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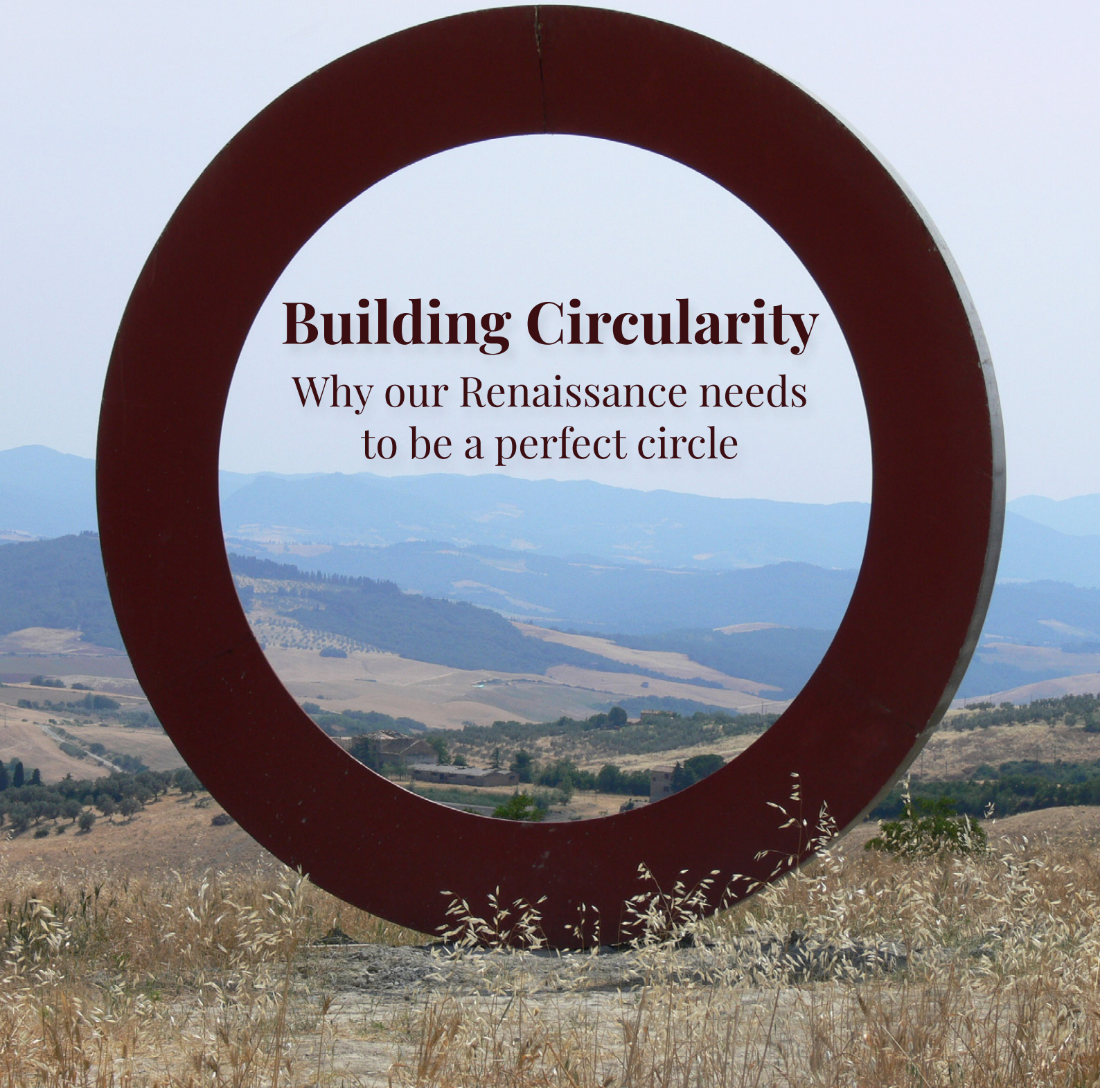

Building Circularity

Why our Renaissance needs to be a perfect circle

BVN

The Footprint Company™

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Contents

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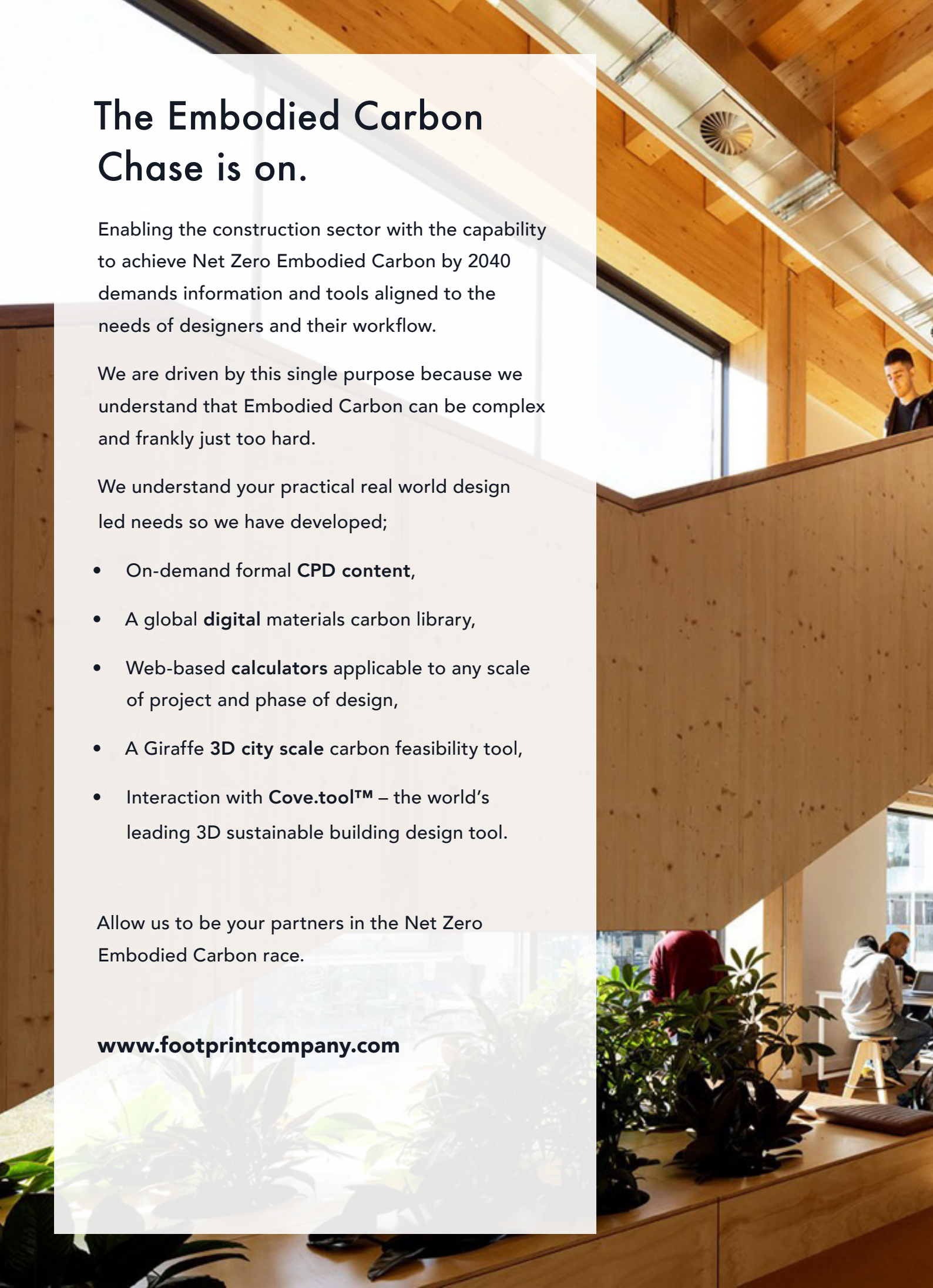

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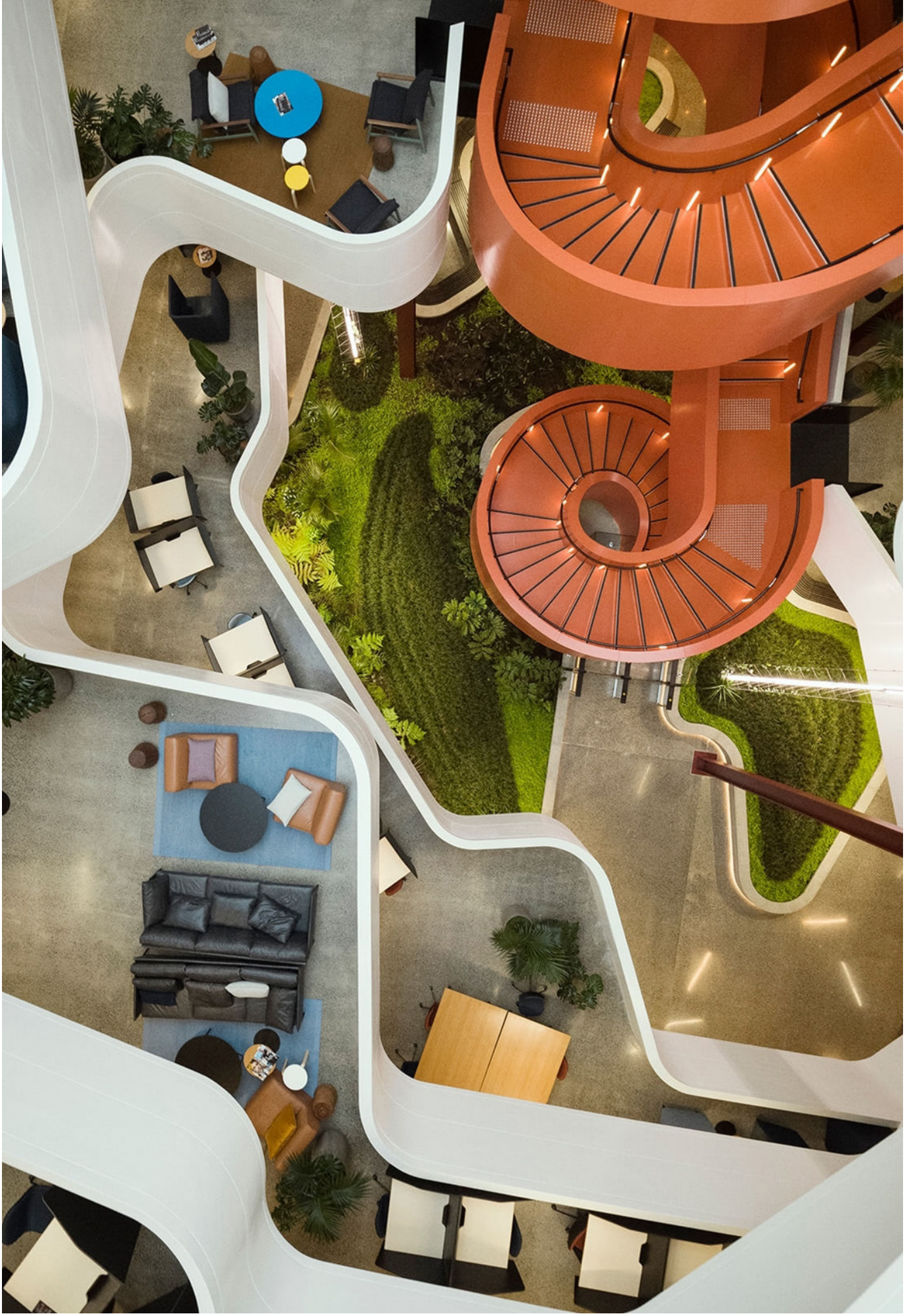
ANU Kambri the world's first precinct scale project to achieve 40% embodied carbon reduction built on TFC technology, data and service. (Image courtesy ColonySix and BVN.



Hive Offices by BVN + Jasmax. Photo: John Gollings

From The Editor

We're excited to offer you our ebook on Building Circularity – why our Renaissance needs to be a perfect circle.

The symposium late last year was a fantastic star-studded event. Leading architects from Australia, the UK and New Zealand joined materials experts and speakers from the private and public sector to shed light on how to better understand building materiality. We had over 20 presenters in all.

This ebook covers off on the main learnings from the event, offers additional content including exclusively for our attendees and TFE members, full videos of the indepth interviews we undertook with a selection of our leading speakers as part of the thorough research we like to do ahead of our events.

It was most exciting to find out who's leading the challenge towards low embodied carbon and building circularity. And why.

The tech giants are among the most powerful leaders; we certainly know how influential they are. Among the most promising developments is the understanding that the solutions to our planet's ability to survive – and thrive – stem from systems thinking.

