DESIGN QUAR-TERLY

ISSUE 10

THE CARBON ISSUE

Designing around a common metric to reduce emissions and help reverse climate change

Stantec

DESIGN QUAR-TERLY

ISSUE 10

THOUGHTS, TRENDS AND INNOVATION FROM THE STANTEC BUILDINGS GROUP.

The Stantec Design Quarterly tells stories that showcase thoughtful, forward-looking approaches to design that build community.

IN THIS ISSUE:
THE CARBON ISSUE

Carbon emissions cause global climate change. And carbon emissions are a result of the choices society makes in transit but also its approach to buildings, landscape and community planning. The architecture, design and engineering industry must refocus its efforts on carbon to meet targets for emissions to avoid irreversible climate change. In this issue we look at carbon as the unifying metric that allows designers and engineers to make a difference. And we investigate the possibilities for carbon appetite reduction in building design, agriculture, energy distribution, and the supply chain.

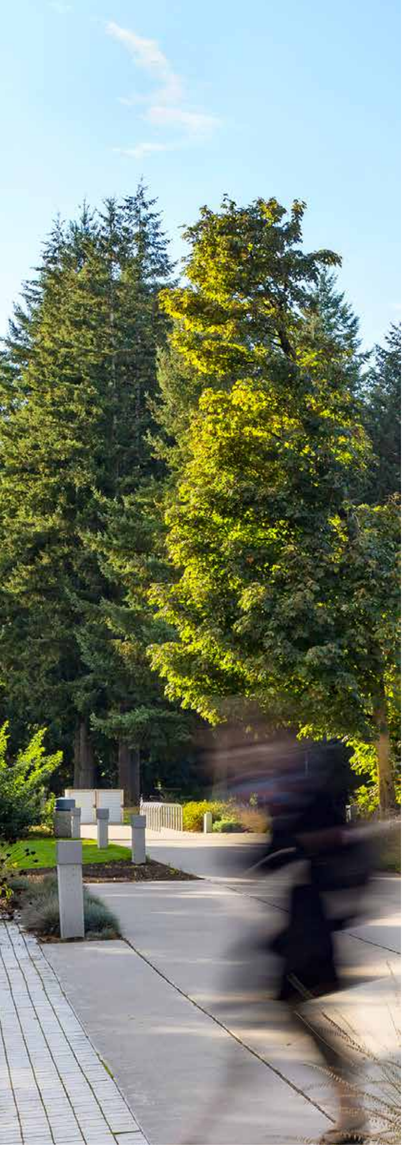
Carbon

A COMMON LANGUAGE FOR **CHANGE**

Denver Water
Administration Building
Denver, CO

Carbon emissions influence everything from the economy to our health, which is why we need an integrated approach to carbon reduction.

