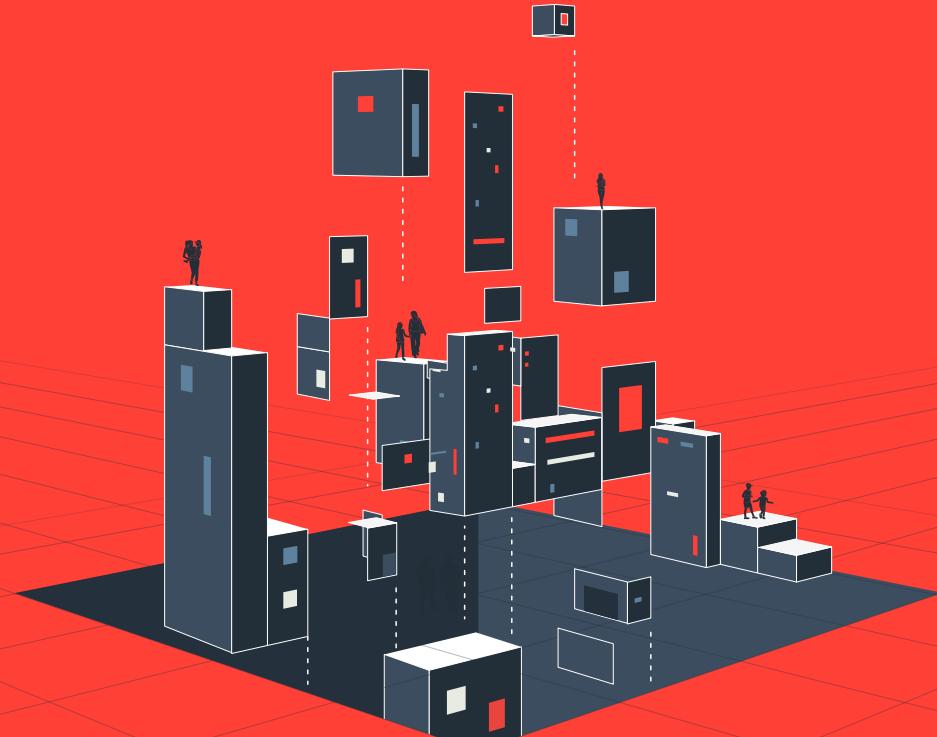


RETROFITTING +

SHAPING THE BUILDINGS WE HAVE INTO THE CITIES WE WANT



WSP

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INTRODUCTION

Retrofitting will be the global property and building sector's greatest contribution to avoiding catastrophic climate change. But the benefits could go far beyond carbon, says **Tom Smith**

The built environment is responsible for just under 40% of global energy-related emissions. In 2022, operating buildings generated nearly 10 billion tonnes of carbon, and construction a further 2.5 billion. Retrofitting is a double mission: we must upgrade existing buildings to use less energy, and we must make adaptive reuse (rather than demolition) the default for meeting new demand, to remain within hard limits on resource consumption.

But decarbonization is not the only challenge facing 21st-century cities – so why would we focus on carbon in isolation? This global retrofitting movement is an opportunity to reflect on how and where we want to live, and to reshape our urban reality to match. It's a chance to transform cities into healthier, happier, more resilient places, to adapt them to flourish as populations

grow and industries change, and to overturn entrenched inequities that stifle economic and human potential.

WSP's Retrofitting+ series is about joining the dots, taking a wider view of sustainability, and optimizing for more than one thing at a time. As we retrofit to net zero, what opportunities could this present to address biodiversity collapse, the housing crisis, or social determinants of health? How could we rejuvenate our cities, without blowing our carbon budget, by rethinking the way we plan, design and build?

Here we present just a handful of perspectives from WSP's global teams on how to shape the buildings we have into the cities we want.

Tom Smith is global director of property & buildings at WSP

CIRCULAR CITIES



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REGENERATIVE DESIGN: THINKING BEYOND SUSTAINABILITY

Q+A **Rahul Patalia** and **Marika Gabbianelli** unpack what 'regenerative design' means for sustainable development, and how it could change the way we retrofit buildings

What is regenerative design?

Rahul: Regenerative design is a philosophy that goes beyond sustainability and just improving on business-as-usual, to say that every development should have a net positive outcome, and actively contribute to restoring and enhancing ecological, social and economic systems.

It was partly inspired by "Doughnut Economics" by British economist Kate Raworth. She outlines a simple model for how the human population can thrive without breaching the Earth's life-support systems, which combines the UN Sustainable Development Goals with nine planetary boundaries. Climate change is just one of those boundaries, and that highlights that we can't use carbon

emissions as a metric on their own. Regenerative design is a response to this, and it brings in the idea of looking at a system in its entirety.

Marika: I completely agree. In more tangible terms, you could say that regenerative design encourages us to consider the impacts beyond a site's boundaries. For example, where materials come from and how they're produced, and also what kind of market demand you're creating or supporting by purchasing those materials – are they local, renewable, environmentally responsible? For a company like WSP, which works on massive infrastructure and redevelopment projects, those choices can have a huge cumulative impact.



“

JUST DECIDING TO RETROFIT SOMETHING INSTEAD OF KNOCKING IT DOWN DOESN'T MAKE A PROJECT REGENERATIVE, BECAUSE IT MIGHT CREATE SOMETHING THAT'S NOT FIT FOR PURPOSE”

MARIKA GABBIALELLI, WSP



Another aspect of regenerative design is that it looks to move away from human-centric design towards a nature-led, place-based approach. That's not to say a development doesn't need to be useful for people, but it can't just be useful for people. It has to take other needs into consideration.

Does a regenerative approach lead naturally to more retrofitting?

Marika: If I were to imagine a "regenerative future", a linear economy model where we don't recognize the value of maximizing existing resources just doesn't fit with that. So I would expect a regenerative approach to lead to more retrofits, or at least more deconstruction projects where most elements and materials are reclaimed for reuse.

However, it's also important to recognize that retrofitting is not always synonymous with regenerative. You can have really bad retrofits, that have very negative outcomes for communities or for the environment, so it's critical to consider a project in its wider context. Just deciding to retrofit something instead of knocking it down doesn't make a project regenerative, because it might create something that's not fit for purpose.

Rahul: Using existing assets has to be the first thing we consider, but we also need to look beyond carbon and gauge the quality of the buildings and their viability in future contexts. Sometimes they may just not be suitable for repurposing for a particular use in a particular area.

So what would make a retrofit regenerative?

Rahul: You'd need to start with a brief for a regenerative building, before you go down the route of whether it should be a retrofit. So, we'd look at what needs the development is meeting, how it integrates with the fabric of society, how it delivers a healthier environment to live or work in. Then, the next stage is to look at what's there at the moment, and how to maximize its value to deliver that overarching purpose.

Marika: A lot of the existing metrics would still apply, but the way they're calculated makes a huge difference. We'd need to incorporate some more qualitative measures, and the story behind the metrics matters. *The Regenerative Structural Engineer* by Oliver Broadbent and James Norman emphasizes the idea of an initial observation phase, to look at how well the current site works for nature and people, what's missing, and the

dependences and feedback loops that already exist. Having that deep understanding before making any decisions naturally leads to a more considerate approach.

How different is that process from what happens on a retrofit today?

Rahul: At the moment, the big drive for retrofitting is coming from landlords, funders and developers who are sitting on assets that are going to be stranded unless they bring them up to modern standards, because no one will lease them. That's positive in terms of reducing the carbon footprint of those buildings, but I do think we're probably missing a trick.

If, say, every building in the City of London was ultimately going to go through that process, could we approach it in a more joined-up way and look at the synergies between projects? A masterplan scale offers a better view of what's missing from an area. There could be a compounding benefit of coming together, and creating an ecosystem of retrofit projects.

Marika: Exactly – a regenerative design process might look at whether the building could provide energy to other developments nearby, or link into district heating networks, or go beyond minimum site requirements



USING EXISTING ASSETS HAS TO BE THE FIRST THING WE CONSIDER, BUT WE ALSO NEED TO LOOK BEYOND CARBON AND GAUGE THE QUALITY OF THE BUILDINGS AND THEIR VIABILITY IN FUTURE CONTEXTS"

RAHUL PATALIA, WSP



on biodiversity to connect into ecological corridors for bats, bees or migratory birds. If you link two or more sites, benefits could considerably increase. This also applies in terms of resource sharing: there will be buildings coming down, and others going up. We are missing a trick if we're not linking them in some way to reuse materials.

Rahul: This probably does need to be set at a planning level. For example, a future iteration of the London Plan might be regenerative. Developers already have their own ESG criteria, but this would enable them to meet those with much greater benefits to society as a whole.

How are you applying this approach on projects now?

Rahul: We're trying to encourage our designers and clients to take a much more holistic perspective. We recently worked on a large masterplan where the client realized that, in the long run, a regenerative approach would benefit their development, because if the environment outside the site boundary is thriving, that increases its value. That does require long-term thinking – our client was a public-sector developer, who tend to take more of a stewardship perspective.

But a lot of our private-sector clients

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**THERE WILL BE
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MARIKA GABBIALELLI, WSP

have also committed to these principles at a high level, because that's what shareholders increasingly expect. They might not know how to translate them at a development level, so that's our role. That's where the true value of consultancy lies: being able to connect a higher ambition with the commercial realities of delivery.

Rahul Patalia is head of urban regeneration for WSP in the UK; **Marika Gabbianelli** is a senior net-zero consultant and structural engineer, based in WSP's London office. Both are passionate advocates for regenerative design and have participated in various cohorts of the [Regenerative Design Lab](#)



RETROFITTING ONCE IS NOT ENOUGH

5 insights To get to a circular economy, we have to design buildings that can be renewed again and again and again, says **Kate Dougherty**

01

Retrofitting is essential for net-zero buildings

Around the world, regulations are changing, as our industry realizes that the carbon emissions from producing and transporting the materials used in our buildings can make up as much as 50% of the carbon they will emit over their whole lives. More importantly, that embodied carbon is entering the atmosphere today, getting us closer to the climate tipping points we need to avoid. Some planning authorities in the UK now require that before you knock down a building and replace it, you prove that this makes more sense than retrofitting it, based on the lifetime carbon impact. That is starting conversations all around

the country. Planners, project teams and clients are beginning to question whether demolition is the right thing to do, and whether they can instead reuse the bones of an existing structure, its facade, MEP or other materials.

02

Necessity is the mother of invention (and the circular economy)

Technically, it's much easier to start with a blank canvas than to mould an existing building to meet a new brief. There is inevitably some compromise with retrofitting, whether that's aesthetic or in terms of flexibility or floor space. So it's about going back and testing that

brief against what we really need, and seeing if we can better align it with what's available. But even if you knock a building down and start again, you still have to work within the same footprint. And you can be equally, if not more, constrained by the need to derive the greatest possible value from the site.

03

There's more than one way to reuse a building

Retrofitting is not all or nothing. Reusing an existing building is a sliding scale, from retaining only the foundations or basement, to retaining the whole building. In the middle, you might knock back to the



WE NEED TO LEARN FROM TODAY'S RETROFITS, DESIGNING NEW NET-ZERO BUILDINGS TO MAKE IT MUCH MORE STRAIGHTFORWARD TO CONVERT THEM TO OTHER USES IN THE FUTURE”

KATE DOUGHERTY, WSP



existing structure. It's about finding those masterplanning and design solutions to make it work. We're starting to move away from the perception that "new" equals "premium", and see the value in existing buildings and their place in a circular economy. Even an obsolete structure can have useful components – if it's demolished carefully, the materials from that "donor" building could be reused in a "recipient" somewhere else. If a client has a campus, an estate or a portfolio, that isn't too difficult to do.

04

Today's retrofits can teach us about circular economy design

Right now, we're in the challenging position of needing to upgrade a massive proportion of our building stock if we're going to meet net zero. We need to learn from today's retrofits, designing new net-zero buildings to make it much more straightforward to convert them to other uses in the future – for example, with higher ceilings or spare capacity in the MEP layout. We also need to design in climate change adaptability, so that our buildings will still be fit for purpose in a warmer world with more

extreme weather events. A building might not require mechanical cooling today, but it might do in 20 years to remain comfortable. There's always a balance, not only between operational and embodied carbon, but between embodied carbon and future flexibility. Some decisions might add upfront carbon today, to achieve the goal of much greater reductions down the line.

05

Retrofitting is not the end of the story

We need to apply circular economy principles to retrofit projects in exactly the same way. We need to think harder about how they are put together, and use standard sizes for components so that they can be easily dismantled and reused. It might be as simple as fixing mechanical equipment with screws and bolts rather than adhesive, so that it's not so destructive or wasteful to take it apart. We don't need simply to retrofit our existing buildings – we need to do so in a way that makes it easy to do the same thing again and again and again.

Kate Dougherty is director of **Net Zero** and sustainability for WSP's building services team in the UK



Photo: Huffton + Crow

▲ WSP's multidisciplinary engineering team helped to transform **The Kensington Building** in London, reusing the structural frame, adding two storeys and extending north and west to increase the floor area by 45%

ADAPTIVE REUSE & MUNICIPAL WASTE: TWO CHALLENGES, ONE SOLUTION

Daylight and municipal waste can both derail adaptive reuse for a single building. Try looking at a precinct instead, says circular economy expert **Maree Marshall**

Maree Marshall's job title has two parts, and retrofitting is a central concern of both. As director of WSP's circular economy team in Australia, she is often approached about adaptive reuse projects to convert surplus city centre offices into much-needed apartments, preserving their embodied carbon and reducing demand for virgin materials. Meanwhile, as director of waste management, she is devising strategies for handling all of the additional municipal waste that much larger numbers of urban residents will generate.

They may be technically very different, but both are essentially challenges of density, Maree says. "We know that commercial buildings are underoccupied, which offers an opportunity for adaptive reuse. But one of the big showstoppers is daylight – in a lot of places around the world, there are rules that say bedrooms and living

spaces need natural light. So, to turn dense office blocks into vibrant residential spaces, we also need to increase daylight and public open space."

At the same time, more waste but nowhere to store it means it has to be collected more frequently. "Nobody wants to give up precious ground-floor space, and it's a challenge to excavate a basement underneath an existing building. Here in Victoria we have four municipal waste streams – garbage, recycling, glass, and food and garden waste. So, that would be four trucks going past your property, three times a week."