The dive into materials with our Spanish-ish inquisition was again a highlight in our event series. Who knew our materials could be so revolutionary?

This is a complex area, full of unexpected innovation, twists and unintended consequences. For instance, is timber really the answer to all our green dreams?

This ebook has a lot of answers but it's also a great jumping off point to the bigger stories we all need to unravel as soon as possible.

Massive thanks, as always, to our co-lead sponsors, BVN and The Footprint Company, and our supporting sponsors, Built and Atelier Ten.

Tina Perinotto

Managing Editor, The Fifth Estate

Building Circularity – the experts

Maria Atkinson AM
Sustainability Strategist, Director, Advisor, Scientist, Mentor & Impact Investor

Dennis Else | Executive Director Sustainability, Safety & Health, Multiplex

Jon Dee
Australia Coordinator, RE100

Muir Livingstone | Partner - Architect, Foster + Partners

Jonas Bengtsson | Founder & CEO, Edge Environment

Lisa McLean
CEO, NSW Circular

Kim Bowden | Global EH&S, Sustainability Leader, Guardian Glass (USA)

Ashleigh Morris
CEO, Coreo

Glenn Carlton | Architectural Design Manager, Guardian Glass

Dr Caroline Noller | Founder & CEO, The Footprint Company

David Chandler OAM
NSW Building Commissioner

Dr Philip Oldfield | Associate Professor and Director of the Architecture Program, UNSW Sydney

Brendan Condon | Director, Australian Ecosystems

Sjoerd Post | CEO, Jasmax

Caroline Pidcock
Spokesperson, Australian Architects Declare

Monica Richter | Senior Manager, Low Carbon Futures Program, WWF-Australia and Project Director, Business Renewables Centre – Australia

Ninotschka Titchkosky
Co-CEO, BVN

Laureate Professor Veena Sahajwalla | Director of Centre for Sustainable Materials Research & Technology, University of New South Wales

Chris Trott | Partner - Head of Sustainability, Foster + Partners

Paul Stoller | Director: Melbourne and Sydney, Atelier Ten

Simon Wild | Group Head of Transformation, Sustainability, Lendlease

Amanda Sturgeon | Head of Regenerative Design Strategy, Mott MacDonald, Sydney

Nicholas Wolff | Program Director - Central Renewal Project, Transport for NSW

Robert Svars | General Manager, Vistek Engineers

Jason Zafiriadis | General Manager, Earth Friendly Concrete, Wagners

Building Circularity: Why our Renaissance needs to be a perfect circle – event wrap

Wendy Frew & Poppy Johnston

The way to radically lower embodied carbon in the built environment, the experts say, is with thorough and thoughtful design over the entire life cycle of a project. The following are some of the insights they shared with our audience in November at our symposium Building Circularity.

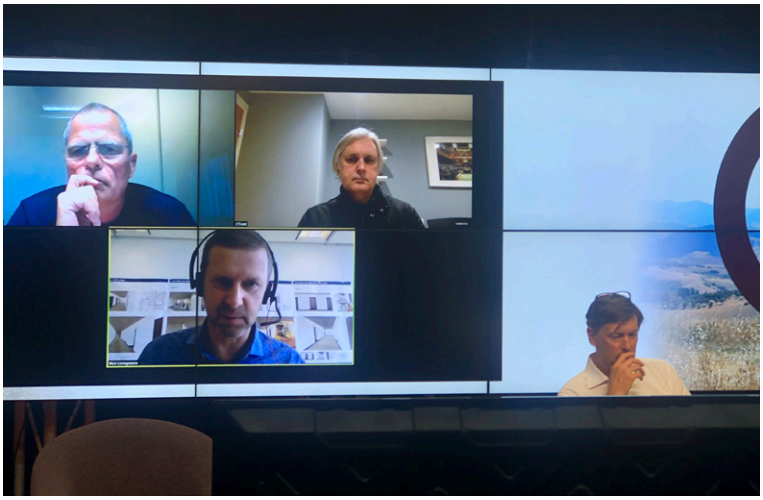
Built environment practitioners must tackle the emissions associated with construction processes, building maintenance and management and even the decommissioning of buildings if they are to create truly sustainable buildings, according to the experts who took part in The Fifth Estate's Building Circularity event held in November 2020.

As managing director of Atelier Ten's Australian office, **Paul Stoller**, put it, embodied carbon must be addressed because "it represents up to 80 per cent of the carbon of a building and it goes into the atmosphere now".

The built environment sector has already started to look beyond energy and water and towards waste and circularity as sustainability priorities, the symposium heard, and good design over the life cycle of any project can help radically reduce both embodied carbon in our buildings and waste on construction sites.

Ninotschka Titchkosky, Co-CEO, BVN

Left to right: Philip Oldfield, UNSW (fact checker); Monica Richter, Low Carbon Futures, WWF; Jonas Bengtsson, Edge Environment; Caroline Noller, The Footprint Company; Lisa McLean, NSW Circular



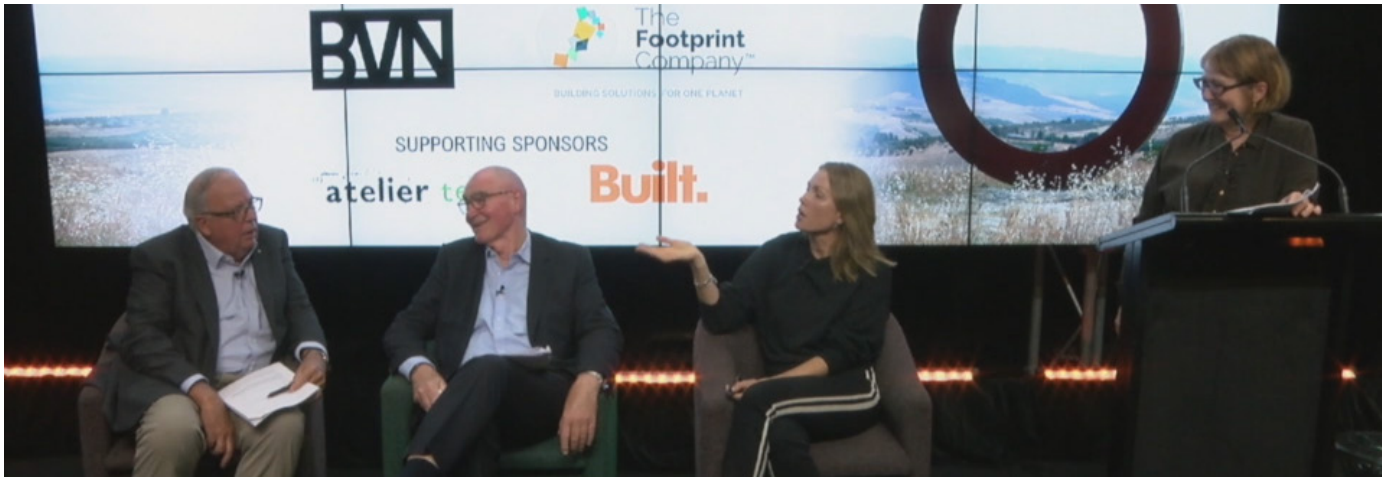
Live streamed: Sjoerd Post, Jasmax; Chris Trott, Foster + Partners; Muir Livingstone, Foster + Partners

In studio: Paul Stoller, Atelier TEN

Left to right: Jonas Bengtsson, Edge Environment; Caroline Noller, The Footprint Company; Glenn Carlton, Guardian Glass; Jon Dee, chief judge

Maria Atkinson, MC, Maria Atkinson Consulting

Jason Zafiriadis, Wagner's Earth Friendly Concrete



Left to right: Dennis Else, Multiplex; David Chandler, NSW Building Commissioner; Ninotschka Titchkosky, BVN; Tina Perinotto, The Fifth Estate

Veena Sahajwalla, UNSW talks about the future of sustainable materials

David Chandler and Ninotschka Titchkosky waiting in the wings to go on stage

Left to right: Brendan Condon, Director Australian Ecosystems, Biofilta, Melbourne Skyfarm, The Cape Sustainable Housing Project | Caroline Pidcock, Spokesperson, Architects Declare | Amanda Sturgeon, Head of Regenerative Design, Mott MacDonald | Poppy Johnston, The Fifth Estate

> “There is little point reducing operational carbon by shading a building if the embodied carbon [associated with creating] the shading exceeds the carbon you are trying to reduce”

But embodied carbon can be hard to deal with, especially as there is often a lack of data, Stoller said. He suggested the industry consider everything from sequestration in timber and landscaping, to carbon removal projects and offsetting.

British based international architectural studio, Foster + Partners, is pushing for design that evaluates carbon across the whole life cycle of a project.

Partner and head of sustainability at the firm, **Chris Trott**, said the concept of sustainability as it relates to the built environment has evolved over the past few decades from “the intuitive to the measured and finally to the holistic”.

Trott said this has helped the industry to realise that an office fitout, for instance, is low-hanging fruit worth picking. Clever design and choice of materials can produce fitouts with 70 per cent less embedded carbon than a conventional fitout.

Sydney based architect and studio partner **Muir Livingstone** said a development site itself can have a large bearing on embodied and operational carbon. Heightened density, for example, can be a positive if a site is well served by public transport.

“You can’t win every move … but for us, it is knowing where the carbon is and reducing it”, he said.

The studio’s design of office tower 126 Phillip St, Sydney, is an example of how access to harbour views, plus ample natural daylight can be leveraged to reduce carbon and improve the overall health of the building and its occupants, as well as that of neighbouring public and commercial spaces.

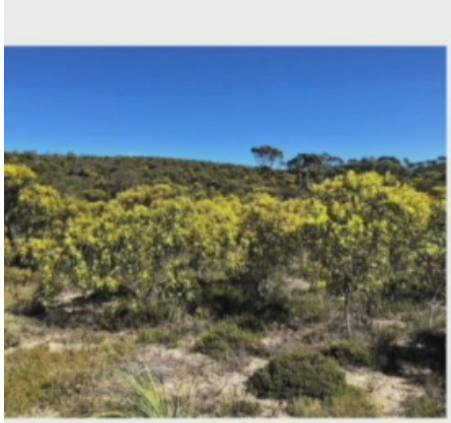
The building’s stepped profile responds to planning guidelines, ensuring daylight penetration to neighbouring public spaces. The design also minimises the amount of shading needed on the façade.

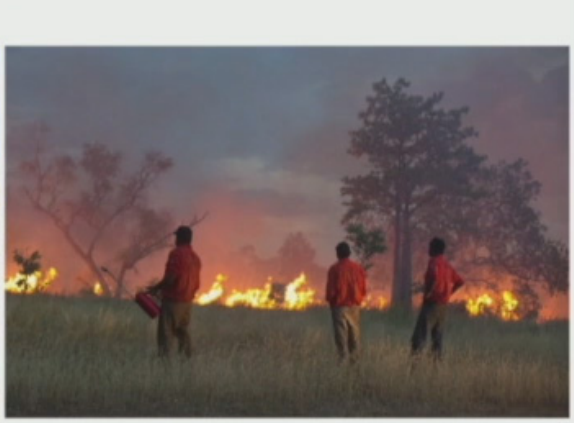
“There is little point reducing operational carbon by shading a building if the embodied carbon [associated with creating] the shading exceeds the carbon you are trying to reduce,” Livingstone said.

Sjoerd Post, chief executive officer of leading New Zealand architectural firm Jasmax, spoke about the surge in demand for net zero outcomes in New Zealand.

Key he said was also a growing practice of bi-culturalism, placing Indigenous thinking at the centre of design, with its integration of sustainability as a core starting point.

As an example of how advanced bi-cultural practice is in New Zealand, the government has granted the Whanganui River the same legal rights as a person – which means you can be sued if you damage it.





Circularity at the precinct scale

The importance of design in achieving sustainability doesn't stop at project stage but must extend to precincts.

The NSW government's Central Precinct Renewal Program around Sydney's Central Station is an example of where great design could make all the difference to the sustainability and success of an underused and mostly unattractive precinct.

The 24 hectares of government-owned land is earmarked for a giant technology hub that unites the transport interchange with diverse businesses and revitalised public spaces.

Project director, **Nicholas Wolff**, said an undertaking this big could take 20 years to complete so "you have to establish your ambition in a sustainability sense and what is world's best practice for precincts".

Solutions that were best practice 10 years ago would not be so today. For example, tri-generation.

Which is why good design needs to be bolstered by scenario planning, said Simon Wild, head of sustainability transformation at Lendlease.

Nobody knows how hot the planet could become in coming decades, Wild said.