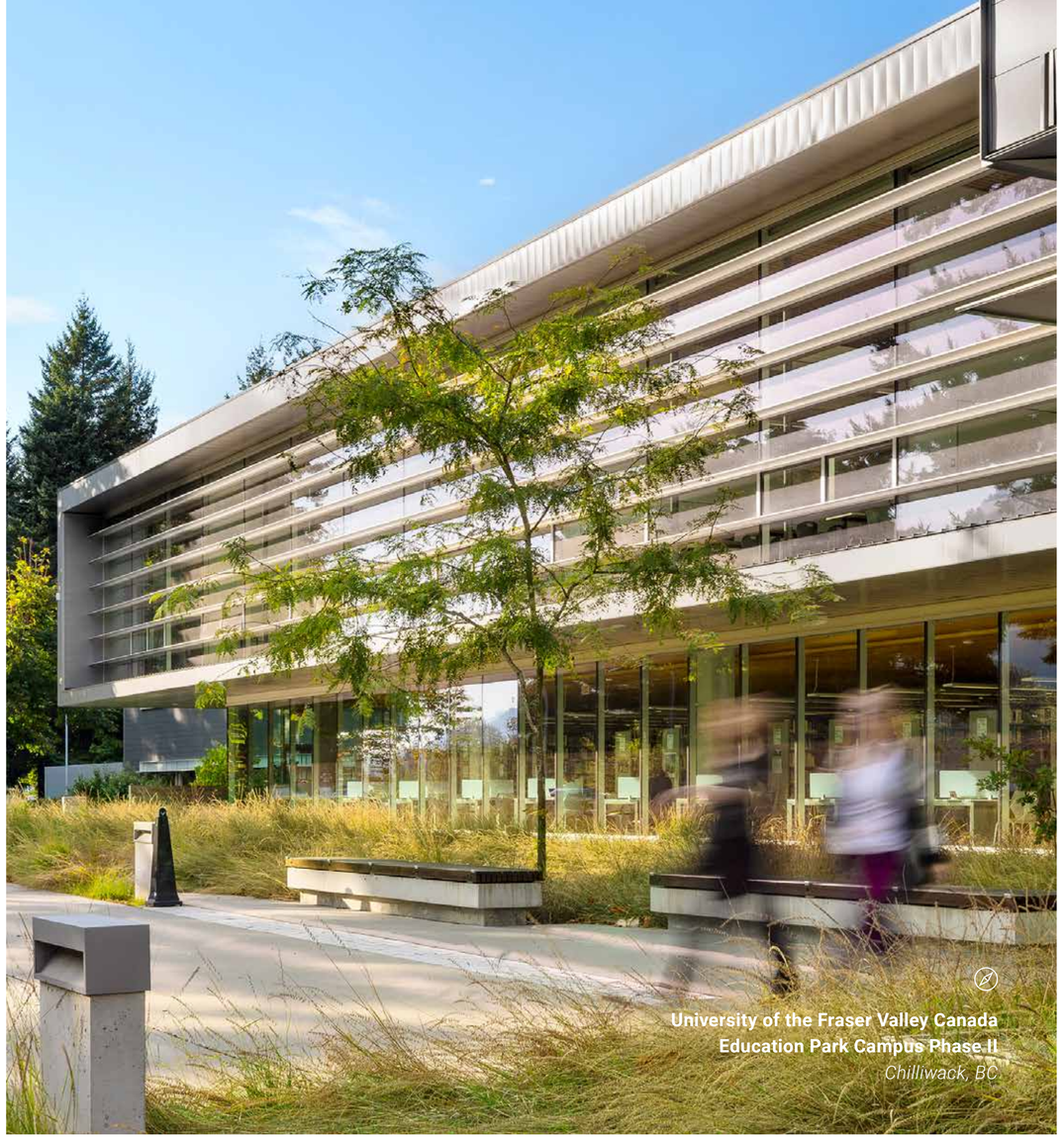
BY RACHEL BANNON-GODFREY



CARBON EMISSIONS IMPACT THE CLIMATE, WHICH IMPACTS OUR HEALTH, OUR ECONOMY AND OUR LIVELIHOODS.

Today our communities are in the middle of a global pandemic and the fallout from an economy that ground to a halt. There are some who say it is not the right time to talk about the climate. That couldn't be further from the truth. Now is the time to utilize every tool in our toolbox to significantly reduce carbon emissions because they are related to, and a multiplier of, every issue our communities currently face.

Carbon is a root cause of socio-economic and public health crises the world over, but it can also be a unifying metric. We need that metric so that we may reach consensus on an approach to create the carbon neutral future we so urgently need. In our practice we see a convergence of disciplines around quantifying the impact of operational and embodied carbon, and the strength of both technology-based and nature-based solutions, from the atmospheric scale of climate science modeling down to the specific plants we choose for a site design, and the sensors, systems, and materials we install in a building.



University of the Fraser Valley Canada Education Park Campus Phase II
Chilliwack, BC

At this moment, during the pandemic response phase, everyone is learning on the spot about the new business-as-usual. Simultaneously, we are imagining and planning adjustments to society for the impending recovery phases. This discussion is largely driven by economics and short-term return on investment.