Solving adaptive reuse and municipal waste together

On their own, either of these issues can make adaptive reuse unviable. But Maree believes there is a solution that could work



for both: "If we took the Barcelona model and applied it to adaptive reuse, we might find a lot more buildings that are suitable."

By the Barcelona model, she means taking a precinct-scale approach and reclaiming land for public space. "In the Eixample district of Barcelona, there are internal gardens located within city blocks – essentially very large lightwells [right]. We might have a block where buildings are stacked too closely together for adaptive reuse to work, but if we cleared one lot to let light into a cluster, that could be a gamechanger. Reinventing old building stock will require brave conversations about the net outcome we can achieve."

A precinct-scale approach would also create more opportunities to consolidate waste, or process it onsite – for example, by macerating and dewatering organic matter. "Collecting waste at a precinct scale is much more efficient. There can be huge savings in space, and that means we can hold it for longer so there are fewer trucks. If we're really going to make denser cities viable, reducing truck movements is key. Then we can increase activation of street frontages and improve safety. Garbage trucks are dangerous, they're very heavy and people find them fascinating, so they're distracted and accidents are common."

Arden's circular economy strategy

Maree and her team are applying this pioneering approach to waste on a 45ha site around Arden station in the north of Melbourne, where they have developed a precinct-wide circular economy strategy.

"It's very much alternate thinking. There will be no collection from individual properties by trucks – that's business as usual, it's not how we design new precincts when we've got the opportunity to do better. The streets are for pedestrians and bicycles and emergency services vehicles. Waste is a necessity, but it's not an emergency service." 

“THE STREETS ARE FOR PEDESTRIANS AND BICYCLES AND EMERGENCY SERVICES. WASTE IS A NECESSITY, BUT IT'S NOT AN EMERGENCY SERVICE”

MAREE MARSHALL, WSP



Instead, waste will need to be transferred to a designated collection point, and Arden will have a circular economy hub. "This will be where we pull together all of the items that can be reused for a second or third time, and all of the materials that can be consolidated," explains Maree. "Then you get high resource recovery with only one truck, and we can remove 80% of the vehicles. There's a massive need to educate people about reusing things, because circular economy thinking is about holding something at its highest value for as long as we can. We need to be a lot smarter about how we separate waste, and just not generating it in the first place."

Retrofitting has taught Maree that it's very difficult to find space for waste if it hasn't been designed in at the start. "It's really important for governments to be forward-thinking. As soon as they think a change is coming, make provision for it in their requirements. Even if they're five years away from offering food recycling in residential buildings, they should be asking for the space now. Otherwise, by the time we get through the design planning and construction, five years has passed and they've missed the boat."



Visualization: Victorian Planning Authority

Maree Marshall is director for waste management and circular economy with WSP in Australia

► WSP is developing a pioneering precinct-wide waste management plan for the 45ha Arden precinct project in Melbourne, based on circular economy principles



REVITALIZED NEIGHBOURHOODS



BRINGING CENTRAL BUSINESS DISTRICTS BACK TO LIFE

5 insights Retrofitting could rejuvenate abandoned urban cores, and be a catalyst for more sustainable urban planning, says **Martin Sing**

01

Retrofitting is an opportunity for reinvention

Repurposing our existing building stock is going to be essential to addressing the climate crisis. Historically, humans have had a use-dispose mentality, and that has been fed by the fact that financial economics was the primary driver: we always think it's more profitable to tear down an old building and replace it than to retrofit. Now we're entering an era where carbon needs to be part of that equation too. From a carbon perspective, we can't afford to simply demolish existing assets, so we need to figure out a mechanism for valuing the

carbon they contain and incorporating that into our decision-making. That challenge also comes with an opportunity: to reinvent our cities and our societies, and bring central business districts back to life.

02

Office-to-residential conversions could rejuvenate central business districts

Covid has highlighted an issue with the way we've planned our cities, particularly in North America. We've always kept business areas separate from residential areas, with the result that they have suffered with the increase in hybrid working. People aren't

visiting our urban cores as frequently, and many shops and restaurants have had to either scale back or close. But, from a carbon perspective, forcing people back to the workplace isn't the right choice, because it means we continue to propagate a built environment for part-time use. If we all commute to an office, for eight hours a day our homes are sitting there unoccupied, consuming energy. Instead, if we embrace a hybrid working environment, it's an opportunity to reduce that duplication of living and working space, so we need less overall. By taking those surplus office buildings and retrofitting them for a mix of uses, including homes, we can diversify our urban cores and revive their economies.

03

Diversifying city centres could cut infrastructure emissions too

Embracing hybrid working and mixed-use urban cores also reduces demand for transportation, either because people live closer to where they work, or because they commute less frequently. With fewer, shorter journeys, alternative transport becomes more practical, vehicle emissions are lower, and we don't need to invest as much embodied carbon in infrastructure.

Using our built environment more efficiently also reduces the amount of energy and water we need. This can extend ➔

the lifespan of existing infrastructure assets, and reduce the amount of new infrastructure that growing communities need. It also brings the goal of decarbonizing our buildings and transport networks closer, because we don't have to generate as much renewable electricity to power them.

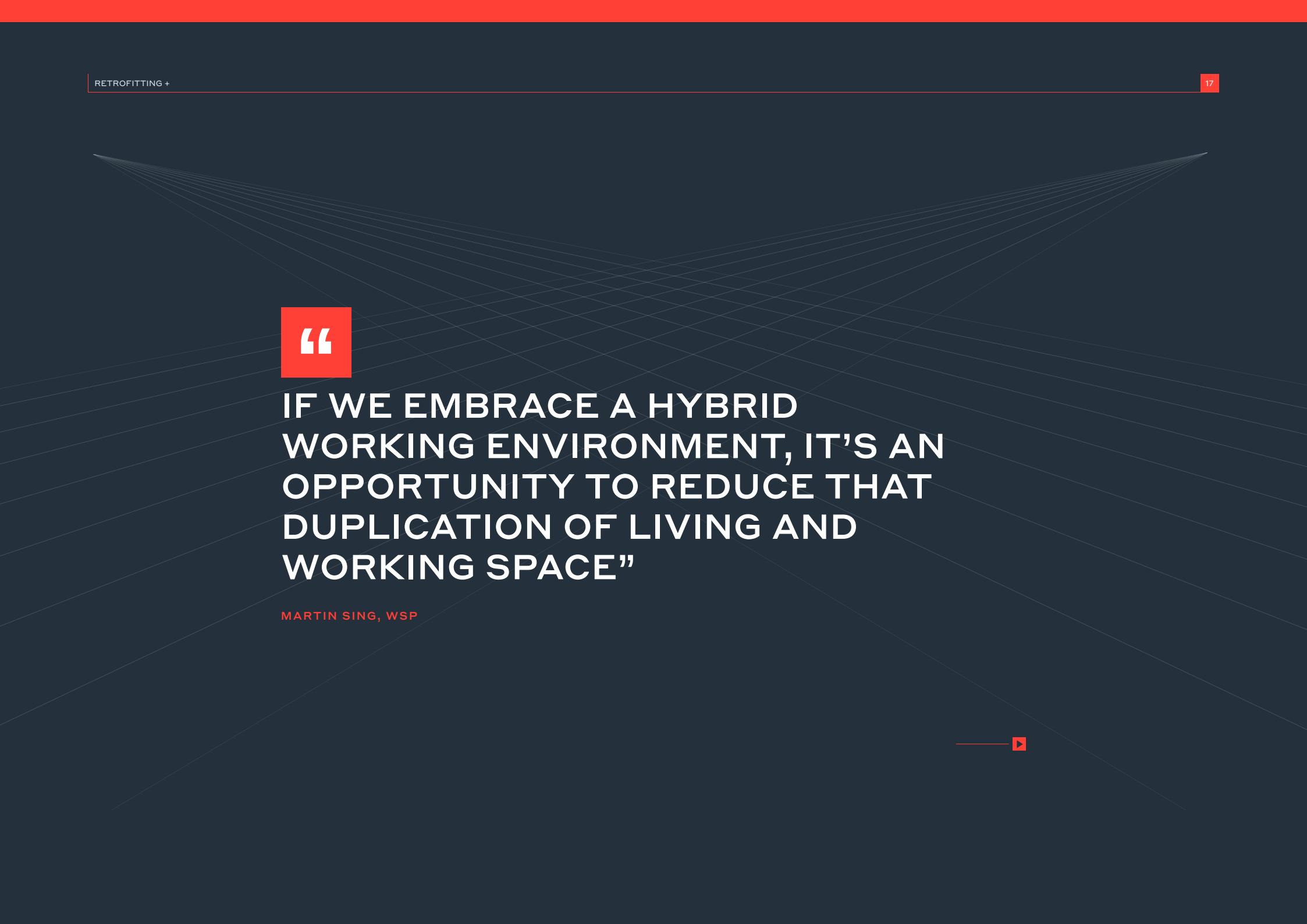
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Sustainable urban planning (re)locates functions where they will use the least energy ...

Right now, there are limitations on our capacity to generate renewable electricity, so we need to prioritize how it should be used. We will need to carry out major retrofitting programmes to not only electrify our buildings but improve their thermal performance to minimize demand – in Canada, we have roughly 480,000 commercial and public buildings that must be decarbonized, and we can't simply tear them all down and start anew.

This is an opportunity to step back and consider how those buildings are used, and whether converting them to different functions would result in a lower carbon impact and avoid the high embodied carbon cost to build new. The location of a

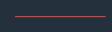




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**IF WE EMBRACE A HYBRID
WORKING ENVIRONMENT, IT'S AN
OPPORTUNITY TO REDUCE THAT
DUPLICATION OF LIVING AND
WORKING SPACE”**

MARTIN SING, WSP



building also has a range of implications in terms of how people travel there, or how supplies or materials are transported, which are just starting to become part of the discussion.

05

... or where their surplus energy could be used by someone else

Achieving net zero needs to be a holistic, concerted effort, and governments have a big part to play in bringing different sectors together to find better solutions. One example is the location of data centres, on which our automated, digitized world is becoming ever more reliant. These facilities reject a lot of heat, and while more efficient technologies are being developed, there is no magic bullet that will stop them being exothermic.

Part of the solution is to recognize that one sector's waste energy is somebody else's resource, and figure out how to link them. Today, every home in Canada has a heating system, and most are powered by fossil fuels. What if we introduced a planning criteria that the waste heat from data centres has to be redirected into a district heating system? That would

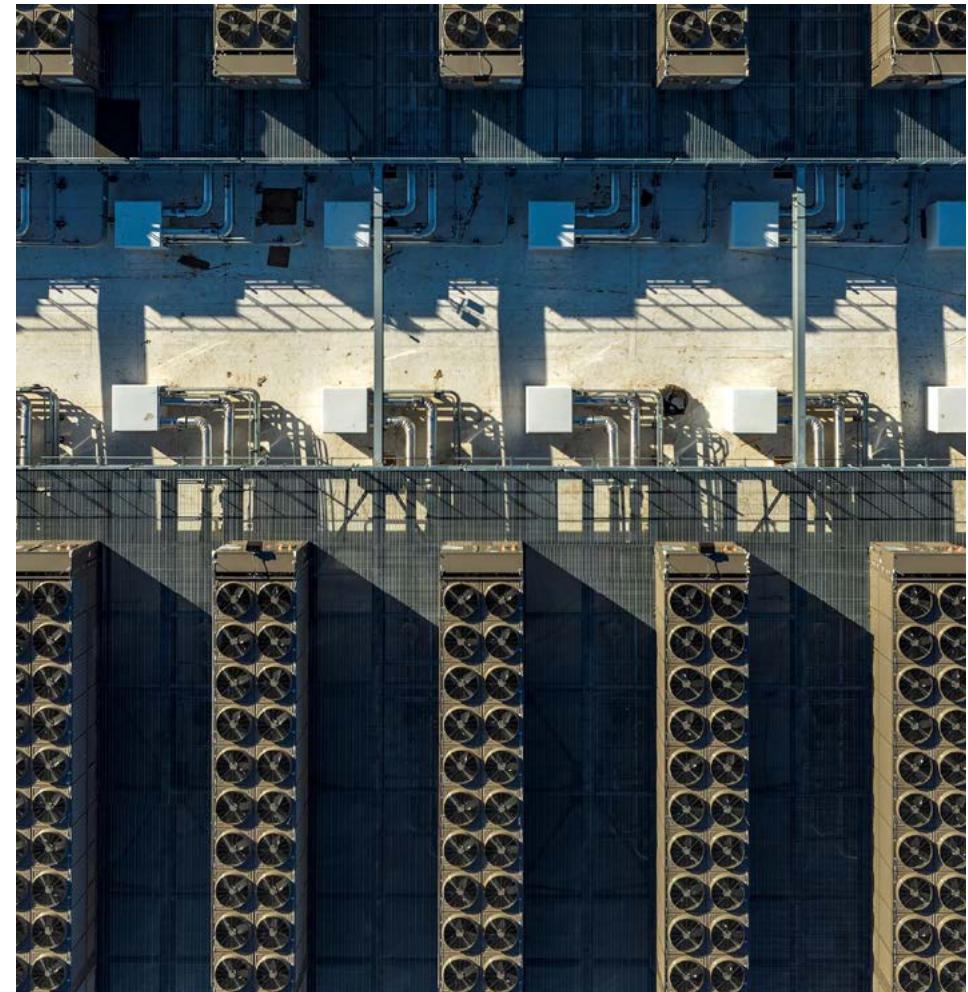
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WHAT IF WE INTRODUCED A PLANNING CRITERIA THAT THE WASTE HEAT FROM DATA CENTRES HAS TO BE REDIRECTED INTO A DISTRICT HEATING SYSTEM?”

MARTIN SING, WSP

offset all of the emissions from buildings that no longer need to generate heat. Retrofitting our cities could be a catalyst for leveraging these symbiotic situations, and taking a more holistic approach to the way we plan.

Martin Sing is head of energy and sustainability in [WSP's Property & Buildings division in Canada](#). He is team lead for energy and sustainability on the [Centre Block](#) parliament building, Canada's largest and most complex rehabilitation project



FINDING THE BEAUTY IN UGLY BUILDINGS

5 insights Retaining ‘ordinary’ structures doesn’t only save carbon, it strengthens communities, says **Helena Klintström**

01

Net-zero means even “ugly” buildings have value

In the past, urban regeneration and retrofitting projects prioritized the aesthetic and the visible: the focus was on preserving beautiful or heritage buildings, and on the materials that we can see. Now, developers are looking deeper at where value lies, led not only by what occupiers want, but investors too. That means they need better arguments to knock something down and replace it. The result is that, for economic and climate reasons, we’re saving uglier buildings, like very ordinary offices from the 1970s or 80s. And we’re looking at preservation in a much broader sense – not just the fancy bricks, but concrete structures or infrastructure as well.