"Scenario planning lets us look at [project] resiliency ... the risks and opportunities ... under different scenarios."

That planning prompted Lendlease to reset its own sustainability targets; they're now net zero by 2025 and absolute zero by 2040, and it hopes to get there without using offsets.

Offsets can play a role, however, said Atelier Ten's Stoller, pointing to Microsoft and Google, which have both invested heavily to offset emissions made in the past by data centers and campuses.

It's time to get the finance people, the managers and accountants around a common set of values to make money work harder to get deeply sustainable outcomes.

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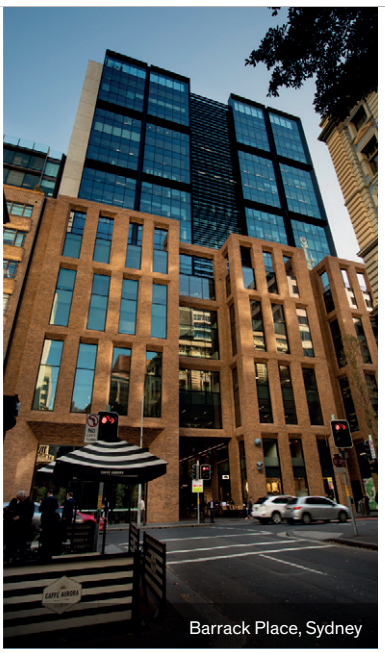

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Tech giants are also pressuring suppliers to reduce their own carbon footprints. Apple, for instance, wants all of its suppliers to be carbon neutral by 2030.

Finance for building projects should also be targeted and there should be an obligation on financial institutions to set carbon targets for the projects they fund, said Stoller.

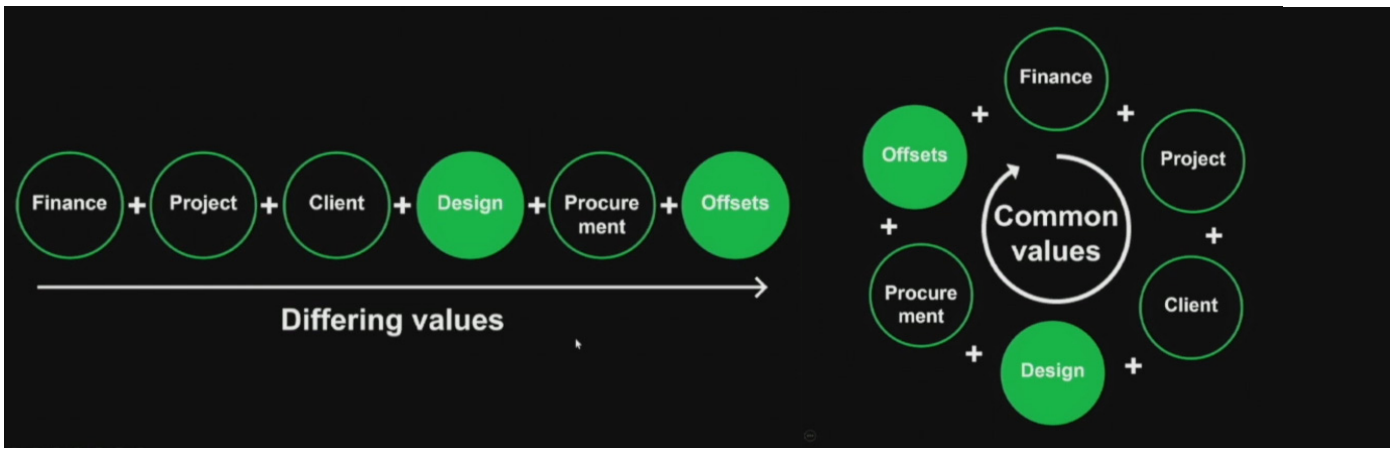
"That is where we should be going; it's tricky territory but finance is slowly coming to the table. [Financers] are starting to expect that of the people they are lending money to, but not as fast as we would like to see."

In the meantime, he suggested developers only borrow from institutions that are committed to sustainability.

"It's time to get the finance people, the managers and accountants around a common set of values to make money work harder to get deeply sustainable outcomes."

"To understand building circulatory we need to understand that everything is connected and requires whole system thinking, which is a bit of a challenge for the property sector.

Bloomberg European Headquaters, Foster + Partners



Chris Trott's presentation

It’s also about the little things

According to **Ninotschka Titchkosky**, co-CEO of architectural firm BVN, circularity should be embedded in projects of every scale.

The studio, in collaboration with SHoP Architects, is working with software giant Atlassian on its new headquarters, the “world’s tallest hybrid timber building” at Central Place next to Central Station in Sydney.

Another BVN project that really piqued the interest of conference participants was an innovative design for a robotically 3D printed air diffusion system

Services are typically the biggest component of embodied carbon for the average office building, Titchkosky said, and looking at airconditioning specifically, steel duct work makes up 60 per cent of that.

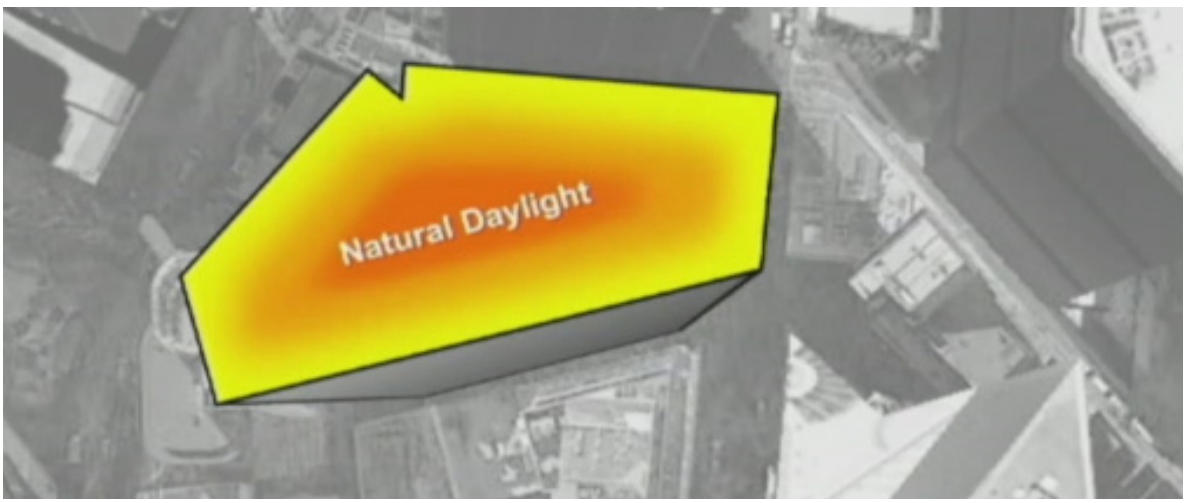
Working in a collaborative partnership with the University of Technology, BVN has designed an aerodynamic system that is 3D printed from recycled plastics, can be fully recycled at end-of-life, and cuts embodied carbon in duct work by up to 90 per cent.

“We need to be smarter and more creative if we are to tackle climate change,” Titchkosky said.

“To understand building circularity we need to understand that everything is connected and requires whole system thinking, which is a bit of a challenge for the property and construction sector.

“Ultimately, the goal is to move to a point where society, ecology and infrastructure sit in balance.”

Services are typically the biggest component of embodied carbon for the average office building, said Titchkosky, and looking at airconditioning specifically, steel duct work makes up 60 per cent of that.



Chris Trott's presentation

Two radically different construction industries

Designing a building is one thing, constructing it is another.

NSW Building Commissioner **David Chandler** spoke of two very different construction industries: one in the northern hemisphere and one in the southern hemisphere.

He said the northern hemisphere, to start, is "endowed with wonderful forests" for building with timber.

The northern hemisphere also has much bigger companies than in the southern hemisphere, which is made up of mostly small to medium enterprises so lack the capital fabric to invest in new manufacturing techniques and modern technologies.

Finally, northern hemisphere businesses are closer to their customers – they don't have to travel vast distances like they do in Australia, resulting in high transportation costs.

"We are still grappling with the fact that it's no good migrating northern hemisphere business models to the southern hemisphere," Chandler said.

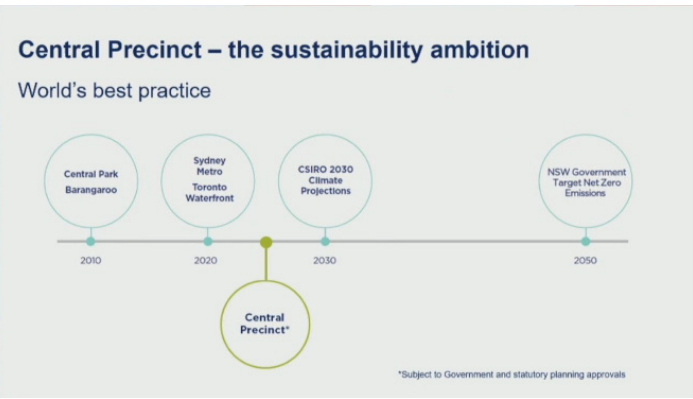
Many of the pioneering prefabrication businesses in Australia have suffered and failed trying to emulate northern hemisphere business models, he said.

"We haven't really come up with what I would call a southern hemisphere version to supply value-adding manufactured products to our market."

The dominance of smaller businesses in Australia's construction market is also hindering much-needed digital transformation in the industry, which will unlock efficiencies and precision that could vastly improve the quality of buildings and prevent waste.

"I can assure you the level of digital maturity across designers and builders is very, very low."

A new survey has revealed that smaller design and construction businesses cannot afford to pay for expensive software licences – which effectively lock customers in – nor the skilled workers to run these programs, he said.



Nicholas Wolff's presentation

Dennis Else, Multiplex; David Chandler, NSW Building Commissioner; Ninotschka Titchkosky, BVN

Disconnect between design and delivery

Chandler also spoke of the mountains of rubbish he sees being carted away from construction sites, pointing to closer involvement of designers throughout the construction process as part of the solution.

“We are seeing in the field a complete dysfunctionality of the process of good design translating itself into projects. We’ve shortcut the engagement of designers, with designers short-scripted in their development.

“We are up to about our thousandth bathroom to be pulled out.

“So, if the message hasn’t got round that you shouldn’t start putting in bathrooms unless someone with some talent has started putting some lines on paper that might point to what it might look like, then you’re about to have a big wakeup call.”

Multiplex executive director, sustainability, safety and health Dennis Else, who has also sat on the CRC for Low Carbon Living’s board, spoke about the challenge of building up industry capabilities in low carbon construction techniques.

