a bucket of warm water.

Unblocking drains
Flush clogged drains with a solution of one cup of sodium bicarbonate and three tablespoons of vinegar. Put the plug in until the fizzing stops and then flush with boiling water.

To prevent drains clogging in future, never pour oil or grease down the sink, and always use a drain sieve.

Walls

Painted walls

Clean with a soapy or mild vinegar and water solution.

Wallpaper

Can be cleaned in the same way as painted walls; just be gentle and use very little water.

Remove grease spots on wallpaper by rubbing gently with a soft cloth sprinkled with Plaster of Paris or Fuller's Earth. Clean small sections at a time, rubbing downward with even strokes.

An art gum eraser will remove grease and pencil marks from wallpaper.

Removing mould from walls

It can be difficult to remove mould from walls using environmentally sound methods. Try using sodium bicarbonate, but you may have to resort to a mixture of water and household bleach (try the recipe for bleach given in the Clothing section) or even commercial mould remover.

Windows

Cleaning mirrors, windows and glass

Use one part vinegar to 10 parts water. To stop mirrors fogging, rub with glycerine or eucalyptus oil applied with a clean rag which may be stored in a sealed jar and reused.

Dry sheets of newspaper give the best shine to windows because of the components of the ink. The newer the newspaper, the better the shine.

Removing black specks from mirrors

Dip a cork in turpentine and rub the specks with it, then polish the glass with powdered whiting.