02

Retrofitting reinforces community

These ordinary buildings have a social value too: they are part of the physical history of a neighbourhood. One feature of urban areas is that they are always developing and changing around us. That can be positive, but it’s also one of the harder things about living in a city. If we retrofit existing structures instead of demolishing them, integrating the old with the new, we can create greater stability and continuity for local communities, and boost social sustainability. The social benefits of leaving local landmarks standing often outweigh the benefits of replacing them, or the risk that an outdated building will drag down a neighbourhood.

03

Small things make a big difference to social sustainability

Even making small changes to the spaces in between buildings can do so much to increase social sustainability – for example, by giving people more opportunities to talk to their neighbours, or be in contact with nature. For many cities, Covid was a spur to rethinking existing streetscapes to encourage a shift towards more active travel. These projects are not at all expensive – you can achieve a lot with very little. Simply reallocating space by moving road markings a few centimetres not only creates more space for pedestrians and cyclists, we also find that cars travel more carefully and slowly when lanes are narrower, which improves safety and reduces pollution.



IF WE RETROFIT EXISTING STRUCTURES, INTEGRATING THE OLD WITH THE NEW, WE CAN CREATE GREATER STABILITY AND CONTINUITY FOR LOCAL COMMUNITIES”

HELENA KLINTSTRÖM, WSP



04

Can we design buildings for future urban regeneration?

One of the biggest impacts of retrofitting could be to change the way we think about new development, so that we build in the potential for future urban regeneration. Designing structures to be more easily repurposed for new uses would reinforce social stability over time, and that goes for the spaces around them too. When we're creating new pieces of city, we encourage clients to think about how they might need to be converted or regenerated in future. Once greenfield land is developed, it is very unlikely to return to nature – it is much more likely to be further developed into something else.

05

We need to think about the neighbours, today and tomorrow

New industries are located away from major urban centres, but then cities grow up around them. Typically, these sites are not designed to the same rules on open space or greenery, and including pedestrian routes or gathering places is not a priority. But in a world where structures are retrofitted rather than replaced, it's more likely that they'll be converted to other uses in the future. So when we design industrial developments today, we try to think about where the meeting places might be, or how greenery could be integrated, to ease that transition in the future.

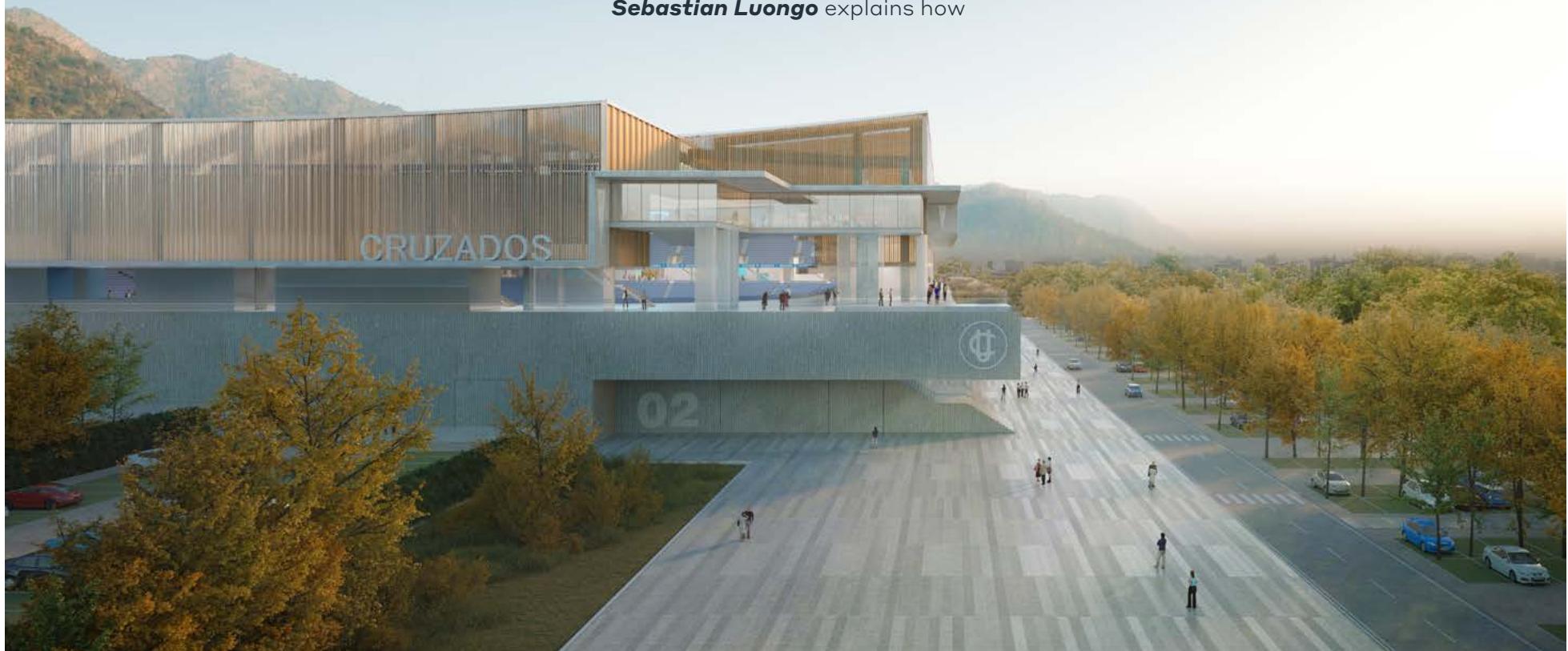
Helena Klintström leads WSP's sustainable urban and property development team in Sweden



HOW TO EXPAND A STADIUM WITHOUT UPSETTING THE NEIGHBOURS

A stadium expansion in Santiago is finally under construction – thanks to a retrofit that will reduce its environmental impact, even as it triples in size.

Sebastian Luongo explains how



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When is a stadium expansion not an expansion? When it's a retrofit. Estadio San Carlos de Apoquindo will have 40% more seats when its renovation is complete and its total area will more than triple. But as far as its owner, the project team and local residents are concerned, this is first and foremost a modernization, which will dramatically reduce its energy and water consumption and the impact on the surrounding area.

WSP is managing the project, as well as being responsible for the community engagement plan, environmental impact statement, sustainability strategy, detailed engineering design and construction management. Project lead Sebastian Luongo explains how they achieved the apparently impossible through early community involvement and a design that will minimize disruption even as the stadium expands.

Community engagement before architecture

The stadium has an enviable location in the foothills of the Andes, among the luxurious homes of one of Santiago's most exclusive districts. But since it opened in 1988, tensions with the neighbours have held back the ambitions of home team

Universidad Católica, a football club in Chile's premier league. "We knew that Universidad Católica wanted to remodel the stadium, but couldn't get approval from the municipality, so we proposed a different approach," says Sebastian. "Rather than having an architect design the stadium expansion and then presenting it to the community, we suggested the club begin by talking to them about what it's like living nearby, and evolve the design to mitigate the problems."

A roof retrofit to address noise and light pollution

Now under construction, the retrofit involves building a completely separate structure over the top of the existing stadium. This will increase the number of seats from 14,000 to 20,000, add five floors on top of the main grandstand, upgrade the current facilities, and add multipurpose spaces to increase utilization outside of match days and concerts. Crucially, it will also address two big complaints from local residents: crowd noise and light pollution. Downward-facing lights suspended inside will replace the four floodlight towers, and the north facade will be acoustically insulated to protect the neighbourhood next door.

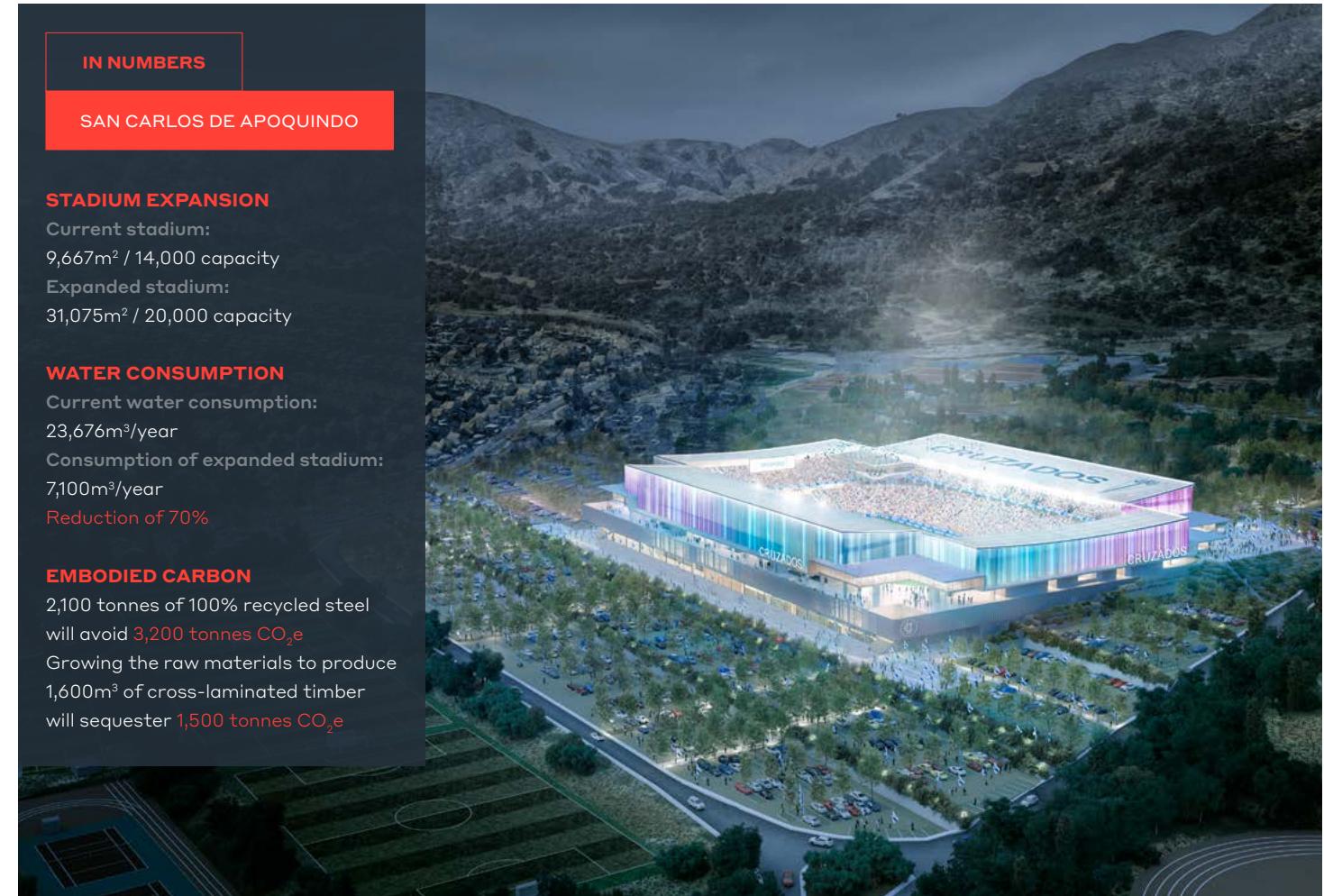


Solving traffic concerns with alternatives to cars

Public transport links will be improved, while partnerships with e-mobility companies will expand non-motorized options. Where parking used to be free, anyone arriving by car will now have to pay, and there will be no new spaces on site. "If you put in more parking, you have more cars," Sebastian points out. "We've also designed a better process in the parking lot, so there won't be lines of cars outside." To disperse the additional capacity, there will be satellite parking areas, and the number of entry points to the site will be increased from two to three.

Make a stadium expansion into a sustainability leader

By renewing building systems and adding the thermally insulated superstructure, the retrofit will lower the stadium's energy consumption and carbon emissions, even as it expands. Universidad Católica is one of Chile's most prestigious higher-education institutions, so it was important that the project have a very strong sustainability strategy. "They are thought leaders here in Chile, and also in Latin America," says Sebastian. "Everyone is looking to them, so this is a big opportunity to make a positive impact, beyond the size of the project."



Rather than diesel generators, the expanded stadium will be powered by 436 roof-mounted solar panels, supplemented by 100% renewable energy supplied by provider Enel. More significantly in severely water-stressed Chile, water consumption will be reduced by 70%. This will be achieved through more efficient systems, by reusing greywater, and by swapping natural grass for synthetic – the pitch replacement alone will save 120,000 litres per day during the summer. Lower-carbon materials have been specified to reduce embodied carbon, and the existing seats will be recycled to make new ones. Around the perimeter, 500 trees of native species will be planted to soften views of the stadium, and another 1,000 in a park that will contribute to the reforestation of Santiago.

Overall, it is these environmental improvements, coupled with community engagement, that made the project possible. "There is no way the stadium expansion could have been accomplished without them," says Sebastian. "This community-focused retrofit made the difference between just having an architectural render, and having a larger stadium."

Sebastian Luongo is project lead and client manager for WSP in Chile



A BIRD'S EYE VIEW OF URBAN BIODIVERSITY

Making bird conservation part of retrofitting projects could help solve the biodiversity crisis, and make urban areas healthier for humans too, says **Jody Enck**

I f urban life can sometimes feel pretty gruelling for humans, it's even tougher for birds. They are preyed upon by cats, confused by reflective surfaces, drowned out by traffic noise, and disoriented by light pollution. Non-native plant species don't provide enough nutrition, or support the insects that they need to feed their young – assuming they're lucky enough to find anywhere to nest.

The growth of cities and their inhospitality to nature has contributed to a steep, long-term crash in bird populations – the US and Canada alone have lost nearly 3 billion breeding adults since 1970, or more than a quarter of their bird life. This is part of

a worrying global collapse in biodiversity, with 1 million species worldwide threatened with extinction.

The good news is that there are some relatively simple bird conservation measures that could make cities significantly more welcoming. If we incorporate strategies to improve urban biodiversity into retrofitting projects to decarbonize buildings and landscapes, it could have far-reaching impacts for people too.