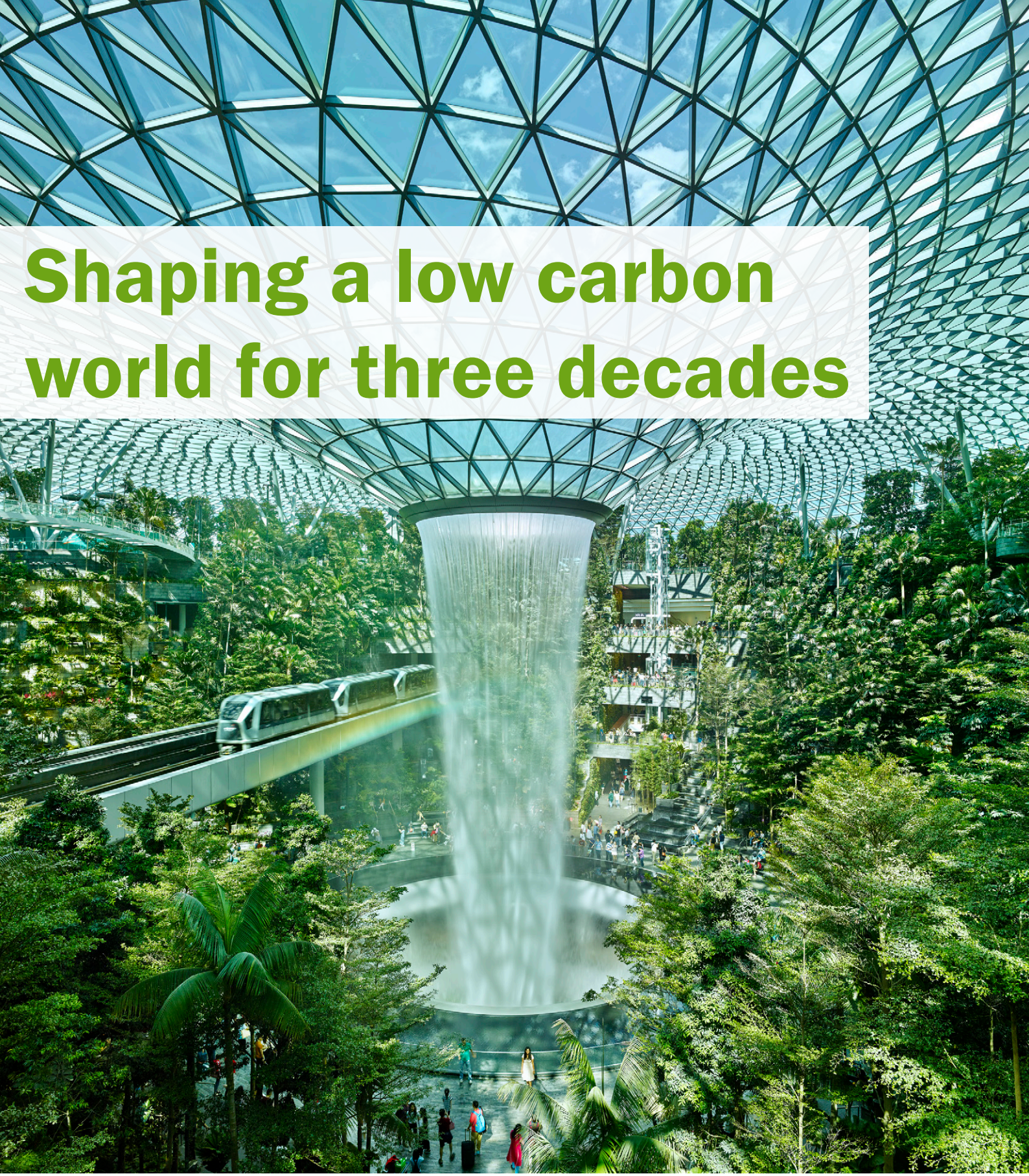
He emphasised the importance of sharing knowledge across the construction industry, which is something builders have long struggled to do. He also believes Tier 1 builders have a responsibility to lead the rest of the industry on the modernisation journey.

For example, Multiplex was the first company to adopt Western Australian invention Roborigger, a computerised hook on a crane with inertia control so that when lifting a large panel it automatically adjusts for wind, keeping the panel in alignment.

The company had the first-mover advantage but its leadership also prompted its competitors to adopt it, accelerating the technology’s growth. It is now being sold Internationally.

Else thinks the Australia construction industry has the potential to build up its own world-leading industry of modern, sustainable construction products and services equal to Australia’s legacy around photovoltaics R&D.

Shaping a low carbon world for three decades



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Let's not give up on our favourite materials just yet

When it comes to the merits of different building materials, Chandler admits to "loving the smell of concrete".

"I'm not entirely swayed by the timber alternative."

One reason is that much of the timber used in construction is shipped all the way from the northern hemisphere, but he also questioned the material's credentials as low waste.

He said plenty of engineered timber ended up in landfill in the construction of many of the outstanding examples of timber buildings in Australia.

The durability and resilience of a material like concrete also has its advantages from an emissions-intensity perspective, especially when compared to some timber products that are likely to need ongoing maintenance and replacement due to moisture issues.

Titchkosky agreed that materials science has come a long way to reduce the carbon quantity in traditionally high carbon materials such as concrete, and warned against Australia's tendency to follow trends.

"It's easy by doing that to miss the broader spectrum of opportunities," she said.

Taking a giant step back

In the final session for the day, panellists reflected on the challenge ahead and the blue-sky thinking needed to achieve true circularity in our cities and towns.

Caroline Pidcock, spokesperson for Architects Declare, believes we need to think carefully about how and where we build.

“If I was queen of the world for a day, or a bit longer, I’d stop jamming people into our cities and have a strong focus on regional areas...”

Pidcock also wanted to see cities be rewilded to foster connections with nature, and a reorienting of our values towards “radical sufficiency”.

“I think the lifestyle that can afford sufficiency, a really enjoyable sufficiency, is great because you don’t need to be working your little a*** off to buy things to impress people you don’t like, and pay for things with money you don’t have.”

She said that the modern world can look to the content-rich lifestyles of Indigenous Australians before white settlers arrived for clues about living happily within our means.

For Mott MacDonald regenerative design lead **Amanda Sturgeon**, the pandemic has fundamentally shifted lifestyles in a more sustainable direction, with people spending more time in their local communities and less time commuting to city centres.

She said this has resulted in a better use of resources and less duplication of space.

“I think there’s an opportunity to rethink where we work and the need for office buildings.

“Yes, we need gathering spaces and spaces to do collaborative work, but that doesn’t need to be in an office tower in the CBD I don’t think,” she said.

“With my magic wand, I’d like to see a connected string of really thriving neighbourhoods and communities that aren’t reliant on people commuting to high rise towers.”

While there’s a strong argument for density to curtail the amount of land humans occupy, Sturgeon believes “we don’t need high rise to be dense”.

"Ultimately, it's really hard to get a high rise building to be regenerative and zero carbon, and that means it has a huge footprint outside of the city to support that kind of project."

Brendan Condon, the man behind The Cape sustainable housing project, Australian Ecosystems and Biofilta Stormwater Solutions, sees massive potential in improving biodiversity, drawing down carbon and improving food security within our cities.

"I look at cities from an engineering and horticultural lens, and I see them as powerful biological and mechanical pumps that are largely open loop systems at the moment," Condon said.

"They are creating valuable waste streams that could be repurposed to create urban biodiversity, urban food, cooling, and improve our health."

Bringing agriculture and biodiversity-enhancing greenspace into cities at scale needs the right infrastructure, Condon told The Fifth Estate in an interview ahead of Building Circularity.

His Biofilta business is developing modular wicking beds that will make growing organics easier in seemingly unhospitable urban spaces.

The invention will be on display at Skyfarm, a rooftop urban farm being built on a 2000 square metre carpark rooftop in Melbourne.

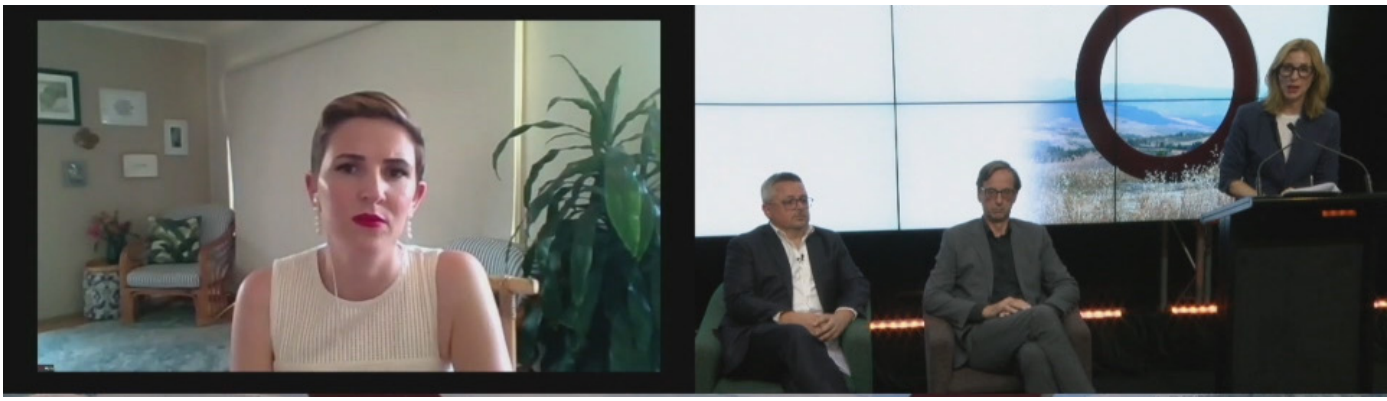
Rooftops are ideal for urban farming and gardening but Condon said that unlike in the northern hemisphere, rooftops in Australia aren't typically load bearing. He would like to see the building code adapted to make way for more urban agriculture.

He also sees the potential to use cities to grow biomass rapidly, harvest it, and use it to draw down carbon. One option is creating biochar to improve soil quality and draw down carbon in large green spaces, and even use it as a component of hempcrete.

"We need to start thinking about getting carbon sinking happening in our cities."

Condon said this is a technique that can help cities meet their carbon neutral ambitions, with carbon neutrality impossible in many urban developments without some help from carbon drawdowns or offsetting.

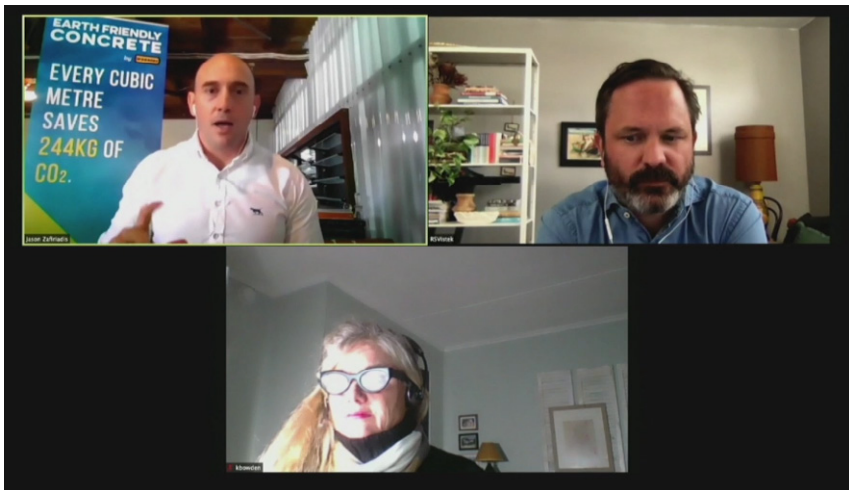
I look at cities from an engineering and horticultural lens, and I see them as powerful biological and mechanical pumps that are largely open loop systems at the moment



Ashleigh Morris, Coreo; Simon Wild, Lendlease; Nicholas Wolff, Transport for NSW; Maria Atkinson, MC

Jon Dee, RE100, chief judge/moderator

Philip Oldfield, UNSW (fact checker); Monica Richter, Low Carbon Futures, WWF; Jonas Bengtsson, Edge Environment; Caroline Noller, The Footprint Company



Left to right:
Jason Zafiriadis, Wagner's Earth Friendly Concrete; Robbie Svars, Vistek Engineers; Kim Bowden, Guardian Glass

Glenn Carlton, Guardian Glass

The Spanish-ish Inquisition into building materials

Wendy Frew

The following is an edited report of the Spanish-ish Inquisition session on materials, where we asked "witnesses" to take the stand and give testimony on key sustainability profiles/metrics of key building materials, including some fresh out of the lab. We've also included some extra material about glass that wasn't presented at the symposium.

According to **Lisa McLean** Australia is only just waking up to the value of the circular economy. As chief executive officer of state government-funded body, NSW Circular, her job is lead delivery of a zero carbon circular economy to NSW.

In an introduction to the Materials Inquisition, Mclean told the symposium that around the world, 11 per cent of economic activity is circular.

"We have reached the stage where technology that can help create a zero carbon economy is coming straight to our doorsteps," she said.

NSW Circular aims to provide the market with more data about the circular economy, McLean said, as well as collaborating with research and finance organisations across the state, setting up circular supply chains, and putting a spotlight on materials that can play a role in the circular economy.

Our Materials Inquisition was made for the job.

Mass Timber

For example, **Robbie Svars**, general manager of civil engineers Vistek, was quizzed about how far we can go in replacing other materials with timber to reduce embedded carbon.

Vistek is working on the world's tallest mass timber vertical extension at 55 Southbank in Melbourne. The 10-storey extension made of cross-laminated timber (CLT) is being built atop an existing six-storey building.

Svars said Vistek had a number of projects involving CLT, which "shows how you can rejuvenate a suburb with mass timber".

Q. How has Vistek handled the 55 Southbank building's engineered connections, which can double a building system's carbon footprint?

"We are very passionate about efficient timber connections," Svars said.

"When we take things out, we take a lot of connections out, bearing and screw-based... We work closely with installers, we 3D model it right down to screws, and we get feedback from installers, asking what will work for them, what will mean more hang time on a crane, reflecting on reducing the material that goes into those connections."

Q. What happens if this material is prefabricated?

"Mass timber offers the opportunity to completely design something before it hits the manufacturing process," Svars said. "There is less onsite waste, and millimetre accuracy."

"It has structural, acoustic and fire issues so it is not perfect for all projects. The sweet spot is three to eight storeys. Mass timber can be cost neutral or cheaper than a conventional build. We are passionate about making sustainability affordable or the industry won't take it up."