How often have we had the opportunity to change how a society functions in such a radical way? Let us not waste it. We should not need a global pandemic to make change on the magnitude we need, but here we are. Let us use this moment of reset to create a world that is less vulnerable, more resilient to future climate change-related shocks. >

Fort Collins Utilities
Administration Building
Fort Collins, Colorado

How? We are paying close attention to the connections emerging between carbon emissions and health in vulnerable communities; uniting around carbon as a metric for assessing what it means to design with community in mind, and working across disciplines and business lines on how to tip the ratio of carbon emissions to carbon sequestered in the direction of a net positive impact.

CARBON, CLIMATE, AND HEALTH

There is a clear link between carbon emissions, climate change and our health. But that link is more evident in some places than others. In fact, the communities that have done the least to generate the emissions often suffer more acutely from the health impacts from climate change. This inequity has been clear during the COVID-19 pandemic. Communities exposed to the worst air quality conditions due to greenhouse gas emissions from vehicles, power plants, industrial processes are more likely to suffer from the respiratory health issues that cause greater vulnerability to illnesses such as COVID-19. This is what it means when we talk about the vicious cycle of carbon-climate-health. This is the big 'why' behind our work.

CARBON AS A UNIFYING METRIC

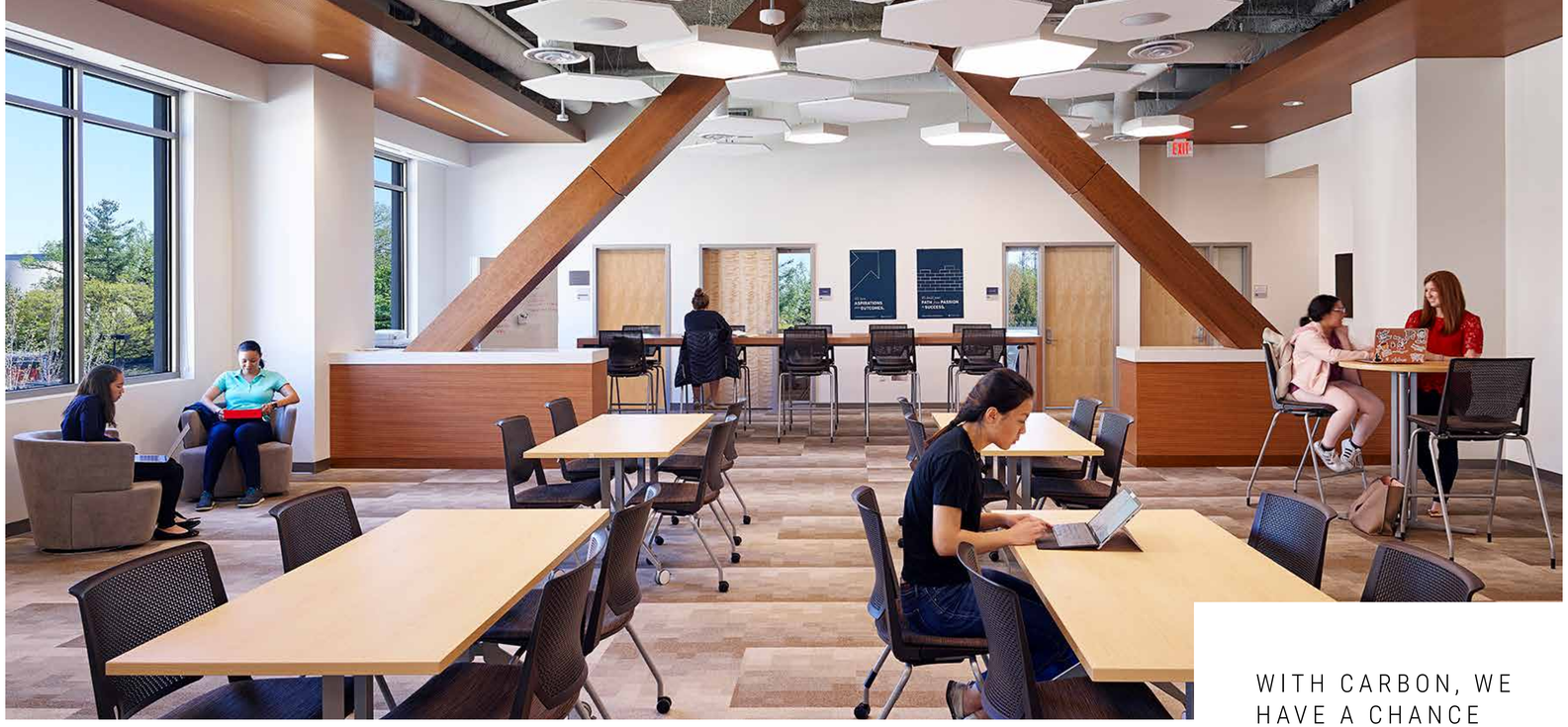
For too long each design discipline has spoken a different language of sustainability metrics. From building energy use intensity (EUI) to stormwater percentiles to recycled content, each of these metrics is important in driving sustainable design and we must factor all of them into our design decisions. But the lack of a common language in our industry has sometimes been a barrier to the all-hands-on-deck approach necessary to really drive change. At the same time, thanks to recent innovations in software tools and reporting mechanisms that span the scale of individual materials to utility grids and power plants, we now see greater recognition of carbon as the universal translator. This brings all disciplines to the same conversation and widens the range of impacts that we must consider when talking about the success of a project. Every discipline's work—its craft—can be quantified in terms of how it contributes to the balance of carbon emissions and carbon sequestration. **>**