Bird conservation in cities

This is the message that Jody Enck is trying to get across in his hometown of Ithaca, in New York State. In his day job at WSP, Jody

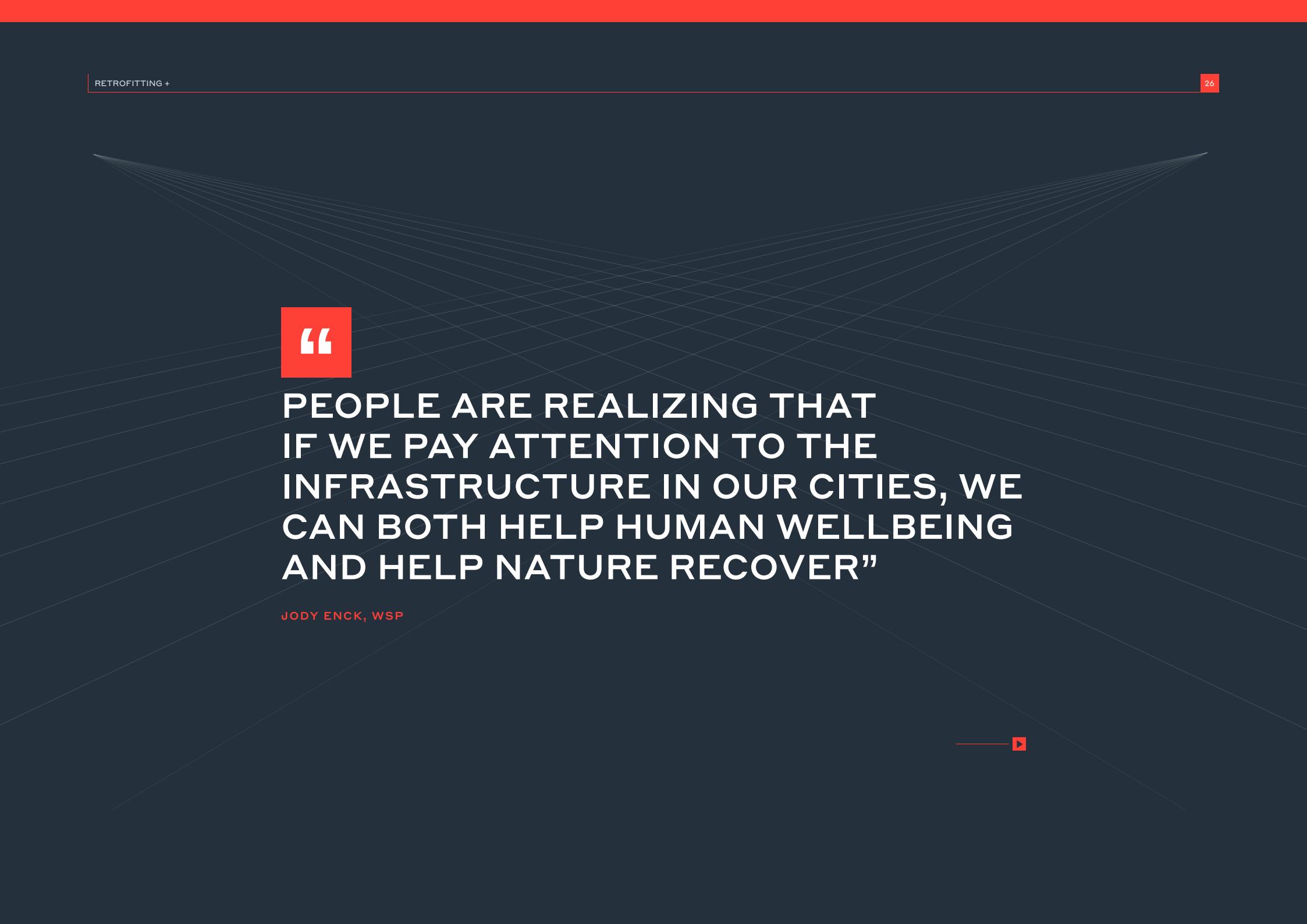
carries out ecological surveys to identify the best sites for wind and solar projects. In his spare time, he's a keen birder, and chair of the Conservation Action Committee for the Cayuga Bird Club. "There's a tremendous amount of research showing that human wellbeing goes hand in hand with biodiversity and access to nature," he says. "People are realizing that if we pay attention to the infrastructure in our cities, we can both help human wellbeing and help nature recover."

In 2021, Ithaca became the first city in the US to vote to decarbonize and electrify its buildings by 2030, as part of its own Green New Deal to reach carbon neutrality.

Now, Jody is hoping it will go one further, and require that all new and refurbished buildings are fitted with bird-friendly glass. Cayuga Bird Club is just one of a growing number of organizations pressing it to make the change – the prestigious Cornell Lab of Ornithology is based in Ithaca, and birds have become a popular cause for the local student population.

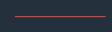
Taking action

After outdoor cats and habitat loss, buildings are the biggest cause of bird mortality, directly through collisions and indirectly from light pollution. Both of these are caused by the way windows reflect ➔



“
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AND HELP NATURE RECOVER”

JODY ENCK, WSP





light by day and emit it at night, and bird-friendly glass addresses both. Crucially, the latest kinds also prevent heat transfer, helping to keep homes cool in summer and warm in winter, explains Jody. "People might see a minor difference when they look out of the window, but within weeks, their eyes will have adjusted and they won't notice. But when their heating and cooling bills go down, they'll see that in their pocketbooks."

Meanwhile, the impact on birds would be huge and immediate, particularly for the migratory species that are declining fastest. While resident birds have been able to adapt somewhat to urban environments, developing smaller eyes and louder calls than their rural cousins, more specialized and transient populations have struggled. "Many have lost 80 or 90% of their numbers over the last 50 years," says Jody. "Most major mortality events, when birds collide with glass windows by the hundreds on one night, occur during migration. So, the benefit of retrofitting could be amplified for migratory species."

This could be further amplified by expanding and improving habitats, another big focus for Cayuga Bird Club. It has been leading groups of volunteers and school kids to replace invasive non-native species

with native plants in city parks and on land owned by Cornell University, supporting urban biodiversity to flourish. "We work on doable plots that are 10m by 10m, and then we fence them to keep the rabbits and deer from munching it to the ground – we learned that the hard way."

Then there's the impact that being involved in conservation has on residents, particularly the younger ones. "They feel like they're part of something bigger than just themselves, and even their community. We explain that there are kids just like them working in other places to help the exact same birds. It shows them the world is a really cool place, with all these connectivities."

Jody recently ran into a student who had taken part in the project a couple of years ago. "She said 'I have to tell you how much that project meant to me, I still tell my friends about it, and it made me feel like I'm doing something and giving back to my community'. I guess I'll never really know if the birds are benefitting, but when you hear straight from the kids involved in the project, it just puts a smile on your face."

Jody Enck is an avian specialist at WSP, based in New York. An ecologist and sociologist, he previously worked in academia studying the human dimensions of natural resource conservation

3 SURPRISING FACTS

TO BOOST URBAN BIODIVERSITY

01 Tall buildings aren't the worst culprits

Towers over 12 storeys each kill an average of 25 birds a year in the US, but as there are relatively few, they account for only 0.1% of building-related deaths. In fact, 56% are caused by the 15 million medium-rise buildings with 4-11 storeys, and the remainder by low-rise buildings.

02 Lots of small parks are better than one big one

Birds are territorial, so only so many can happily live and breed in one place. An amenity on the scale of Central Park is fantastic for many reasons – but providing many little green spaces is important too, both for resident birds and for migratory birds stopping over.

03 Localized efforts can help solve global challenges

Migratory birds may travel over many thousands of miles and cross continents. But there are specific areas where they rest and refuel. If we focused on urban areas close to or within those important stopovers, we could have a much bigger impact.

URBAN EXPERIENCE



01

+ CIRCULAR CITIES

02

+ REVITALIZED NEIGHBOURHOODS

03

+ URBAN EXPERIENCE

04

+ EQUITY

05

+ CRITICAL SYSTEMS

'NOT JUST ABOUT THE BUILDING': THE SOCIAL IMPACT OF RETROFIT

Looking closer at how retrofitting projects affect people will help us achieve sustainability goals, says social scientist

Vivienne Ivory

Buildings don't exist in isolation. So, as a social scientist, the first question Vivienne Ivory asks about any development is: "If I reside in this location and this type of building, how do I live well?" That could encompass everything from environmental quality, to how walkable or well-connected a neighbourhood is, to the amenities or economic opportunities in the local area. "It's not just about the building, it's everything else that's around it too that could affect your livelihood and economic wellbeing," she explains. "It's always buildings, context, lifestyle, and when we change one element, all the others change too."

Many of Vivienne's research studies hold important lessons on how communities experience change in their built environment, and how the large-scale retrofitting projects

required to reach net zero could be managed to reduce negative social impact and maximize the positives.

How does retrofitting impact communities?

For the last four years, she has been looking at how people's wellbeing is affected when the social housing they live in is knocked down and replaced. "We're capturing their experiences as they move around the area, and using government datasets on aspects such as hospitalizations, education records and benefit status. We're also looking at what happens for households during the redevelopment works – what it's like living in a neighbourhood with trucks going up and down, where the amenities have shut or your neighbours have moved out, or many more

new residents have moved in. The impact of that uncertainty, and how long it takes people to recover, is often underestimated."

Neither should we underestimate the sense of place or identity that buildings create, and the value that people attach to them, she warns. "It's possible to reconstruct a neighbourhood while retaining what it means to people. But equally, it's possible to keep the structures but retrofit them so that their meaning changes."

To date, retrofitting projects are less common in New Zealand, where Vivienne is based, because many of its older buildings are poor quality or unable to meet current standards on earthquake resistance. But it's an accidental leader in the circular economy: there is already a thriving market in relocatable wooden houses, and that



**THE IMPACT OF
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VIVIENNE IVORY, WSP



can have an unexpected social impact too: "Existing structures are taken apart, put on the back of a truck and reassembled in a different location. Sometimes that creates distress in the original community because a building is locally iconic – it held meaning for people in that place."

The social impact of active travel

Vivienne has also studied the impact of changing local road patterns or transit, helping local authorities to promote active travel or greater use of public transport. "One of our local councils recognized that they had all these different strategies and policies, but there was no oversight so there was a risk that they would be counterproductive. We did a lot of work looking at trends and projections and demographics, but we also carried out surveys and in-depth interviews to give the community a voice. It was really valuable to have those difficult conversations about the implications for the whole community, and how to achieve bigger-picture outcomes."

One of the biggest takeaways was how changes that are poorly sequenced could increase the vulnerability of the most at-risk groups. "For example, if you are dependent on a car to get around because you live

outside the public transport network, can't afford an e-bike, and live in the hills, you're going to be doubly jeopardized if the parking in the city centre or around the hospital is suddenly limited or more expensive. It's much easier to work with privileged communities who have more options, but we can't afford to ignore the ones with harder problems to solve, whose need is greater. You might get a good mode shift overall, but you won't get transport equity."

The research also highlighted how small improvements can unleash benefits throughout a network – for example, if you fix a particularly dangerous intersection or a pinch point to make it easier for bikes or buses to get through, the whole system can become more reliable.

With any change to the built environment, the complexity of human interactions makes it very hard to get everything right first time. So retrofitting will need to be an ongoing process, she says. "That's why it's really important to keep evaluating and create feedback loops where you adapt and monitor again. If you put in temporary infrastructure, you can watch how people interact with it and then make modifications to solve the problems. When it comes to retrofitting, I think we could save a lot of heartache that way."

Vivienne Ivory is a technical principal in WSP's social sciences, resilience & public health research and innovation team in New Zealand. Her work develops evidence to support decisions that create thriving communities. Examples include Reducing greenhouse gas emissions in communities – evidence and opportunities for change in Aotearoa (2023) and Inclusive and collective urban home spaces: the future of housing in Aotearoa New Zealand



ACOUSTIC ENGINEERING: THE QUIET HERO OF ADAPTIVE REUSE

Mixed-use building conversions only work if tenants can't hear each other. So think about acoustic engineering early, says **George van Hout**, and be prepared to get creative

Converting obsolete buildings to new uses preserves the carbon in their structures, and minimizes the upfront emissions from new construction. But how to retrofit them to modern standards without adding so much embodied carbon that it risks defeating the point?

That's the tricky problem facing acoustics engineering specialists like WSP's George van Hout. In New Zealand, where he is based, structures are typically made from lightweight materials such as timber: safer than masonry in the event of an earthquake, but less good at reducing noise transfer. This can pose a real challenge on adaptive reuse projects where a single-function building is converted for multiple uses – for example, an underoccupied office repurposed to accommodate a mix of residential, commercial and leisure.

"Fundamentally, the way sound transfers between two spaces depends on the mass between them," he explains. "There are innovations coming out all the time, but it always comes back to the same principles. We can provide cavities and insulation, as well as including vibration isolation to separate spaces more efficiently – but to reduce noise, you need mass (because of what we call the 'mass law') and that won't change."

How is sound transmitted through buildings?

George and his acoustic engineering team consider three key types of sound transfer: "The first is sound transmission between two spaces: how much sound is reduced from one side of a wall or floor to the other, particularly for speech privacy. The second

is reverberation time, or how much the sound builds up in the space. If you're in a restaurant that gets noisier and noisier until you can't hear the person across the table from you, that's because the reverberation time is too long. The third is impact noise. In lightweight structures, you may be able to hear people walking on hard surfaces above you. Or if there's a gym, you might hear the dropping of weights or people jumping up and down."

In a brand new building, everything can be controlled: the mass of the structure, the wall construction, the surface finishes. With an adaptive reuse, there are more constraints, says George. "A lot of old buildings have quite low floor-to-ceiling heights, which reduces the scope to add drop ceilings, or to build up the floor to control noise transfer and vibrations.



IF A SPACE IS WELL DESIGNED ACOUSTICALLY, NOBODY NOTICES. BUT IT'S THE FIRST THING THEY'LL COMPLAIN ABOUT IF IT'S DONE BADLY"

GEORGE VAN HOUT, WSP



We need to work within the loading capacity of the existing structure, and if it can only support a lightweight wall, that may need to be thicker, which potentially reduces the footprint available."