Q. But how can we maximize the reuse of the timber that goes into these builds?

"You need to design buildings that people want to hang on to for 150, not 50, years," he said, adding that the next best solution is designing buildings to be demountable so they can be redeployed elsewhere.

"Mass timber offers the opportunity to completely design something before it hits the manufacturing process"

"Design and detailing done correctly means there is no reason the wood isn't as good in 50 years' time." Svars said there could also be a secondary market for standardised panels, so that future projects could have 20 per cent of their material sourced from re-used panels. Sending used wood to land fill, or burning it, should be a last resort.

Q. In light of hardware retailer Bunnings' decision in mid-2020 to stop selling Victorian native timber products after the Federal Court ruled the timber was felled illegally, how important is it to ensure the timber is certified by credible organisations?

"It is vital and market forces talk," Svars said. "A company in Europe wouldn't last in the market if it turned out it wasn't sourcing its timber from a sustainable place. The forests need to be well maintained. You don't sequester carbon by building a wood building; you sequester it by growing trees."

"You have two gold standards (for sustainability certification), unless you want to spend a lot of time researching that more, you have to rely on those certifications. But things can still go awry. On some level, we have to trust the certification. Mass timber in Australia is Radiata Pine so it's not as much of an issue [as it is] with endangered timber species but it comes with its own issues. There will probably always be a trade-off."

Q. You haven't nailed how timber gets us to net zero. What's your role in enunciating that?

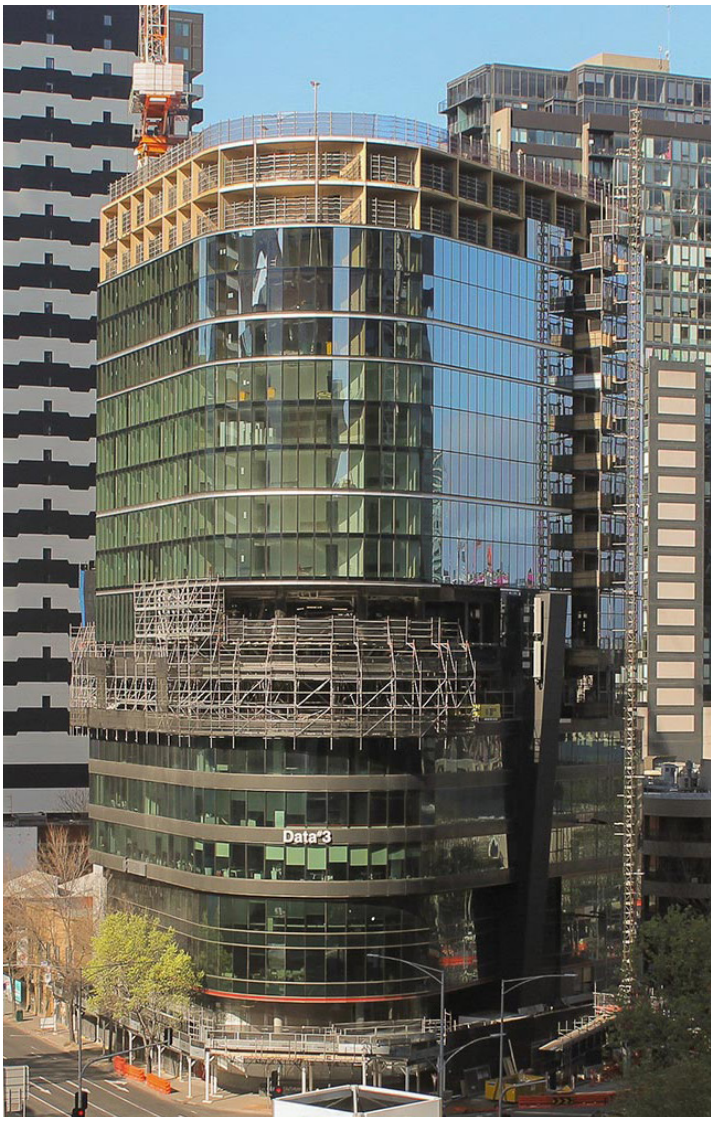
"We are structural engineers; we don't sell timber, so we work with third parties. All we can do is pull data from the public space but I will say, in many ways, timber is a no brainer because you don't need much analysis to see it is better than a conventional build."

You need to design buildings that people want to hang on to for 150, not 50, years

Panel Judgement

The judges withheld their decision, in part because the whole life cycle of timber has to be included in any consideration. Mass timber can play a significant role but don't be fooled that more timber in a build is always better.

This Barry St, Brunswick townhouse development makes use of CLT. Photo: Milieu Property/Fieldwork



55 Southbank CLT extension. Photo Bates Smart

Concrete

Diversified Australian construction materials and services provider, Wagners, has created concrete that uses a geopolymer binder system made from the chemical activation of two industrial waste by-products: blast furnace slag (waste from iron production) and fly ash (waste from coal fired power generation).

General manager of Wagner's Earth Friendly Concrete (EFC), **Jason Zafiriadis**, said every cubic metre of EFC saves 244 kg of Co2. The ratio improves with higher megapascals (MPa) or strength, he said.

"Secondly, there are technical benefits from durability, and it is better for mass pours, like airport runways."

Q. So, what is the secret sauce?

"There is zero cement," he said.

The cement is replaced with glass slag and fly ash, some sand and aggregates, and then Wagner's uses a propriety chemical solution that replaces some of the water content.

Q. People have been experimenting with geopolymers for years. What are the key barriers to manufacturing GFC at scale?

"The developer, or end user, being willing to try a new material. We have found in Australia that it is very challenging to harness that.

Wagners Earth Friendly Concrete

The cement is replaced with glass slag and fly ash, some sand and aggregates, and then Wagner's uses a propriety chemical solution that replaces some of the water content.

"In the northern hemisphere, [the industry] is more open-minded. Australian standards are difficult to work with and it takes a lot of time and money to develop new products that are accepted under our standards.

"We have spent about $20 million and we are still not technically accepted by Australian Standards but we have engineer reports that prove we meet all the standards."

Q. How do we convince government bureaucrats to use GFC?

You have to engage with key product specialists in government, Zafiriadis said.

"Governments carry a lot of risk so they are conservative [when it comes to breaking with convention for big projects]. They often want to see new products used somewhere else first so they can test it. Aussies love to be the first to be second."

Judgement

We need more data on whether, if Wagners were to use 100 per cent renewable energy, it could achieve zero carbon, but it's encouraging that Wagners is talking to Atlassian about a hybrid timber and EFC build.

University of Queensland's Global Change Institute. Photo: FIGLIOLI Photography

Glass

Guardian Glass's architectural design manager **Glenn Carlton**, and its global EH&S sustainability leader, **Kim Bowden**, made the pitch for glass.

While already providing net carbon-avoidance products, the flat glass sector is investigating massively scaling up its contributions to the carbon neutral transition, including by developing novel ways to lower industrial emissions.

On average, 48 per cent of a building façade is glass, rising to as much as 100 per cent in skyscrapers. Windows stay on buildings for 40 to 50 years, on average, so it's important they are as efficient and durable as possible to minimise replacement.

Glass is also an integral part of ground and air vehicles. Over the past 20 years, the glass area in passenger cars has increased by about 17 per cent.

The European Union flat glass sector leads the world, having already cut its CO2 emissions per output by 43 per cent between 1990 and today. But more needs to be done.

One of the biggest issues to deal with is the extremely high furnace temperatures needed to produce flat glass, Bowden said.

Seventy-five per cent of CO2 emissions from flat glass manufacturing derive from the use of natural gas to heat the melting furnace. The remaining 25 per cent of emissions come from the release of CO2 from raw materials carbonates.

The sector is looking at improving furnace efficiency, increasing the use of broken glass and different fuels, as well as targeting emissions associated with the transport of glass products.

For example, when producing flat glass, the tin bath that holds molten glass can be left in place for the life of the furnace, and some of that material can be used when a furnace is rebuilt.

About 26 per cent of the raw materials' input that goes into European flat glass furnaces is what is known as cullet, that is, recycled glass as a raw material. Moving from 20 to 26 per cent of cullet in recent years has made possible a further reduction of 6 per cent of CO2 emissions.

The glass sector is also investigating the use of alternative energy sources to

fire a furnace, such as green hydrogen, but no perfect solution is yet to hand.

Carbon associated with the transport of glass product could be reduced if more glass was manufactured in Australia but Bowden said the market lacks the capacity.

"High performing, low e-coatings are all made offshore. The secondary and tertiary processes are labour intensive and so they go to low-cost manufacturing markets."

There are also hurdles to jump before large amounts of glass can be recycled for the same purpose or some other purpose.

"It is good to recycle it into a furnace but recycling commercial glass from buildings involves a lot of sorting, cleaning and collecting. And if you are using electricity [rather than natural gas or fuel oil] for a furnace it has to be on for longer, among other things," Bowden said.

As one of the judges noted, another problem with glass is the amount used on building facades at a time when global temperatures are rising and exacerbating the urban heat island effect. Triple glazing is not necessarily better than double glazing because the extra energy used to make the triple glazing can be more than the energy you save from lower cooling costs.

Another problem with glass is the amount used on building facades at a time when global temperatures are rising and exacerbating the urban heat island effect.

Panel Judgement

We need glass but it isn't yet a circular economy product.


UNIQLO
SEPHORA
sunglass hut
swatch

Chadstone Shopping centre. Image: Aaron Pocock

Future Products

Veena Sahajwalla, Laureate Professor, director of Centre for Sustainable Materials Research & Technology, University of NSW, delivered a fascinating insight into the latest innovations in materials recycling.

The work being done by her team at UNSW's Centre for Sustainable Materials Research and Technology (SMaRT) comes as Australia's governments have agreed to ban the exporting of glass, plastic, paper and rubber tyres from January 2021.

Fresh out of the lab is green aluminium.

"So much of it is used in food packaging," Sahajwalla said. "The quality is fabulous. Why would you look at it as waste?"

"Micro factories are being developed as we speak. One commercialised product is an Australian version of green steel, using waste rubber tyres, replacing coal and coke and using an electric furnace.

"You can create hydrogen in situ when using waste tyres. The hydrogen is liberated from the tyres themselves."

Green ceramics are being produced from waste glass and textiles to create a product with a hard-wearing surface that is sourced from waste entirely, said Sahajwalla.

"The strength is good enough to put on floors.

"You want micro factories producing it so that you aren't moving waste all around the country."

Sahajwalla said nothing is standing in the way of scaling up manufacture. Mattress Recycle Australia in Cootamundra in regional New South Wales is collaborating with SMaRT on the manufacture of high-quality green ceramics using old beer bottles and mattresses.

"We have proven viability, the first commercial deployment, at Cootamundra, is showing the economic viability of the factory, and the business case lines up."

Cootamundra was chosen to demonstrate the benefits this kind of manufacturing could deliver to regional areas, including jobs, and to show that an existing recycling business can use other waste material, and upskill and upcycle.

Micro factories are being developed as we speak. One commercialised product is an Australian version of green steel, using waste rubber tyres, replacing coal and coke and using an electric furnace

Veena Sahajwalla, Laureate Professor, director of Centre for Sustainable Materials Research & Technology, UNSW

BVN's Ninotschka Titchkosky on slashing embodied carbon with robotics, 3D printing and other technology

Wendy Frew

BVN's co-chief executive officer Ninotschka Titchkosky, talked to The Fifth Estate ahead of last year's Building Circularity symposium about the importance of technology, low-carbon materials and innovation.

BVN is passionate about deploying building circularity in its work, from its biggest projects, such as Atlassian's hybrid timber tower (its new headquarters near Central Station in Sydney), to smaller details such as the shape of air-conditioning ducts, as well as in the adaptive reuse of older buildings.

The Australian-based studio is using state-of-the art technology, such as robotics, experimenting with new, lower carbon materials, and working in collaboration with everyone from builders and engineers to universities and government agencies.

The goal is a dramatic reduction in embodied carbon in new buildings and existing stock, said Titchkosky, who addressed The Fifth Estate's symposium and took part in one of the panel sessions.

It's a goal the sector is beginning to embrace, she said, but we need more builders to innovate beyond the conventional framework of design and construction.

Ninotschka Titchkosky, Co-CEO, BVN

"I do see change, I really do. I think part of it is client driven. However, to make real progress we need construction and the rest of the system to engage. In the end, we have to have an industry that is willing to innovate because even if the client has the aspiration they are [often] told that it can't be done.

"We need to push past what we know into some of the more radical territory because if we don't, we are just tinkering around the edges."