Dearing Elementary
Pflugerville, TX

AN INTEGRATED MULTI-DISCIPLINARY APPROACH

By uniting around carbon, we can take a multi-disciplinary approach that crosses geographic and market boundaries. We've created an Embodied Excellence task force comprised of structural engineers, landscape designers, specification writers, building performance engineers, and sustainability consultants dedicated to raising awareness of the tools and technologies for calculating and minimizing the embodied carbon of our projects. We believe this integrated approach to assessing carbon adds value to our clients.

Project Drawdown's Drawdown Review 2020 draws an analogy between the atmosphere full of greenhouse gases and an overflowing bathtub. To address it, not only do we need to immediately address the source of the overflow, turn off the tap and stop sending greenhouse gases into the atmosphere, but we also need open the drain and let some of those greenhouse gases out, which means sequestering, or storing, carbon. Our industry must look beyond the footprint of a building and approach the carbon equation from two angles–carbon emissions reduction and carbon sequestration.



In the **2018 Intergovernmental Panel on Climate Change** (IPCC) Special Report on Global Warming almost all the pathways analyzed by the panel relied to some extent on carbon removal approaches. Approaches to removing CO_2 from the atmosphere fall into three broad categories: nature-based solutions such as reforestation and restoration of ecosystems; technology-based solutions for carbon capture; and hybrid approaches such as technologies used to improve farming and land management. Designers, ecologists, and policy makers can tackle carbon everywhere from a building to a watershed.

We face a global pandemic that remains a devastating and imminent threat to us all. But as we experience the reset for many aspects of our lives, we can also choose a new direction for a low carbon future. >

WITH CARBON, WE HAVE A CHANCE TO AMPLIFY THE ISSUES THAT CAUSE CLIMATE CHANGE, THE SCALE OF THE PROBLEM AND HIGHLIGHT THE PATH **FORWARD**.

American University Don Myers Technology & Innovation Building
Washington, DC

MORE SUSTAINABILITY AND BUILDING PERFORMANCE

Discipline Leader **Rachel Bannon-Godfrey** leads Stantec's Buildings Sustainability team from our Denver, CO office. Her experience spans architectural design, building performance analysis, and sustainability consulting on high-performance and net-zero energy buildings across six countries and three continents.