On the other hand, because the structure and envelope are largely fixed, it's an opportunity to provide better, more specific design advice at an earlier stage. "That allows more accurate costing and detailing, so there's almost always a cost or time saving because we have something already there to work with."

Step-by-step approach to acoustics

George starts by measuring how sound transfers through the structure, and then makes recommendations for bringing it up to the performance required, for inter-tenancy walls and floors, and for the external building fabric, to reduce noise coming from outside. "If a space is well designed acoustically, nobody notices. But it's the first thing they'll complain about if it's done badly."

The most effective strategy is to avoid the problem in the first place: "We don't want to put sensitive areas right next to noise-generating areas – we want to separate them as much as possible. When we're talking about multipurpose buildings, it's critical that we come in at an early

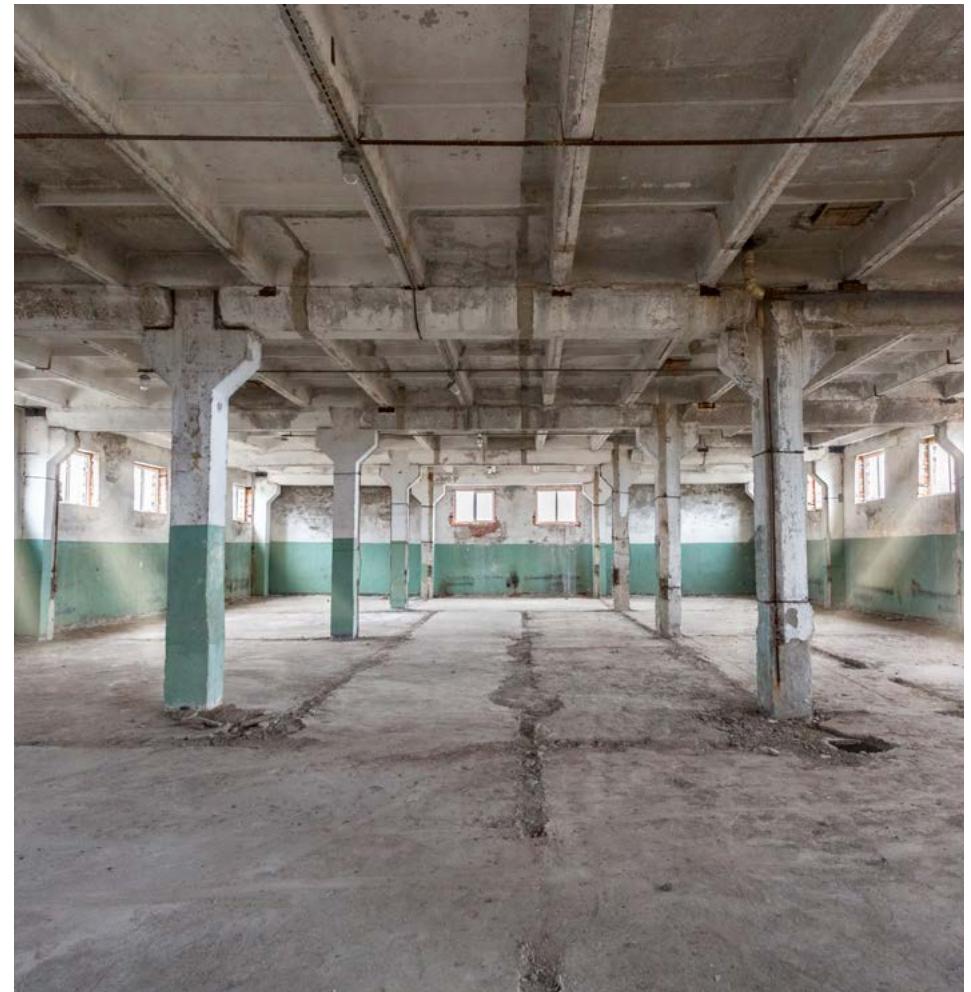
stage so we can influence the adjacencies between different uses."

Next, they consider how sound will transfer between individual building elements, but also through the wider structure. "Noise might travel though ventilation ductworks, through the facade, or through columns that span between floors. We want to stop all of that."

The way to dampen the sound is typically to add mass to the structure – which also means adding embodied carbon. "So we try not to overdesign structures, and to limit additional materials to where they're really needed to control noise," says George. "But certifications like Green Star or BREEAM take a more holistic view of a building, and part of that is use. If people start complaining because they can hear their neighbours, apartments could become difficult to sell, or remedial work might be necessary afterwards. Making sure we get it right first time is critical to what we do."

The bottom line, he adds, is that if a building isn't fit for purpose, it's just going to sit there idle again – and any carbon invested in a retrofit will be wasted.

George van Hout is a principal acoustic engineer in WSP's acoustics, noise and vibration team in New Zealand



LOW-CARBON STRATEGIES TO IMPROVE NEIGHBOURHOOD SAFETY

Q+A Thinking about neighbourhood safety during retrofitting projects can unlock even greater benefits for communities, says security specialist **Aditya Kamble**, without adding carbon

Why should we think about security as part of retrofitting projects?

The ageing infrastructure of our cities is often a major factor in increasing fear of crime. To create a sense of community, it is important that people feel safe in the built environment. For example, if there are disused spaces or dead ends where there's no natural surveillance, or a lot of graffiti, these things make people feel they're at higher risk of being a victim.

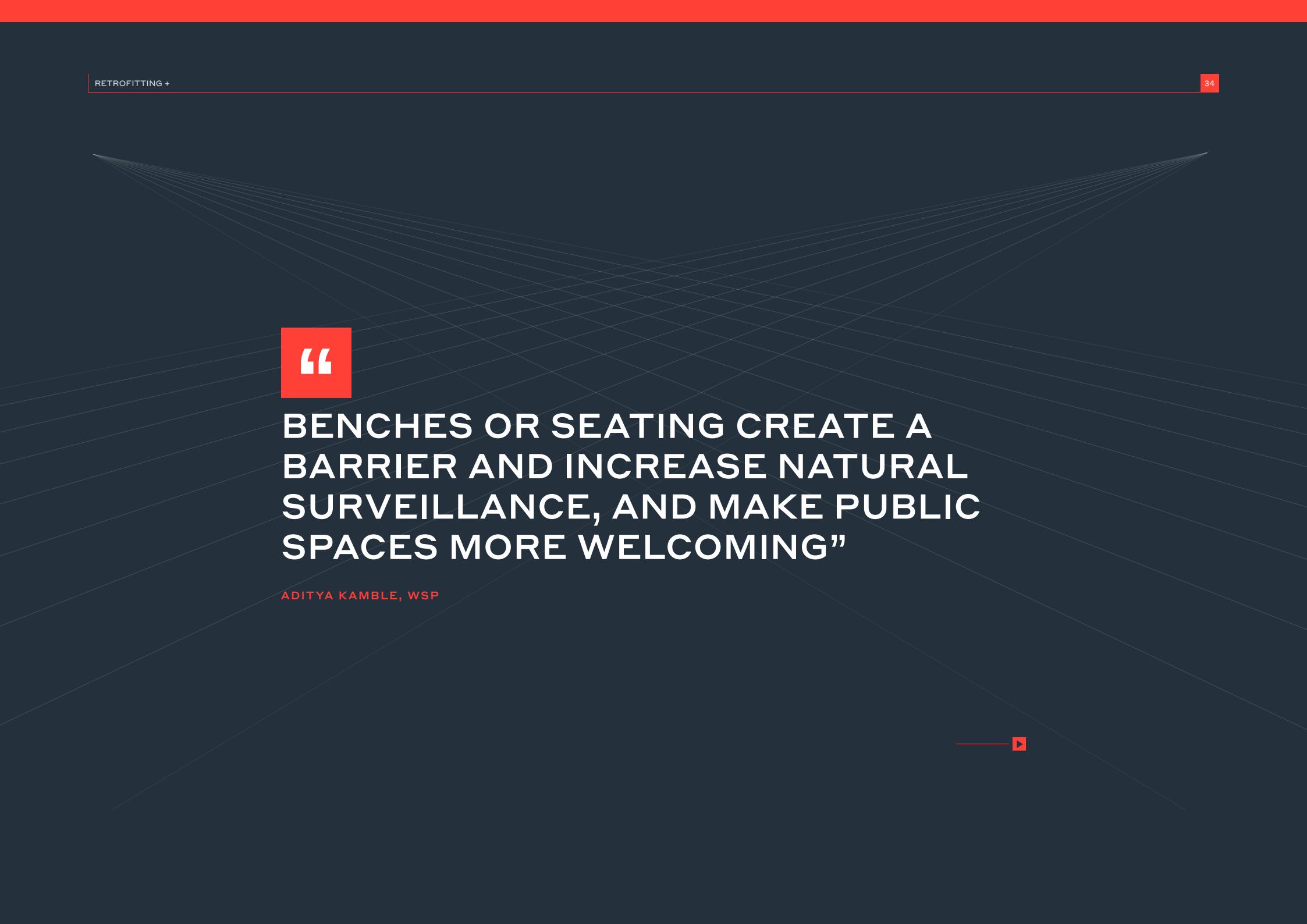
This particularly affects women, who are often reluctant to use public spaces for fear of harassment or attack. For example, research by my WSP colleagues in London

found that 94% of women felt threatened when using public transport, and that 76% avoided doing so at night.

What strategies could we incorporate in low-carbon retrofits, to improve neighbourhood safety?

One effective low-carbon option is to apply Crime Prevention Through Environmental Design (CPTED) principles, which are about designing urban environments to reduce both crime and fear of crime. If we're retrofitting neighbourhood safety measures, we might consider ways to promote natural surveillance, eliminate





“BENCHES OR SEATING CREATE A BARRIER AND INCREASE NATURAL SURVEILLANCE, AND MAKE PUBLIC SPACES MORE WELCOMING”

ADITYA KAMBLE, WSP



hiding places and create boundaries. Removing unnecessary fencing, or replacing it with more transparent options, makes a space feel more open. Rather than bollards, we can use natural access control measures such as planting to divert people onto a certain route through the development or restrict vehicle access, while having a positive environmental impact.

We can also introduce benches or seating, which creates a barrier and increases natural surveillance, and makes public spaces more welcoming. [A study in South Korea looked at effects of applying CPTED principles](#) to regenerate deteriorating neighbourhoods in Seoul. They found that in areas that were better maintained, with CCTV coverage and streetlighting, fear of crime was lower and people walked more frequently.

There are technological solutions too. Replacing fluorescent bulbs with LEDs in streetlights makes urban landscapes brighter, while reducing energy consumption. Digital camera systems that use video motion detection take up less hard drive space than analogue systems, and as we move towards the Internet of Things, they can be integrated into central building management systems so that energy is only used when required.



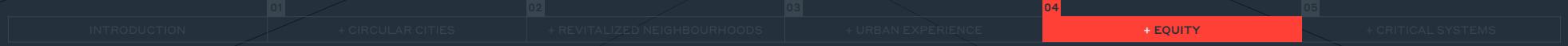
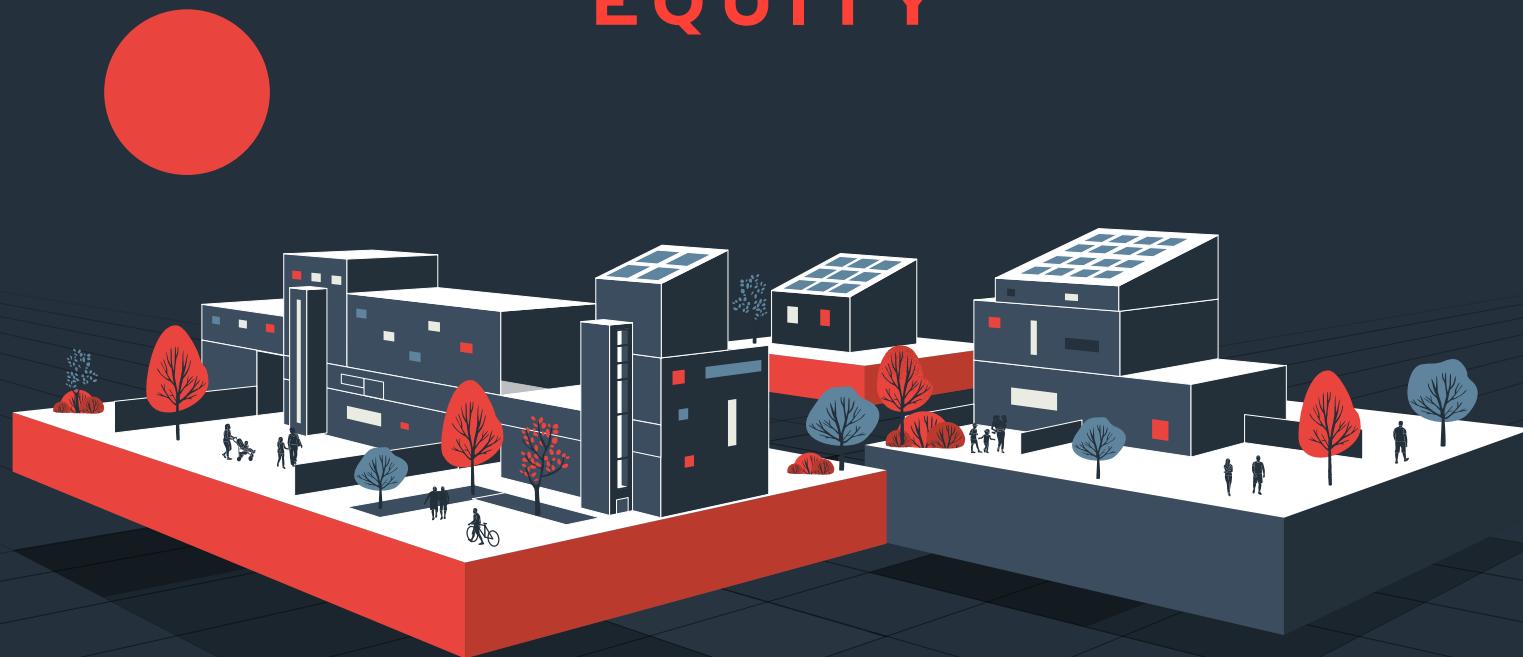
What are the simplest, most effective ways to improve security, in an existing development?

There are many different structural retrofitting solutions that we can use to improve physical security. Where we can't reconfigure a streetscape, we can introduce technologies such as CCTV and access control systems in problem areas, which discourages criminals and makes residents feel protected. Conducting workshops to educate residents can also be effective.