Envisioning new ways of designing building services to support new ways of working, reduce waste and embodied carbon has played a key role at BVN.

"The services that support us in existing office buildings really haven't changed that much over the past 50 years, yet we are starting to occupy space in a more fluid way.

"For example, why are we occupying space with big metal airconditioning ducts that make up about 60 per cent of the embodied carbon of airconditioning and that are very difficult to modify?"

That's why the practice is exploring a new aerodynamic 3D printed air diffusion system that breathes like a frog's skin to softly release the air through tiny pores and improve human comfort. An advantage of the super-efficient design is that it is fully optimised in design, so much less material is required.

"This system we are designing has about 90 per cent less embodied carbon than conventional duct."

However, taking new designs and products to the market is not easy.

"We have just about finished the demonstration project and the research papers so we are at the point where we will soon have a completed proof of concept.

"Going to commercialisation for something like this is a pretty big step. We are currently reviewing if we will get to that step or not ... That would require additional funding and industry backing.

The project is in collaborative partnership with the University of Technology Sydney, and with the assistance of The Footprint Company and Arup.

The role of technology in innovation

New technologies can help crack open problems and shift the way designers, builders and engineers think about things, Titchkosky said.

“People are really interested in the 3D printing processes... We can optimise materials in a way we can’t do at the moment, finely tune what we are producing, use new materials that have less carbon, use less labour, just use what we need and no more.

“In Australia, we need to start thinking about large-scale 3D printing so one of the next projects we would like to do is large-scale 3D printed concrete.

“It can’t just be done architecturally. Construction needs to come on board with these concepts to enable clients to make those choices.”

It helps to have clients with courage, such as software giant Atlassian, which has commissioned a 40-storey hybrid timber tower with SHoP Architects and BVN as architects

Re-ply is an BVN initiative that up-cycles plywood barricades into work and dining spaces in NYC.
Photo: Ernesto Roman

I would say Atlassian is the most courageous client we are working with.

"I would say Atlassian is the most courageous client we are working with. Our industry is constantly putting red flags up about why something can't be done. That is something I really hope we can move away from."

How far you can push sustainability in a building depends also on the site and the type of building.

"The Atlassian building has a constricted site and it is very tall, so it has a different set of constraints from a low to mid rise building."

Atlassian wanted to retain its culture of familiarity so the building has been designed by SHoP Architects and BVN in subsets of four levels called Habitats.

"Each Habitat has access to a park, there is a shift to natural ventilation as you move closer to the façade, and there is a combination of timber, steel and concrete.

"The building is really designed to be a democratic model of a tower, and a building that moves away from being a hermetically sealed box to a breathing ecosystem," Titchkosky said.

It is split into zones of outdoors, indoors and mid-doors. There are parts of the building that are airconditioned; others are mixed mode, and there are also fully naturally ventilated spaces.

"We are starting to think in a more nuanced way about how we occupy spaces in the sky and how we stay in touch with nature and our environment."

The building is really designed to be a democratic model of a tower, and a building that moves away from being a hermetically sealed box to a breathing ecosystem

Sustainable materials

Currently, the world's tallest fully timber building is 18 floors, and the technology to build one significantly taller doesn't yet exist.

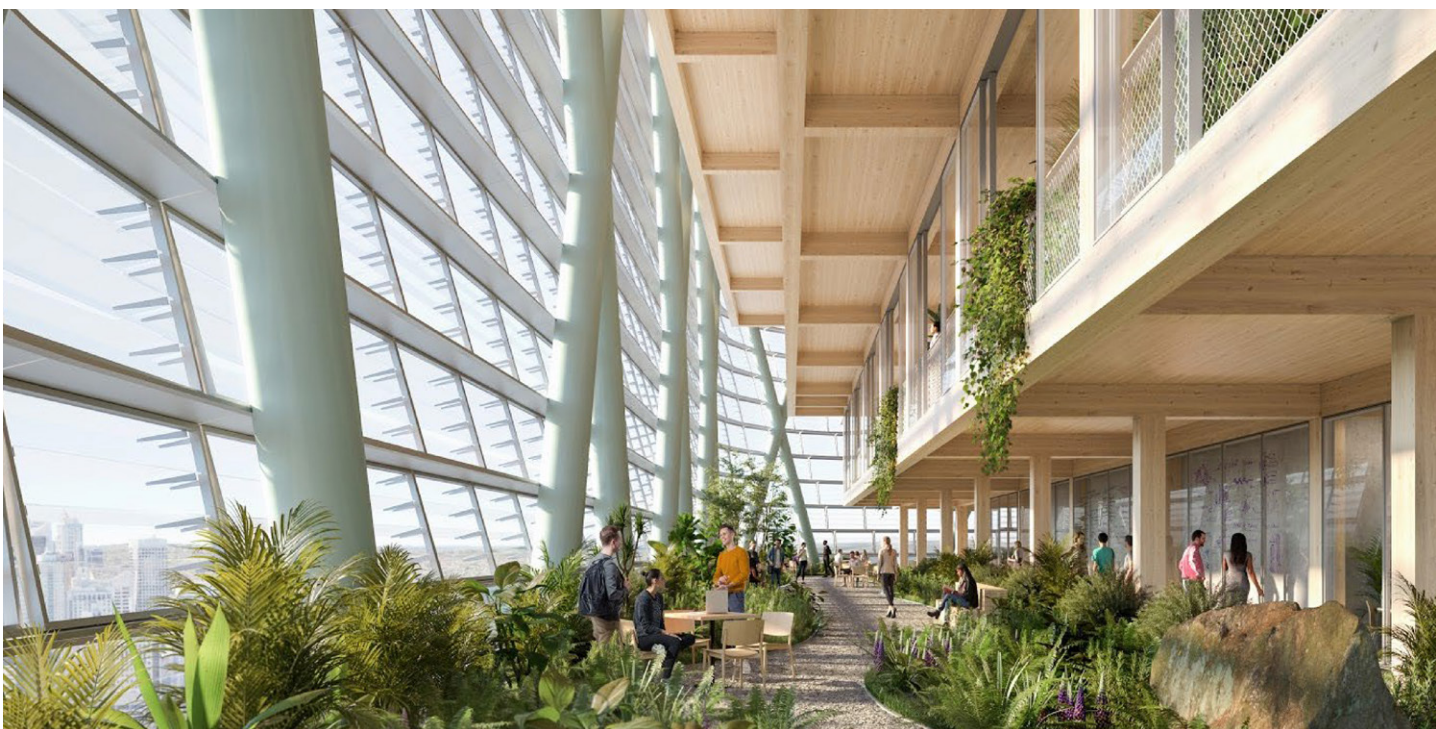
"Timber has so many great qualities. We did a big project at ANU with Lendlease that had two big timber buildings. For the 450-bed student accommodation building, we had a 70 per cent reduction in labour compared with a conventional build ... 13 people built it, with three of them on the crane.

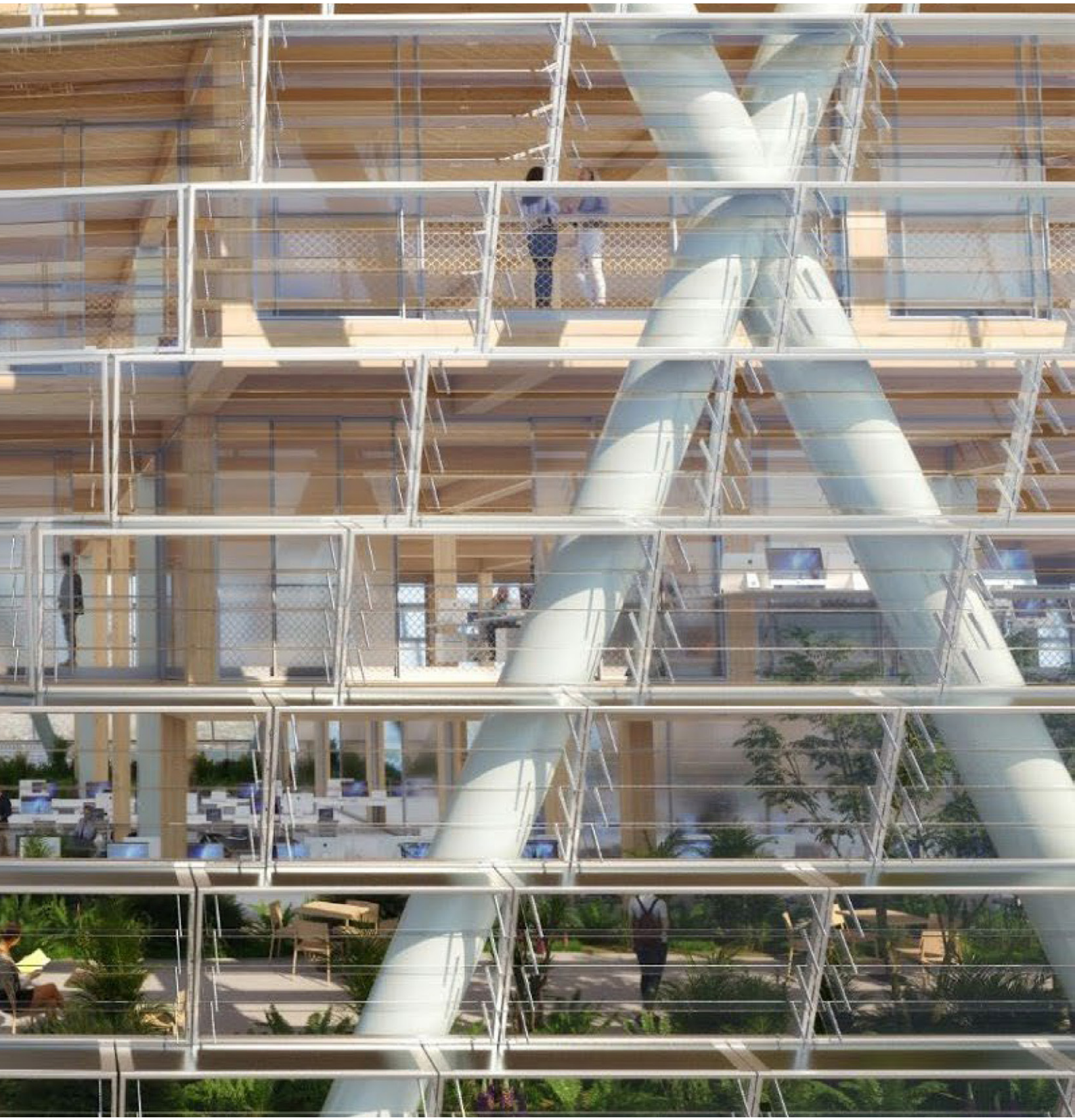
"The whole building was put together like a Meccano set, all the facades were prefabricated so construction time was reduced by over 30 per cent.

"When you go on site it is incredibly clean and quiet, and when the building is finished the aesthetic qualities and the warmth of the timber is outstanding. You are not then layering on additional materials to create the human habitat component.

We can't keep going with the knock-down mentality. While it may be cheaper in the capital cost, it is not cheaper for the planet and a whole range of other things."

Atlassian Headquarters, Sydney. Image: SHoP Architects and BVN





Atlassian Headquarters, Sydney. Image: SHoP Architects and BVN

"I am a big fan of timber; it is a no-brainer to use it where you can. And we are getting better pathways for supply and tender in Australia."

Having said that, timber is not the only option. The industry is developing a number of "green" concrete products, which is fantastic, but more work needs to be done, she said.

"You can 3D print concrete, which can enable us to craft new aesthetics and optimise material use and form. I think there is a really good future for concrete, we just need to keep working on it.

"Interestingly, there is no established industry in Australia for the manufacture of green steel. There may be a production facility opening up in South Australia but at the moment you cannot buy green steel at scale in Australia. If we can change our production methodologies, steel will make a better contribution to embodied carbon also."

In Australia, we need to start thinking about large-scale 3D printing so one of the next projects we would like to do is large-scale 3D printed concrete.

Atlassian Headquarters, Sydney. Image: SHoP Architects and BVN

Existing building stock

We mustn't forget that only about 1 – 2 per cent of our building stock consists of new buildings, a sector BVN has been concentrating on for some time.

"I think the potential is only limited to our imagination. We have cut big holes in buildings, we have opened them up, we have completely transformed what even the client thought was a defunct piece of building stock.

We can't keep going with the knock-down mentality. While it may be cheaper in the capital cost, it is not cheaper for the planet and a whole range of other things."

The solutions always come back to innovation.

"In NSW we have Design Excellence, but I would support moving to something like Innovation Excellence where it is not just about the design but innovation within the whole model," whether that be in construction or occupancy or leasing, Titchkosky said.