In security, we talk about the four Ds – deter, detect, deny, delay – and for optimal operations, we need a balance between technological and non-technological solutions. Human surveillance is the most important thing, and it decreases dependency on complex security measures. Making public spaces more open and functional can revitalize communities, as well as creating opportunities for people to look out for one another and helping everyone to feel safer.

Aditya Kamble is a specialist in security risk management at WSP, consulting on projects in the Middle East

EQUITY



MAKING CLIMATE ACTION WORK FOR LOW-INCOME COMMUNITIES

Q+A WSP is helping US metropolitan regions to develop climate action plans for low-income communities. **Catherine Prince** explains what she's learned about equitable decarbonization

Why do we need to approach climate action differently for low-income communities?

The easiest thing to do is be inequitable – simply because that's how the systems and processes are set up.

An example is solar panels. We were assembling a grant programme to encourage households to install solar panels. It's an awesome idea, and the potential savings for the household are enormous. But there's a barrier: the roof needs to be able to support the solar panels. The reality is that the majority of housing stock in low-income communities has roofs that are way beyond their 30-year life.

As with many grant opportunities, the one climate action grant did not support roof replacements in addition to solar

panels. So, an agency would have to find another source of funding and have the capacity to administer the larger scope of work, which means a much bigger grant programme. It's much easier to make having a solar-ready roof one of the conditions for receiving the panels, but that's only going to benefit people who can afford to change their roofs.

Another example is electrification of personal vehicles. Even if households can afford to buy an electric vehicle, how do we make sure they have access to overnight charging in the places where they live? Installing a charger at home can cost a few thousand dollars, and that's an even bigger barrier if you are renting, as the majority of low-income communities are, and you're in an apartment not an independent house.

There are inherently so many challenges with integrating equity with these solutions – we would need to go topic by topic and talk about why it's difficult.

How can we design more equitable decarbonization programmes? Where do you start?

We begin by actively listening to the people these strategies are meant to serve. We have found authentic engagement by first speaking to community leaders helps garner trust. Before we go out to the community, we talk to people who have worked or lived with them for several years or decades and who understand their everyday lives. They guide us on the best ways and places to engage community members, which will be unique to that community.



IT'S MUCH EASIER TO MAKE HAVING A SOLAR-READY ROOF ONE OF THE CONDITIONS FOR RECEIVING THE PANELS, BUT THAT'S ONLY GOING TO BENEFIT PEOPLE WHO CAN AFFORD TO CHANGE THEIR ROOFS"

CATHERINE PRINCE, WSP



This engagement is essential because solutions that make sense on paper, or that come easily to us as professionals, can be very hard to translate into other lifestyles. We tend to use the way we live as a baseline, because that's where we come from and what we know. Take waste management. The most carbon-intensive part of household trash is the organic waste, so composting to remove it from landfill seems like the low-hanging fruit. It takes five or ten minutes at most, it's not a burden, it's just a small change. But when we spoke to community leaders about it, they basically said they couldn't make that change. Somebody who's working two jobs just trying to make ends meet and keep their children healthy is not thinking about composting – it does not fit into their lifestyle. That's a reality.

So how do we translate climate action from paper to reality?

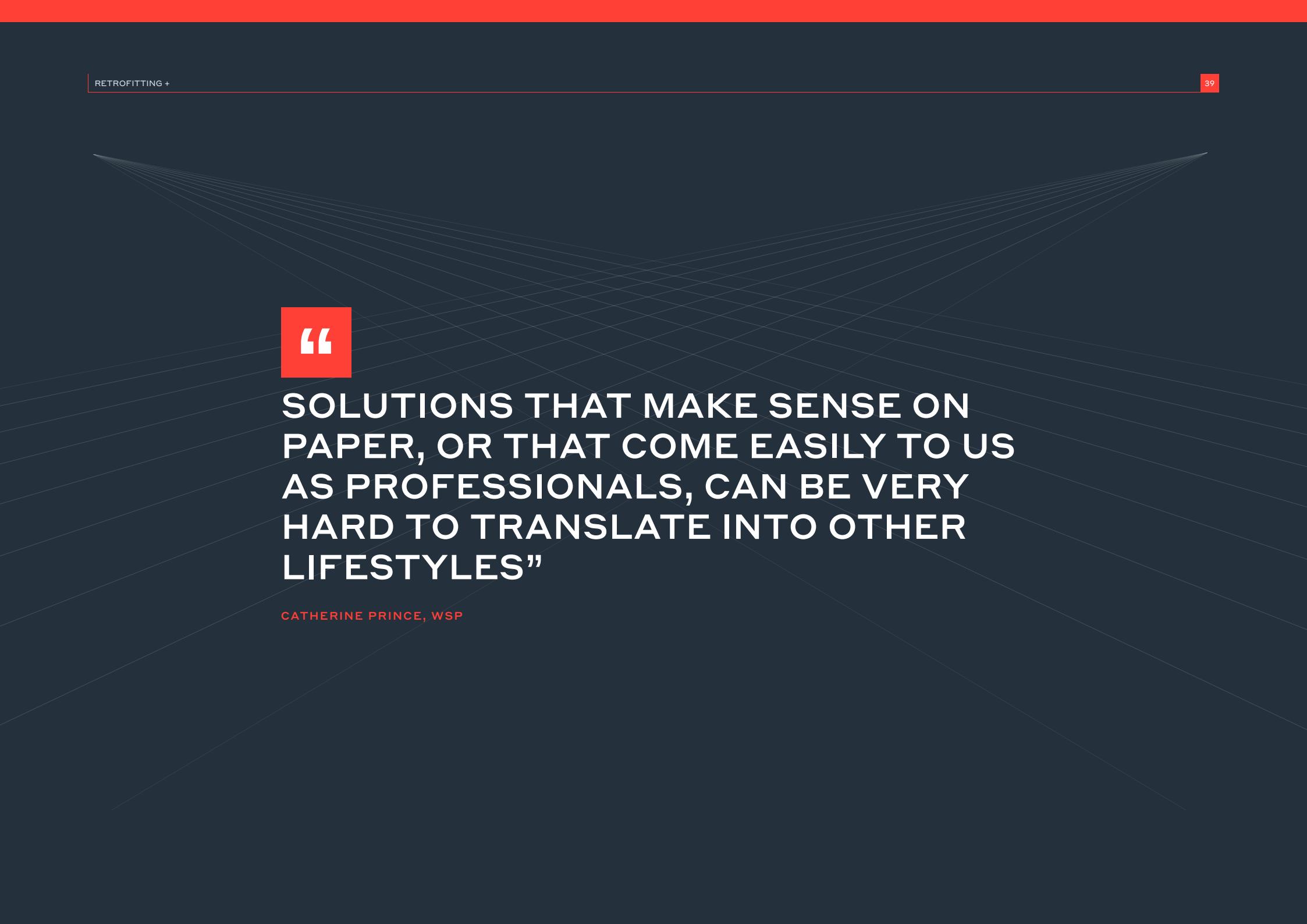
After community engagement, we feel fulfilled – we did the right thing and checked the box. Then, we go back to our desks and begin our technical recommendations. This is a missed opportunity! From my desktop, I can see which activities are the most carbon-intensive, and which solutions would achieve the greatest reduction. But if I just

stop there and make my recommendations based on the numbers, the solutions will be inequitable.

As professionals, we need to acknowledge that equitable solutions are not obvious for various reasons – our training and backgrounds are likely dissimilar to those for whom we are designing these implementation strategies. So, we need to question our assumptions, based on what the community shared, and make more deliberate decisions.

What are the solutions and how will they work for people in low-income communities? Are there any unintended consequences? What are the benefits and can we put some figures on them to make a case for investment? It is one thing to qualitatively describe the benefits for low-income communities, but quantifying them is revealing. For example, we could say: "This strategy will reduce their monthly costs, and they will have health co-benefits". But it's much more impactful to say: "This strategy will result in \$6,000 annual monetary benefits per low-income household, compared to an annual income of \$40,000 per household". These numbers are eye-opening and may justify the effort involved in assembling three or four different grants for implementation.





“

SOLUTIONS THAT MAKE SENSE ON PAPER, OR THAT COME EASILY TO US AS PROFESSIONALS, CAN BE VERY HARD TO TRANSLATE INTO OTHER LIFESTYLES”

CATHERINE PRINCE, WSP

► So quantifying the benefits is the key?

I would be remiss to say that quantifying the benefits is the best or only solution for equitable decision-making. In fact, quantifying equity benefits and co-benefits can be challenging because there isn't a set methodology, and one framework does not fit all communities.

That said, we must make the case for investment – so, when possible, we should quantify the direct benefits. We also consider the unintended consequences. You've got to look at both sides and understand the limitations, and it's good to acknowledge that you're not going to reach everybody. Then you can plan for phase two, phase three, phase four and bring in new partners – because an agency or entity can't solve everything alone. So, for a solar programme, an agency might acknowledge that it can't upgrade all of the housing stock at once, so they start with the okay roofs, but make a plan to expand in the future. Then bring in a non-profit partner to assist with future phases.

Catherine Prince is vice president of climate resilience and sustainability with WSP, based in Fort Lauderdale, Florida. She leads the practice for the Southeast United States as the regional business leader



HOW CAN WE AVOID MAKING THE AFFORDABLE HOUSING CRISIS WORSE?

5 insights We can't let decarbonization price people out of their homes, says **Scott R Armstrong**. We need to distinguish between upgrading properties and just maintaining them properly

01

Retrofitting preserves the larger units we're not building any more

There's an inherent goodness within some of our existing housing stock. In Ontario, for example, suite sizes have shrunk by 35% in the past 25 years, and there's a broader mix of sizes in existing properties compared to what's being built today. A lot of the multifamily residential buildings we have in Canadian cities are of a type that's less financially viable now: an older building might have a two- or three-bedroom unit that's 1000-1200ft², whereas newer suites might be in the 800-1000ft² range.

02

We don't just have an affordable housing crisis – we have an affordable maintenance crisis too

A lot of properties don't have enough money to pay for planned capital repairs, let alone decarbonization upgrades. Owners may have been tempted to show a better return on investment by deferring maintenance and minimizing capital repair reserve contributions. Now, interest rate increases and construction inflation mean projects are more expensive than anticipated and reserve funds have not kept pace. Even in situations where multiple owners share

responsibility for common areas, such as condominiums or strata complexes, the level of contribution to a reserve fund is a very sensitive topic. If there's a proposal to pay more over 10 years to upgrade all the windows in 2034, but you don't think you'll benefit because you will no longer living there, you might vote against it.

03

Decarbonized homes still need to be affordable

Older private rental buildings at the more affordable end of the market could be



IF YOU DECARBONIZE A BUILDING BUT RENTS INCREASE 30% OR 40%, THAT'S A HUGE RISK TO THE LOWER END OF THE MARKET"

SCOTT R ARMSTRONG, WSP



facing significant lifecycle capital repairs for which they do not have funding. My concern is that decarbonization could be used to suggest that retrofit costs are too high and that they need support, or relief from building decarbonization targets to maintain affordability. In some cases, they may have put themselves in that position by deferring maintenance and not properly building up their own capital reserves. Some owners may also seek above-guideline rental increases because retrofitting is seen as improving the asset. If you decarbonize a building but rents increase 30% or 40%, that's a huge risk to the lower end of the market, and it could make the affordable housing crisis worse.

04

Building decarbonization funding should also be linked to maintenance

Government is reluctant to overreach and tell private owners how to run their buildings, but it's also putting a lot of money into funding decarbonization, so we may need policies to help target that investment. Fundamentally, we need to improve the alignment between decarbonization and planned capital repairs. Part of the solution

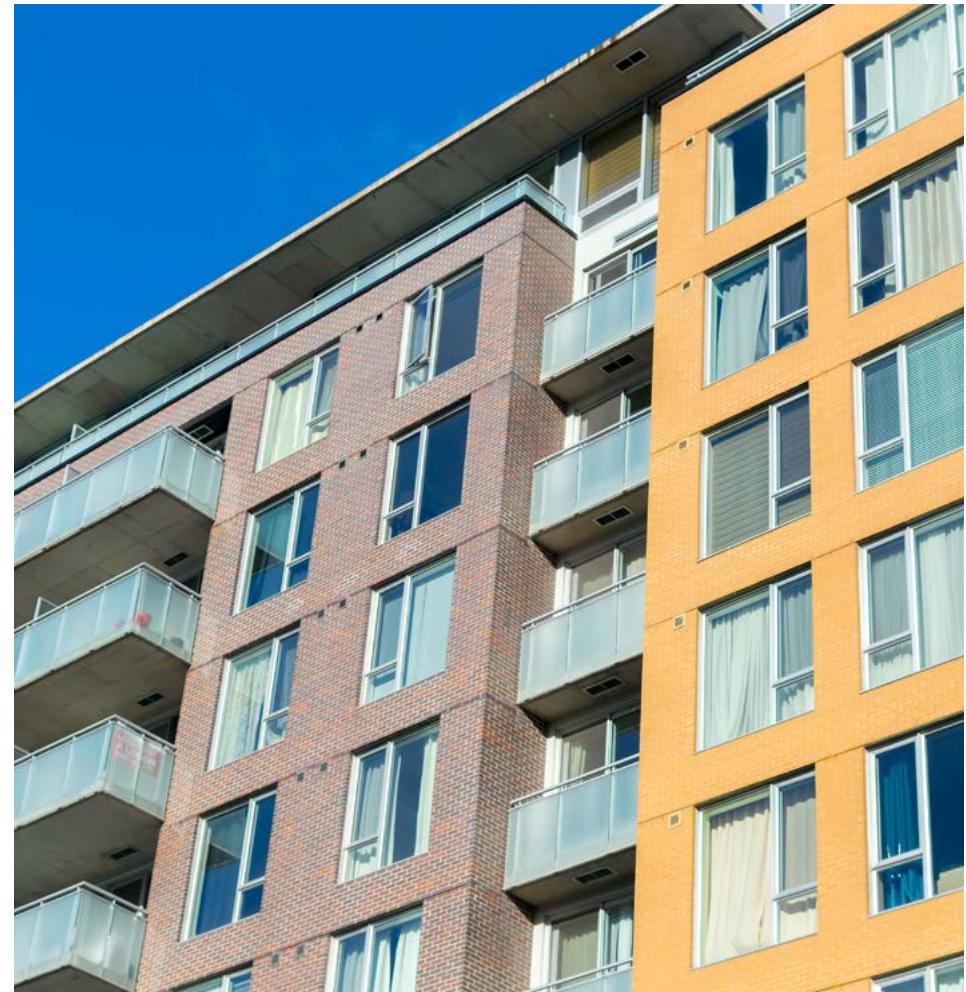
could be for the government to fund the differential costs, or to ask for evidence of the already planned capital as part of a building decarbonization strategy or a funding request. Policymakers may also need to clarify what counts as an upgrade versus essential maintenance, and tie incremental funding to affordability metrics.