She would also like to see more construction companies invest.

Her ideal builder is someone who is introducing incremental innovations to conventional builds but who is also investing "in the space of tomorrow and thinking about more radical innovations".

"What's worked really well for us is finding a real-world problem and bringing partners together to solve that problem. If everyone did that ...together we could lift the entire industry."

The Australian National University's Kambri precinct. image: BVN

The race is on to cut embodied carbon and big tech is in the lead

Wendy Frew

Paul Stoller and Claire Maxfield from Atelier Ten talked to The Fifth Estate ahead of last year's Building Circularity event about how big tech is driving sustainability in the corporate sector. They also pointed to the latest trends in the built environment, such as tailored offsets and 24/7 carbon.

An increasing number of companies want to lead the pack when it comes to commissioning low-carbon buildings, according to Atelier Ten's Paul Stoller. He said this is because they recognise business as usual is no longer good business.

"Especially in the past five years, we have seen a real acceleration where businesses are just going for it, especially in the UK and the US," said Stoller, who is the director for Melbourne and Sydney for the international environmental design consultancy.

Young employees are a major driver for tech companies, said managing director of Atelier Ten's San Francisco office, Claire Maxfield.

"Tech companies began hiring younger people and those recruits cared about sustainability, so the tech companies had to care about sustainability," explains Maxfield.

It started with a focus on health and amenity at the workplace, and then became a values conversation that dragged everyone along.

"Google started to care so its competitors had to care and the developers who work for Google had to care and before you know it, all commercials are fighting tooth and nail to have credentials on this issue."

Paul Stoller, Atelier TEN

Government inaction

And it is just as well Millennials are driving this change because, in many countries, the push to embrace sustainability and low-carbon outcomes isn't coming from government, especially in the US under outgoing President Donald Trump.

"It was really heartening to see how many commercial outfits of various forms – developers, private companies – took up this charge to say 'we still think this matters and we are going to make it happen even though there is no policy around it'," she said.

What really lit the fire under Atelier Ten was a report released in late 2018 by the Intergovernmental Panel on Climate Change that said the world had to act on carbon between 2030 and 2040 and keep the rise in global warming under 1.5 degrees Celsius, rather than under 2 degrees by 2050, as was earlier called for.

"When we started looking at a shorter time frame, [the focus] becomes about 50-50, embodied carbon is half the carbon [that must be reduced] and operational carbon the other half," Maxfield said.

"That totally changed our lens. We don't want to trade off between them but we absolutely have to focus more on embodied carbon than we have been."

Sydney Modern Project for the Art Gallery of NSW. Photo: Atelier Ten

Data is key

For that to happen, it is vital to get more and better data about carbon in the built environment.

“There is some great research coming out of universities, who are trying to get manufacturers to play by the same set of rules,” explains Maxfield.

“Let’s say you want to choose carpet that has the lowest carbon outcome. Each manufacturer was measuring different things, and including different things in their measurements. You couldn’t get an apples-to-apples comparison.”

Things started to change when Carbon Leadership Forum was formed at the University of Washington that reached out to industry to figure out a new set of carbon rules for product categories that takes into account market location and other conditions.

“Now we can understand where things make a difference,” said Maxfield.

“For example, for some materials, the data here in the San Francisco Bay area will be different from the data in Los Angeles and very different from New York.

“It is not completely seamless. If you wanted to do a global survey you will have gaps where there is no data. But if you want to do something in North America or Europe you will have access to good data.”

2021 trends

Forget high tech silver bullets. The big trends as Atelier Ten sees it are:

- Questioning how much we are building and whether we need “fancy finishes”
- Scale: Look at what is happening district-wide to see if residual carbon can be offset in the local area
- Local, tailored offsets rather than generic global offsets
- Going beyond zero carbon with design elements, such as landscapes, that can sequester carbon
- 24/7 carbon: A new concept emerging from policies at Microsoft and Google that incorporates the time value of carbon, second by second

Sydney Modern Project for the Art Gallery of NSW. Photo: Atelier Ten

Low hanging fruit

There is an awful lot designers and builders can do to reduce embodied carbon without even trying.

"We have realised that you can make some pretty good savings even by building the same thing you would normally build, but by paying attention to exactly what materials you are using," she said.

For example, she said people can opt for earth-friendly concrete that cuts the embodied carbon by about 30 per cent. "You specify the concrete, what is in the cement mix, which part of the building you use the concrete – all of these things slash embodied carbon but still get you the building you want.

"We are on the cusp of saying 'okay, we took the easy wins now look at the design'. Do we use timber, do we build smaller, should we be going beyond the low-hanging fruit?

"There is an appetite to push the design more fundamentally and to dig deeper into the harder parts of the project so that you are looking at embodied carbon across the entire material palate and not just at the big ticket items of the structure," said Maxfield.

We are on the cusp of saying 'okay, we took the easy wins, now look at the design'. Do we use timber, do we build smaller, should we be going beyond the low-hanging fruit?

Clients who don't care

There are plenty of places around the world, and certainly in the US, where clients don't want to talk about climate change or the emissions associated with their project.

But that doesn't mean you can't deliver them a low-carbon building, said Maxfield, "they just don't know about it".

And it doesn't necessarily increase a building's price tag.

"We had a client recently who said they were interested in embodied

carbon savings but wanted no changes to the cost of the building or the construction timetable or the design, which was already completed."

The end result was a 27 per cent carbon saving on the project.

Costs are more likely to rise when a project design calls for less conventional materials, such as timber or different kinds of cladding.

"We seem to be pretty cost neutral on interiors ... so there is a lot we can do before it becomes a cost discussion."

Sometimes, it can be as simple as returning to first principles, said Stoller: using less material or having a more structurally efficient design.

The buildings of the past could, in fact, be more carbon efficient, such as the industrial loft building where floor plates have more columns.

"You use less material, they sometimes cost less to build but it is currently not a commercially attractive offering to have columns [on your floor plate] even though cool companies want old-fashioned loft buildings," he said.

"The discussion [with the client] is driven by cost-risk, about who will move in and how quickly a building can be leased."

Some tenants are open to floor plates that are interrupted by columns but a designer doesn't usually get to talk to a tenant.

"Leasing agents call the shots and you deal with the developer. That's a long game."

"The real estate sector is deeply conservative because it has so much money on the line; it is very reluctant to do new things. Slipping in better cement and changing the concrete mix is a win because nobody sees it, it is invisible."

Claire Maxfield, Atelier Ten

Australia plays catch-up

Australia is only now starting to pay attention to embodied carbon in the built environment, with companies such as software giant Atlassian leading the way with its proposed hybrid timber tower in Sydney's CBD.

These kinds of projects tend to drive change in the rest of the market, said Stoller, evidenced by Atlassian's role in Transport for NSW's renewal project for Sydney's Central Station precinct. Other developers in the precinct want to keep up with Atlassian, and Transport for NSW wants to attract the Atlassians of the future to the precinct.

Diversified property groups such as GPT and Dexus have entire portfolios with zero carbon operations, said Stoller, and any building added to the portfolio also needs to be zero carbon. In turn, that is driving the rest of the market to do the same, and it prompted the Green Building Council of Australia to issue a new, zero carbon version of its green star ratings.

Carbon has gone from being a future issue to be something that we consider in great detail and with a time value, said Stoller. He said there's a sense of urgency about tracking carbon in precise time scales all the time.

"There are these big shifts in how we think about carbon from being a scary thing in the future to a complicated thing now, every hour and every second."

Making offsets work harder, and closer to home

There is plenty of work still to do on carbon neutrality but some players in the built environment sector are already looking beyond carbon zero.

Even the best designed building will still have residual carbon but that can be offset by designing landscapes that sequester carbon, said managing director of Atelier Ten's San Francisco office, Claire Maxfield.

If there is anything the world has learnt from its experience with COVID-19, Maxfield said, it is how much people value green space.

"There are health benefits, ecological benefits, air quality benefits, embodied carbon benefits from green spaces," said Maxfield. "We need to think about our green space as part of our city system and as part of our industrial ecology of buildings from an embodied carbon standpoint."

"That is more exciting to me somehow than thinking about new building materials ... we need some more options for [low-carbon materials] ... but even if we do all of those things we are still left with this question of what else can we do," she said.

Maxfield and her colleagues worked with San Francisco studio CMG Landscape Architecture to develop a tool for landscape-based carbon emissions.

Pathfinder is a free, interactive web-based application for landscape architects to use to create climate positive designs.

It can be used in the design phase or for completed projects to estimate the carbon footprint of a landscape and the carbon sequestration potential of its elements over time.

Factors considered include project type, site boundaries and the percentage of impervious and pervious.

Why we need a rating tool for embodied carbon

Wendy Frew

Founder and CEO of The Footprint Company, Dr Caroline Noller, surfaces the mysteries around embodied carbon and explains how we can eliminate it from the built environment. This is an edited version of an interview The Fifth Estate conducted with Dr Noller ahead of last year's Building Circularity Symposium.

The property and development industry drives over 50 per cent of annual global carbon emissions so there's no time to spare when it comes to making radical cuts to embodied carbon in the built environment, said Caroline Noller.

Noller and her team at The Footprint Company want to accelerate the sector's transformation to net zero by 2040 by distilling the complex black box of carbon calculations into information that can help designers make easy decisions about how to radically eliminate embodied carbon in building projects. Preferably, it would be displayed visually.

"Embodied carbon is sort of like the problem you didn't know you had and didn't understand," said Noller.

"It involves complicated mathematical and theoretical concepts and it is quite complex to measure but a designer's job is very time poor. If we want to radically reduce carbon, we have to simplify all of that."

Making design decisions about carbon early in a project is especially important,

she said, because that's the time when up to 50 per cent of embodied carbon can be eliminated.

"Embodied carbon is the energy-related emissions associated with the production and life of a product from its extraction until the end of its life. Mostly what we are concerned about are the emissions from the cradle to the finished product, which is the vast majority of them.

"The task in front of us is to educate an entire sector of architects, designers and builders on radically cutting the emissions generated from cradle to finished onsite project."

For much of the twenty or so years she has been working in this field, Noller felt like she was talking to herself. Attention was focused on cutting operational emissions. But that's rapidly changing. In March, 2020, just before COVID-19 closed down the world, Noller attended the world's first embodied carbon conference, in the US.

"The most exciting part of the job, particularly over the past 18 months, is that embodied carbon is now a 'thing'. People want to know about it," she said.

"The other exciting thing is that there are lots of ways of reducing embodied carbon. You don't have to use green steel and green concrete; there are lots of design styles that can achieve the same cuts to embodied carbon.

"Once we get good metrics and present them in a way that designers can understand ... it opens up opportunities for innovation and design.

"In the next three to five years, I believe we will have an embodied carbon star rating in the same way we have NABERS for operational carbon. That is where we are going and that will completely transform everything," she said, because it will drive demand for low-intensity carbon materials.

Initiatives such as the Architects Declare movement and the World

The most exciting part of the job, particularly over the past 18 months, is that embodied carbon is now a 'thing'. People want to know about it

Green Building Council declaration on carbon, and the adoption by many cities and governments of a net zero philosophy, has energised the push to radically cut embodied carbon, said Noller.

Now we need incentives to cut embodied carbon built into our regulatory and planning systems, for example, offering developers accelerated planning approval, floor space ratio improvements or fee reductions, in return for internationally verified cuts to embodied carbon in new buildings.

"There is already regulation in the Netherlands, France and Japan. If you put in a DA there you have to account for embodied carbon in materials," she said.

"Within the next five years, I see all of the countries that are signing up for net zero by 2050 introducing regulations for the process. People in Australia are already talking about what the roadmap will look like, whether there will be mandatory reporting, or a regulated amount of embodied carbon you aren't allowed to exceed."

But, with between 250 and 300 different labelling systems around the world for $2 trillion worth of materials, there's a lot of work still to be done.

Information is increasingly being shared. For example, in the case of a tonne of aluminium for windows, if it is produced in North America in a certain way we know how much embodied carbon is in that product thanks to a global life cycle inventory published by the international aluminium industry. You can compare the embodied carbon in that product to one produced elsewhere.

There are some careful calculations to be made from here on. With so much of the focus traditionally on operational carbon – better insulation, more shading for buildings, more efficient heating and cooling and so on – we are at risk of using more carbon than we save via these efficiencies, she said.

"For the next 10 to 15 years, 50 per cent of the problem is embodied carbon. Energy efficiency initiatives usually take three to five years to pay back in terms of the embodied carbon, and you are relying on building managers to maintain those systems, on people turning the lights off [to get the carbon savings], and so on.

"We need to start thinking about incentives around the fact that avoiding embodied carbon today is worth more to us now than it is in a few years' time."

“We need to start thinking about incentives around the fact that avoiding embodied carbon today is worth more to us now than it is in a few years’ time.”

Net zero carbon has its limitations because there isn’t enough room on the planet to build all the solar farms or plant enough forests to generate the offsets, Noller explains.

Repurposing of buildings, building more with less, recycling material ... all of these things will have to play a role.

She cites carpet manufacturer Interface as a great example of what is possible. Some years ago, it retooled its operations so that the carpet it makes can be returned to the company at the end of its life, pulled apart and made into new carpet.

BMW’s new electric car is another example. BMWi has 25 per cent recycled material, and 75 per cent of the car can be returned to BMW. Part of the price of the car is a take-back levy that the consumer pays up front. Eventually, that car will be a closed loop system.

When it comes to materials, Noller is a fan of plastic because of its durability, weight and flexibility, and because it is a waste material that we have so much of. She is also keen on geopolymers as replacements for carbon-intensive products such as cement.

“We have to double the amount of buildings on the planet between now and 2060 and as Bill Gates said, that is equivalent to building a New York City every 40 days for the next 30 years.

“Everybody can win out of that. We don’t have time to stop things such as geopolymers from being viable alternatives. As long as they can jump the hoops in terms of things such as durability and strength, they need to be brought onto a level playing field.”

The BMWi has 25 per cent recycled material

Veena Sahajwalla on reforming old materials into the next generation of better ones

Poppy Johnston

When people think about recycling, they usually imagine used products turning into a like-for-like replacement: plastic bottles into plastic bottles; glass jars into glass jars. But next generation recycling and upcycling technologies developed in Veena Sahajwalla's Centre for Sustainable Materials Research & Technology (SMaRT) at University of New South Wales will unlock endless possibilities for "reform".

SMaRT is now producing a range of upcycled building materials out of its microfactory in the university's basement, including green ceramics made out of waste glass, plastic and textiles and a type of green steel that involves extracting hydrogen and carbon from old rubber tyres and plastic.

It's also created a new green aluminium product using a new technique to recover aluminium from complex, multilayered packaging, such as food and coffee packaging, and turn it into high-quality green aluminium.

Sahajwalla was also recently picked to lead national research into sustainable communities and waste, as part of the federal government's $149 million second phase of the National Environmental Science Program.

"Recycling is about more than converting a product from like to like – you want to be recycling from one product to another," the Australian Research Council Laureate Scientia Professor told The Fifth Estate in an interview before Building Circularity.

Veena Sahajwalla, UNSW

She said the notion of "reforming" is an important piece of the circular economy puzzle.

"You can reform structure, reform products, reform chemistry."

She likes to think of "desynthesising" products into their raw materials and then "resynthesising" them into something new of high value.

For example, her team's method of recycling ewaste involves first crushing electronics down, using a basic robot to extract useful parts before heating materials in a small furnace to separate parts into useable materials like metal alloys.

Bridging the gap between the lab and the market

The microfactory at the university was set up because Sahajwalla wanted to bridge the gap between research and commercialisation of products.

Commercialising products out of the lab can be slow as investors need to be 100 per cent confident in the viability of a product before backing its manufacture at scale.

"We wanted to be able to design something, test it and then deploy it for commercial use all from a factory at the university."

The microfactory allows for flexibility, with more room to test and develop products in collaboration with private partners.

The centre is currently supplying Mirvac with its green ceramic products and Sahajwalla said she often gets excited text messages with new ideas for applying the recycled material: in flooring tiles, kitchen splash backs, wall features and more.

The university is currently building another factory in Cootamundra to manufacture more of the green ceramics products.

The green steel Holy Grail

The polymer injection technology behind the SMaRT centre's green steel product has now been patented and commercialised in Australia and overseas in countries including South Korea, Thailand, the UK and Norway.

SMaRT teamed up with OneSteel to commercialise the product, which Sahajwalla said was created with the view to eliminate coal-based materials from the popular building material.

While this iteration of the product still relies on some coal and coke, she said the "Holy Grail" is completely eliminating coal and coke from steel making.

SMaRT has supplied Mirvac with its green ceramic products

"We wanted to be able to design something, test it and then deploy it for commercial use all from a factory at the university."

Simplifying products isn't the answer

Sahajwalla said that some types of products, such as electronics, need to be really sophisticated because "we expect so much from them".

That's why she doesn't tend to talk about designing for disassembly. "It's a simplistic view that it's about mechanically unpacking something so that it can be put back into production."

While Sahajwalla believes innovation has a key role to play in the transition to a circular economy, she said product designers should also be thinking about the lifespan of their products.

"Both the start and ends of the product lifecycle need to be working together in a holistic manner to close the loop."

She said procurement policies that prioritise products with non-virgin materials are an effective lever for creating demand for upcycled products.

The circular economy in action on a bustling street in Maroochydore

Roxanne Fitzgerald

In a conversation with The Fifth Estate before Building Circularity, chief executive and co-founder of Coreo, Ashleigh Morris, delved into her passion for accelerating the transition to a circular economy, how she elevated a busy street out of its waste woes, and why food scraps should be the new way of creating energy.

Starting out at the hyperlocal level, on a grungy coastal Queensland street, businesswoman and conservationist Ashleigh Morris has built a growing circular economy consultancy that's now collaborating with Lendlease, Mirvac, Rio Tinto, universities and the Brisbane and Sydney councils.

It all started in 2017 following eye-opening trips around the globe, but mostly to Indonesia, where Morris saw the challenges of Australia's linear economy playing out and wreaking havoc on neighbouring countries left to deal with our waste.

A thesis on electronic waste cemented her enthusiasm in the circular economy, she said, "it really sparked an interest for me in regards to it being a new economic model that was not as wasteful as the one we have today, which would actually enable us to have a prosperous and healthy functioning economy as well as society".

In 2017, there wasn't any "tangible demonstration" of a circular economy, Morris said. But in six months an ambitious experiment provided exactly that.

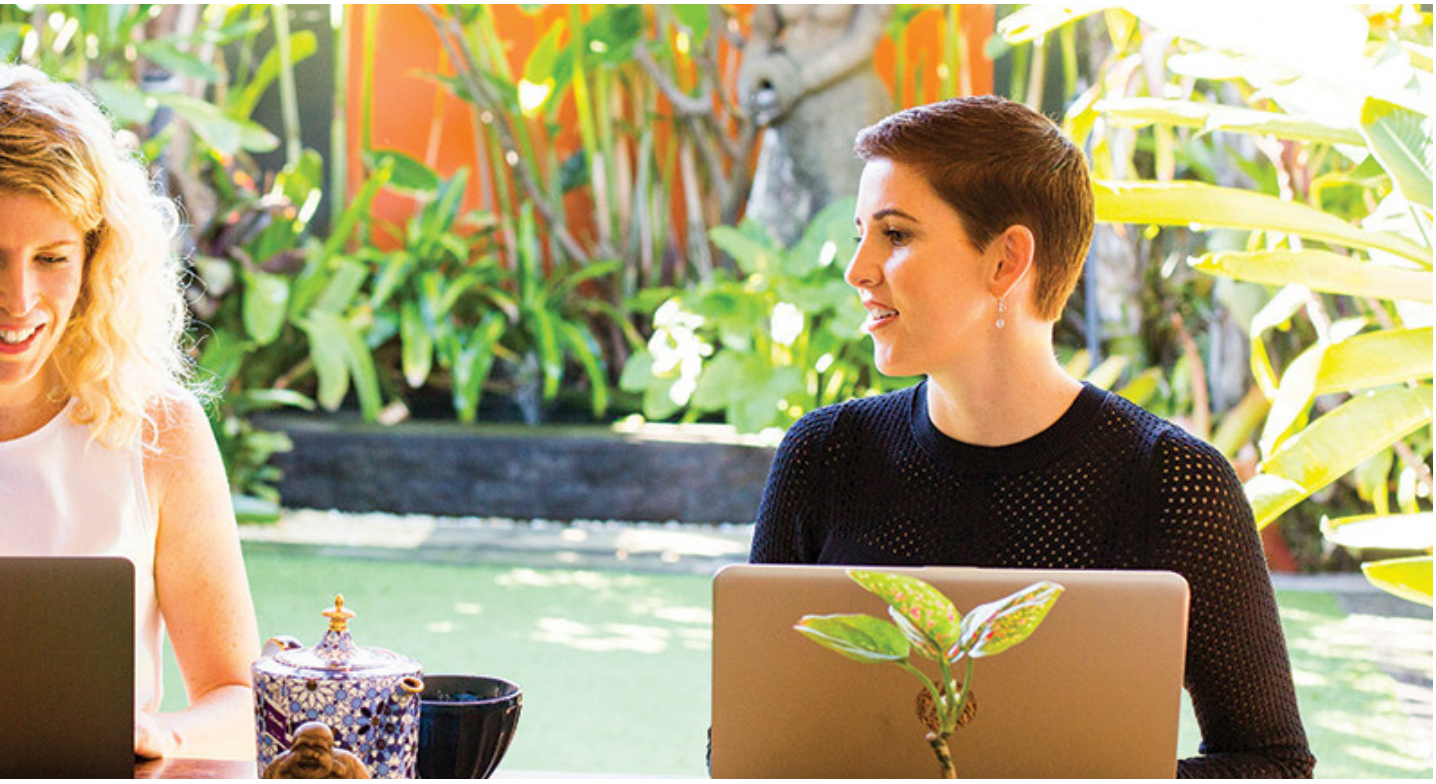
Morris and her sister Jaine Morris worked for free for six months to test the merit of a circular economy by putting it into practice on one city street.

Titled The Circular Experiment, the pair overhauled an eclectic collection of 45 businesses on Ocean Street in Maroochydore, Queensland, shifting old practices and designing out waste and pollution.

Looking at resource efficiency, reverse logistics and asset sharing, the women implemented regenerative principles, infrastructure and green space.

Big, provocative street stickers warned off littering. Coffee grounds – one of the heaviest materials entering waste streams, increasing costs for businesses – from nine cafes were collected by a local farmer for its rich nitrogen benefits to composting. The local farmer then sold pesticide-free micro herbs back to the cafes.

And a brightly coloured ballot bin for cigarette butts, which were a problem on the street dotted with late-night bars, gamified "doing the right" thing by getting smokers to vote with their butt on whether Donald Trump's hair is real or fake.



Co-founders: Jaine Morris and Ashleigh Morris (left)

BETTER BUSINESS

ON A ROLL: Ashleigh Morris (left) and Jaine Morris have founded The Circular Experiment, based on the principles of the Circular Economy. PHOTO: CONTRIBUTED

How to turn your waste into a revenue stream

TESSA MAPSTONE
tessa.mapstone@scnews.com.au

WHAT if you could make learnings big global businesses like Apple and Google thriving on.

"The circular economy is a rethink and a redesign of the system that we operate in,"

"Things should last longer, be built to be disassembled and when they get to the end of their life become a new resource.

"Any Ocean St business that really wants to give this a go, that is passionate about seeing what's possible should contact us.

"From the research we've done and the conversations

“It changed the identity of a grungy street to somewhere people wanted to bethe university.”

“It changed the identity of a grungy street to somewhere people wanted to be,” Morris said, pinning the experiment’s success to boots-on-the-ground effort, and perseverance.

“We found it is always best to connect face-to-face and most importantly not project what we want to do but understand what mattered to those businesses... that was a pivotal turning point for us in successfully engaging all those businesses.

“That really catalysed our work thereafter.”

Morris said a “disastrous” composting project with the 19 hospitality businesses on Ocean Street led her to a food-waste solution she said should “absolutely be implemented in our country”.

“Maceration, I absolutely love this,” she said, highlighting the benefits of infrastructure already in existence, and the high-value outputs.

Water utility plants could become the centre of energy production, Morris explains. In-sink macerators can grind food waste into a “slurry” and send it down into the sewer network to the waste water treatment utility.

“If you add food waste to a water treatment utility it can increase their biogas generation by up to 70 per cent, the capture of that gas can then be used to generate energy to displace the purchase of energy from the grid... this has a huge emissions reduction aspect to it,” she said.

Morris pointed to technology pioneered in Queensland by Urban Utilities that uses biosolids to create calorific briquettes, which she claims could replace the use of coal “because they have a calorific value, so they burn really well.

“We’re seeing a number of really high value nutrients and products being created out of what we would class as a waste,” explaining that in a circular economy, anything that is biological should be returned to regenerate the natural system.

In doing that, we then have renewable resources for the economy.”