05

Focus on the co-benefits

Many ageing apartment buildings don't have cooling and, in our warming climate, they're becoming almost uninhabitable in summer. The City of Toronto has a bylaw related to minimum indoor temperature in winter, and there are growing calls for a new bylaw on maximum temperature in summer. One of the co-benefits of decarbonizing those buildings is that it often involves adding cooling, and that improves the liveability of the unit. We need to work out how to tackle decarbonization, liveability and the affordable housing crisis all in one.

Scott R Armstrong is a project director in WSP's building sciences team, providing building science, sustainability and decarbonization consultancy on projects across Canada. He is based in Toronto



CAN DECARBONIZATION DELIVER EQUITY TOO?

5 insights Where decarbonization and urban planning intersect, there is an opportunity for greater equity. We need to rise to meet it, says **Gabi Brazzil**, co-founder of WSP's Equity Center of Excellence

01

Community planning can help avoid the mistakes of the past

When we're working in an equity community – historically underserved, underinvested and underrepresented – we always want to understand how historical and current decision-making shapes infrastructure and development, as that's the root of legacy impacts. Previous "urban renewal" or "blight removal" projects were not human-centred or community-driven. For example, in US cities from the 1950s through the 1970s, acres of homes and small businesses in thriving communities of colour were bulldozed to make way for highways, often to connect White suburban neighbourhoods to economic hubs. Today, we're identifying

those infrastructure mistakes through the Reconnecting Communities programme and trying to repair that harm.

Redesign and removal is an opportunity to create more multimodal streets and diverse transportation options. We can also implement circular economy strategies for the materials that we use, and add green infrastructure like parks, trees and community gardens to absorb emissions and reduce pollution.

02

Restorative investments can achieve decarbonization AND equity

One of the things we see more often in equity communities are vacant or underutilized

parcels of land, both residential and commercial. People with privilege experience generational wealth through property and business ownership, where descendants reap the benefits of accrued value. In equity communities, that process can be less linear – maybe the grandparents owned a home or business, maybe their children were able to maintain it, but their adult grandchildren may not have the economic opportunities to meet ongoing expenses like property taxes.

These properties are reclaimed by banking institutions or they fall into the ownership of cities, and over time, they can fall into disrepair. Recovering these land parcels is an opportunity for infill development and neighbourhood-level planning, not only achieving investment without displacement but a lower carbon

footprint compared to demolition and rebuilding. For-profit redevelopment would likely involve creating new, larger structures, with a significant carbon impact. Redevelopment for community benefit would mean responding proactively with strategies to preserve and restore existing properties and reimagine them.

03

Infrastructure maintenance is an urban equity issue

Sometimes, we do have to start from scratch. In the US, we see a water crisis in equity communities like Flint, Michigan and Jackson, Mississippi due to ageing, poorly maintained and overburdened ➔

infrastructure. This disproportionately affects equity communities because the cadence of maintenance can be less frequent, or the approach may be band-aid fixes rather than long-term solutions. This is another opportunity to look at decision-making, and whether public investments are proportionate to a community's challenges, as opposed to its political power or tax revenue. The energy usage of water infrastructure is a contributor to carbon emissions. As new, more efficient technology becomes available, we need to prioritize implementation in equity communities where it's needed most urgently.

04

How can we make decarbonization real for people today? Community planning can help with that too

Many solutions for reducing carbon are very long term. We've got to bring it down from that 30,000ft level to make it more accessible and relevant to laypeople. When you're working two or three jobs to keep food on the table, carbon can seem a distant threat. We need a framework that considers near and mid-term solutions too, and includes more innovative solutions beyond



infrastructure. There are areas of the US, like Cancer Alley in Louisiana, where there are petrochemical facilities that produce a lot of pollution. These companies have started to develop and implement decarbonization and remediation strategies, but that can be a 30-year plan. In the meantime, what might it look like to have a community public health fund, that uses tax revenue from carbon-emitting companies to relieve the burden of medical debt and improve access to healthcare? That would respond to the day-to-day experiences of equity communities in managing the health of their household, and create a public message about decarbonization that resonates far more.

05

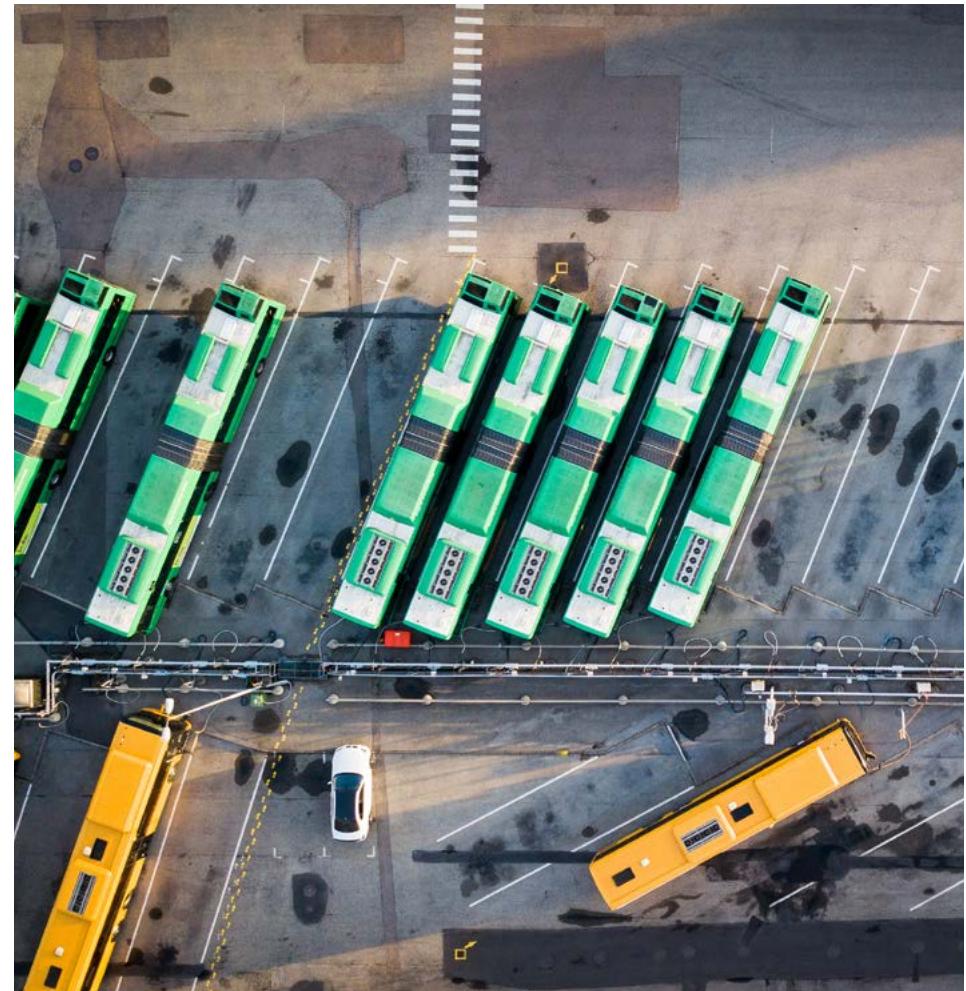
Urban equity is not just about what we do, but how fast we do it

WSP's Equity Center of Excellence has been helping US transit agencies to prioritize zero-emission bus fleets in equity communities that are transit-reliant and experience disproportionate environmental and public health outcomes. Some agencies that were early adopters have developed "range anxiety" when the promised battery life is not matched by real-world usage. So

electric buses may be limited to use on short to moderate routes, which are less likely to serve equity communities who often live further from economic and activity hubs.

Range limitations are a tough realization for transit agencies, given the significant investment and planning to acquire and sustain zero-emission fleets. To move toward our ambitious climate goal, a mixed fleet of hybrid and zero-emissions buses would deliver greater benefit than a mixed fleet of diesel and hybrid buses. This "happy medium" would allow time for reliability to improve, making entirely electric fleets more feasible for all bus routes in future. In our eagerness to reduce carbon, we need to consider how we're scaling that and steadily improving the baseline for everyone.

Gabi Brazzil is assistant vice president at WSP and co-founder of its national Equity Center of Excellence in the US. Under her leadership, it was awarded Best New Practice 2022 by Environmental Business Journal. WSP recognized her as a National Changemaker in 2024. She is based in Chicago



CRITICAL SYSTEMS



SOLVING THE INFRASTRUCTURE FUNDING GAP

5 insights We face major infrastructure funding challenges, and climate change is forcing tough decisions. Let's think differently to do more with less, says **Rachel Lawson**

01

A funding crisis can be an opportunity

There's a quote attributed to the New Zealand physicist Ernest Rutherford: "We have not got any money, so we have got to think." That's a pretty good summary of where we're at now. Like many other countries, New Zealand is grappling with spending constraints, combined with a massive deficit in infrastructure funding, estimated at more than NZ\$200bn over the next 30 years. But there is only ever so much investment available, and some financing models tend to kick the spend down the line. This is a real opportunity for

us to think about how we can regenerate our cities and infrastructure with the most effective use of public money.

02

A systems approach can reframe the problem, and unlock new solutions

One way to do that is by taking a systems view, looking at the outcomes we need to achieve, and leveraging the interdependencies between different types of infrastructure. Rather than starting with the need to build a new road in a certain location, or to increase the number of

buses in order to decarbonize our transport system, we might take a broader view. What does a project actually need to do? Is it as simple as creating a new road, or do we need to develop housing in a different location, that might be better suited to a net-zero future? What if we retrofit empty office blocks to provide homes instead, removing the need for people to drive (or take the bus) because they'd already be in town? Rethinking the outcome potentially changes the infrastructure funding model, by broadening the budget pool or opening up new sources, because it's responding to a greater range of issues.

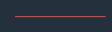
03

Is rebuilding always the right response to climate change?

We're in the process of rebuilding infrastructure, homes and even whole communities that were demolished by huge floods in January and February 2023. That throws up a lot of tricky questions, especially when we are dealing with interrelated issues such as climate change and social equity. Should we rebuild these homes in the same place, when we know these events are no longer likely to be one-offs? Who gets to decide, and who should pay to relocate those homes or that infrastructure, or to — ▶

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WHAT DOES A PROJECT ACTUALLY
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DIFFERENT LOCATION?”

RACHEL LAWSON, WSP



rebuild it every time it gets washed out? With such a long coastline, and a relatively small number of rate payers, these are big, gnarly decisions.

04

We've been here before – so let's use what we already know

Relocation has been discussed, but it is yet to be applied with complete success. Perhaps the need is not widely understood, or people would rather take the risk, or it's down to optimism bias, where people underestimate the chance that bad things will happen to them.

It's heartening to see a big shift towards incorporating our indigenous peoples' knowledge into infrastructure planning, because it is an incredibly valuable addition to our toolbox for understanding and predicting natural events. For example, [mana whenua in the coastal town of Matatā](#) have a *pūrākau* (legend) that tells of a *taniwha* (monster) that lives in the bay and flicks its tail back and forth – a warning not to build on the floodplain. The earth scientist Daniel Hikuroa suggests that these legends are a way of communicating information about natural hazards across generations,

and that *taniwha* are effectively guardians to protect us from disaster. When Matatā was decimated by flash flooding in 2005, its *marae* (meeting grounds) were untouched.

05

Identify the ideal outcome, and backcast from there

If we look forward to the outcome that we want to achieve, and then backcast the actions that would get us there, that might lead us to make different choices about existing infrastructure and buildings. Rather than starting with what else the building could accommodate, we could stand back and make a longer-term plan for retrofitting a community. In Sydney recently, I went to a seminar by Emma Bacon from campaign group [Sweltering Cities](#). I was really struck by her message that whenever we talk about climate change, we just talk about existing in that future state. She encouraged us to question why we aren't being more aspirational, and designing for a future state where everyone in society is thriving. Why are we settling for just existing?

Rachel Lawson is *tumuaki kaiwhakamāhere*, head of planning at WSP in New Zealand



▲ Cooks Beach on the Coromandel Peninsula in New Zealand after Cyclone Gabrielle in February 2023

RETRO-COMMISSIONING: HOW TO RESET A CITY SKYLINE

Where replacing MEP isn't an option, 'retro-commissioning' can still cut energy use by 10%. **Kenneth Li** explains how small tweaks are optimizing Hong Kong's towers

Hong Kong has more skyscrapers than any other city in the world, and keeping them running in its humid subtropical climate takes a lot of power. Buildings account for 90% of its total electricity consumption, and generating that electricity causes 60% of its carbon emissions.

The Hong Kong government has committed to reaching net-zero by 2050 – partly through a major energy efficiency drive targeting mechanical, electrical and plumbing (MEP) systems. But the first step to reducing their consumption is identifying how they're currently performing, and that's not always easy to do.

WSP executive director Kenneth Li has been carrying out energy audits for building owners for 30 years, getting to the bottom of how systems are running

and how to make them function better. "Clients want to know how bad the energy consumption of their building actually is," he says. "Actually, the most difficult part of an energy audit is to detect and measure energy use properly. Older buildings may not even have thermometers or pressure sensors, so we have to take live measurements to verify the operating condition of the MEP."

His team also produces net-zero roadmaps, with strategies for the short, medium and longer term. In line with science-based targets, these aim to reduce fossil fuel consumption by at least 90%, but exactly how to get there depends on the client, and the building. "With new buildings, we can design systems to meet the client's expectations, whether that's deluxe levels of comfort and optimum energy savings, or

just to meet the minimum requirements. With an existing building, there are more constraints. We may not be able to scrap MEP systems completely, and we can't expect new ones to fit in easily. We may only be able to make changes to the major systems, or only within the plant room itself."

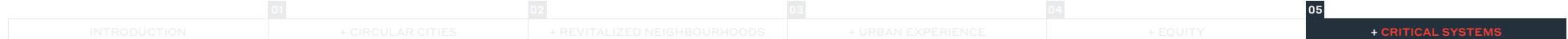
What is retro-commissioning?

In 2016, the Hong Kong government appointed WSP to develop technical guidelines on "retro-commissioning" for building maintenance teams, which are now being applied on around 300 government buildings. "On a new building, the commissioning process happens when a building is near completion – we finetune the settings so that the MEP systems work according to the design parameters," explains Kenneth. "But after

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KENNETH LI, WSP



it's been operating for 10, 20, 30 years, that day-one commissioning may no longer be a perfect fit. The operating conditions may have changed, or the purpose of the building, or user perceptions of comfort. Or there may have been a lot of deviations so the systems are no longer functioning properly. Often, we find that a lot of problems that might seem trivial – faulty sensors, mismatched settings – are affecting the plant quite seriously. It's not as drastic as replacing the equipment, but the savings will be in the range of 5-10%."

At the other end of the scale, one of the biggest opportunities for savings is to swap out air-cooled chillers for water-cooled equivalents. Due to acute water scarcity, buildings constructed before 2000 were only allowed to install air-cooled systems. Now with access to a more reliable water supply from mainland China, the government has been promoting more efficient water-cooled systems. This can halve the cooling energy consumption, says Kenneth. "Say 30% of the building's energy is used in the air-cooled chiller, when we replace that with a water-cooled chiller it may fall to 15%, so the saving is quite substantial."

Kenneth Li is WSP's executive director, building MEP and sustainability, for the China region



INTRODUCTION	01	+ CIRCULAR CITIES	02	+ REVITALIZED NEIGHBOURHOODS	03	+ URBAN EXPERIENCE	04	+ EQUITY	05	+ CRITICAL SYSTEMS
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USING NATURE TO MAKE CITIES COOLER, HEALTHIER AND MORE RESILIENT

Q+A If we stop trying to battle urban problems into submission and work with natural processes instead, we can make our cities cooler, healthier and more resilient to climate change, says **Alison Lumby**

What are nature-based solutions?

There are various definitions, though I like to think of it as nature doing what nature does best. Nature has had since time immemorial to develop ecosystem processes that sustain, repair and adapt the environment. Much of Western modern civilization is built on the assumption that we could do better and shape the world to suit our needs, and now we're coming round to the realization that perhaps we hindered more than we helped. A large part of what we do here at WSP is rethinking how to care for urban environments, informed by nature. Rather than control and dominance, it's about understanding the relationship between people and place, and adapting our infrastructure to work in harmony with natural processes.

What problems could we solve by retrofitting nature-based solutions?

When we talk about nature-based solutions, it's often in terms of addressing impacts of climate change such as flooding or intense storms. For example, we might shift our reliance from limited capacity sewer systems (grey infrastructure) by integrating landscape features that allow the Earth to absorb the water, or that capture and reuse it locally where water might otherwise have to be piped in.

They can also reduce the urban heat island effect. Green spaces absorb much more heat than hard surfaces. If you simply put down a lawn instead of a concrete driveway, the temperature drops. If you turn that lawn into a biodiverse habitat, now we're looking at co-benefits beyond

our original cooling target. Add some large-growing shade trees and you've cooled the area even more, increased potential habitat, improved user comfort, with knock-on economic and social benefits.

We tend to start with one objective, but it's really about an integrated ecosystems approach, and the co-benefits often outnumber or outvalue the original target. A traditional sewer will only ever be a sewer. A low-impact development (LID) system like a bioswale with natural planting will help manage flood risk, and also provide wildlife habitat and safe corridors, cool the environment, improve air quality, buffer noise, and bring nature prominently into our cities. There is no question that biophilic design, or even just being able to see a natural environment, improves our wellbeing.



WE TEND TO START WITH ONE OBJECTIVE, BUT IT'S REALLY ABOUT AN INTEGRATED ECOSYSTEMS APPROACH, AND THE CO-BENEFITS OFTEN OUTNUMBER OR OUTVALUE THE ORIGINAL TARGET”

ALISON LUMBY, WSP



► **Are there any disadvantages to using nature-based solutions instead of traditional ones?**

There will always be challenges to new approaches and techniques. A disadvantage right now is that we're often working with standards or policies that have not yet been reset to support green systems. A classic example is the mandate in many communities for mown lawns, which are sterile, high-maintenance, thirsty and of low ecological benefit.

Another one is maintenance. Many of the groups responsible for our public spaces are unfamiliar with caring for naturalized landscapes and there can be resistance to change, often tied to concern that we're increasing the burden on already stretched resources. But when we're truly getting out of its way, nature does most of the work. Our team spends a lot of time helping to adapt entrenched operation regimes.

In an urban environment, many of the solutions we use are more engineered and grounded in biomimicry. This is where we consider the inherent performance benefits of the forms, shapes, textures and colours that nature has evolved, and incorporate them in new technologies or construction techniques – such as more permeable surfaces, or a green roof that mimics a field



INTRODUCTION	01 + CIRCULAR CITIES	02 + REVITALIZED NEIGHBOURHOODS	03 + URBAN EXPERIENCE	04 + EQUITY	05 + CRITICAL SYSTEMS
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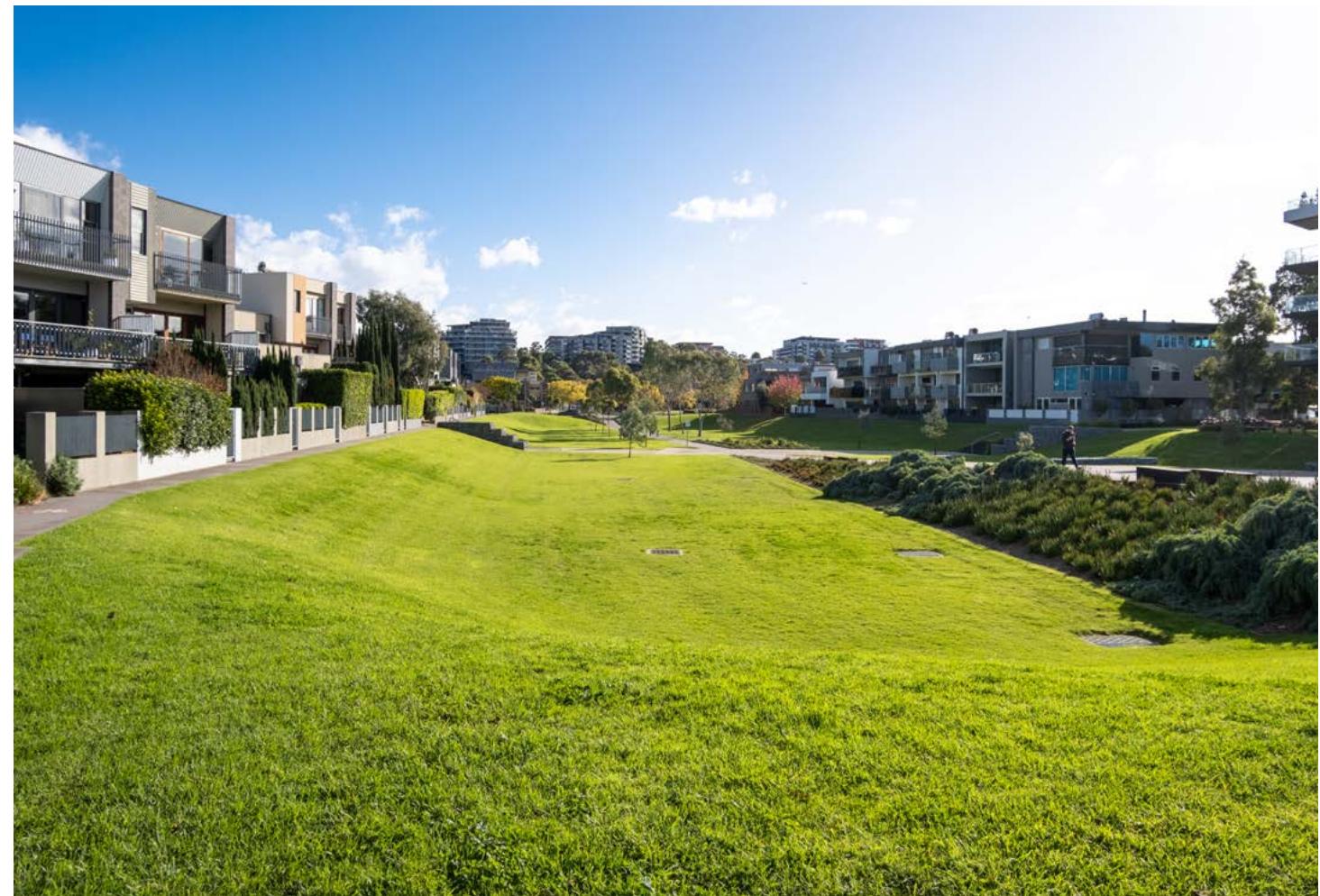
on top of a building. In those cases, there can be higher maintenance requirements than for a traditional grey infrastructure system.

Implementing these systems may also come with a higher upfront cost, so political will and market desire are important too. Rather than being a premium or an add-on, we are working to incrementally reset norms so that nature-based solutions become the baseline.

When you're retrofitting nature-based solutions in an existing cityscape, where do you start?

My starting point is to look around and ask "what here is fighting the environment?" If we are having to manage underused or problematic spaces, such as paved areas that serve no functional purpose, these could be an opportunity to introduce landscape features that provide infrastructure services, like green open space for the community, water attenuation and flood prevention, habitat, or even food production.

If surface car parking is required, permeable surfaces can help to refill natural water systems, with planting for added filtration. Introducing green walls or roofs to blank facades helps to cool our cities, purify the air, absorb rainfall and provide safe habitat for urban wildlife. Microforests



pack multiple benefits into small packages. As our cities rise higher, it's even more important to keep our focus at ground level and think about how landscape features such as street trees mitigate wind tunnel effects and provide shade.

Step back and look at the problems you're trying to solve. You might have pristine, manicured grounds, but you're spending huge amounts of money to mow that lawn and trim those trees. Meanwhile, everyone's complaining because their car is baking in the sun and getting too hot.

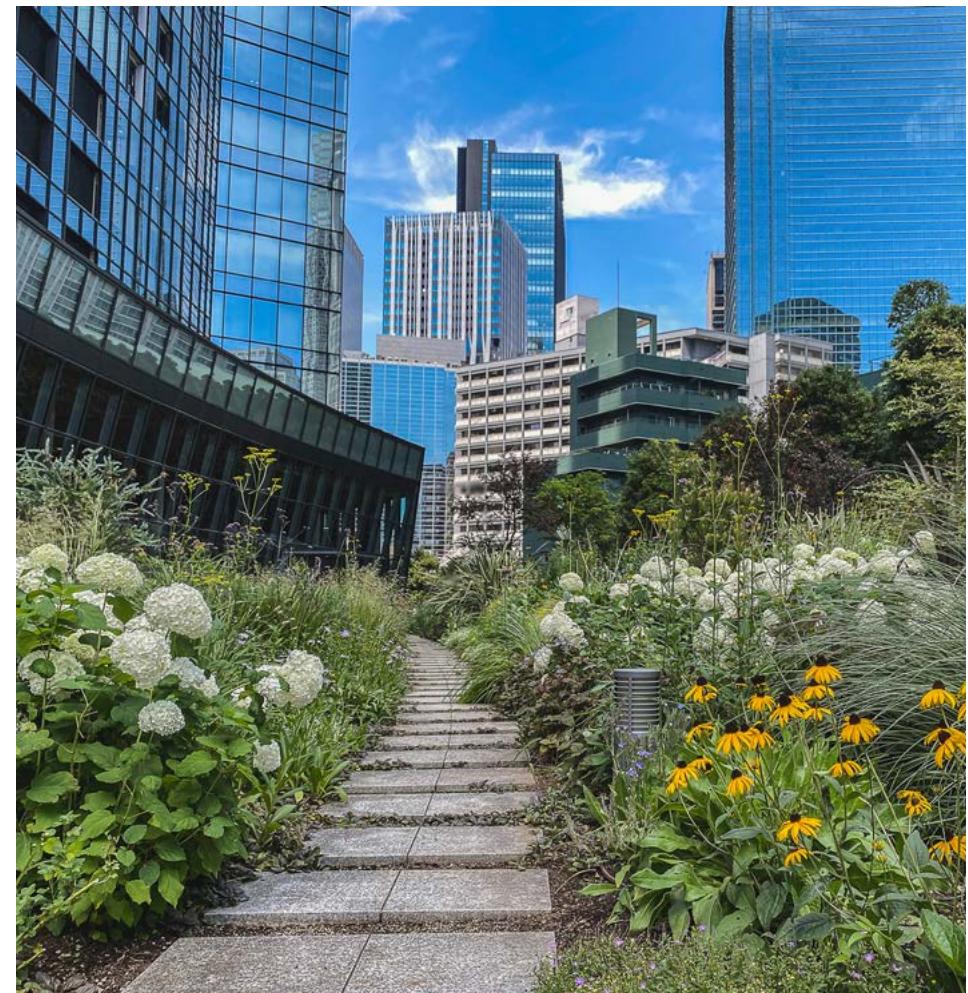
Instead, you could take an ecological approach and transition to natural meadow. Consider investing in solutions such as soil cells to support trees or giving up a few parking spaces to trees and biodiverse planting. As a co-benefit, that makes the space more comfortable and improves people's behaviour too. They're cooler, they're calmer, they're less likely to become frustrated. A common problem in busy urban areas is people sitting in cars idling because they've got the air conditioning on. If the environment was cooler and there was the potential to listen to birds chirping in trees, they might roll down the window, or even get out and engage with the space instead.

How do you reconcile people to more messy, natural environments?

We are seeing a cultural shift in what is perceived as beautiful, away from traditional Western paradigms that focus on control. We may have been culturally programmed to think that naturalized landscapes are messy or an eyesore, but as our awareness of their benefits grows, so does our appreciation, and we perceive them as thriving and healthy instead.

In order for any space to be successful, we need communities to care about it so that they become stewards of their local environment. That might mean using parks to their fullest, while making the choice not to tramp through the well-signed regeneration area. Or taking a picture rather than breaking off a flower to take home, because you understand the impact on wildlife and pollinators, and the wider benefits that they bring.

Alison Lumby is a landscape architecture and urban design principle with WSP in Canada



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