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CARBON CAPTURE & NATURAL CAPITAL

In addition to continuing our work in delivering buildings that operate at net zero emissions, we are looking into using carbon capture technologies such as CarbonCure on our projects, and editing our standard project specifications to include thresholds for the embodied carbon of cement.

Stantec's Urban Places team is looking at the carbon footprint of its landscape design and calculating how many years it would take to reach 'climate positive,' which means the total embodied carbon of the materials used in the landscape design is less than the carbon sequestered by the trees, plants, and other natural species.

At a larger scale, our Environmental Services teams are working on Natural Capital assessments of entire sites and landscapes as a means of helping clients, from portfolio managers to municipalities, understand the full environmental impact of their assets.

Natural Capital quantifies the biodiversity value of a site and how it impacts nature and human health, rather than just the real estate value of the land or how many parking spaces can fit. Instead of just talking about the carbon emissions associated with a building, we also look at the carbon sequestration potential of the landscape surrounding the building.

Once we assess the biodiversity value of the site, we can then look at nature-based solutions to improve the resiliency of the site to weather events such as flooding or extreme heat. We consider nature-based solutions 'no-regrets' approaches because using nature to add value to a site typically has a benefit to our health and well-being no matter if the final outcome was not fully achieved. And as an added-bonus, nature-based solutions are typically the most cost-effective. D

Université de Sherbrooke – Longueuil Campus
Longueuil, QC

Electric Quebec

How one province has set the stage for carbon reduction at the societal level

BY ANTONINO LAGANA

Reducing the carbon appetite in the developed world and its effect on climate change can seem daunting—insurmountable even—for those committed to addressing climate change. But today we have case studies and examples from communities that have taken the initiative to reduce greenhouse gas emissions at the societal level.

One such case is the province of Quebec, where I live. Over the previous three decades, we have put building blocks in place to reduce greenhouse gas emissions. It worked and (up until the pandemic) had a positive impact on the economy. Quebec is a good example for North America because of its economy, climate, and geography, but also because it has done a good job of making carbon reduction a viable business. As an engineer with a specialty in deep energy retrofits, I know how to marry the downstream building energy consumption with the upstream clean and affordable energy provided by Quebec.

I believe, Quebec could be a blueprint for the rest of Canada and for the US, where with the right ingredients (for example, hydro, solar and wind, and increased telecommuting, etc.) we can set the stage to fuel an economic boom and drive responsible use of fossil fuels in a less carbon-dependent future. But how best to accomplish this?

In 2017, Quebec's GHG emissions per capita were 9.4 tons CO_2e—52% below the Canadian average of 19.6 tons CO_2e.*

Provide clean and affordable electricity
In Quebec, we rely on water and gravity for our electricity. While the initial investment might be large, hydro-electric power is relatively cheap and the infrastructure lasts a century or more with the occasional turbine replacement. The embodied carbon invested in hydro lasts a long time. While there are environmental concerns around dam placement, hydroelectric power where feasible, is in my opinion, a sustainable choice. In Quebec, we upped the price on natural gas and made electricity cheap and reliable. Then, we applied a carbon tax and funded incentives.

Promote electrification
Through inexpensive and cleaner electricity as well as utility, provincial and federal rebates, Quebec incentivized practices like LED lighting installation in residences and businesses. Concurrently it has incentivized the installation of 240V chargers and the purchase of zero emissions vehicles. >

**Source: Environment and Climate Change Canada (ECCC)*

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MORE BUILDINGS ENGINEERING

With a background in aeronautical engineering, **Antonino Lagana** brings a passion for thermodynamics to his work in energy performance for government and corporate clients from **Stantec's Longueuil, QC office**. He's dedicated to implementing Canada's EE and GHG Reduction initiatives.

Reduce consumption

Why build 50 dams if you only need 20? Quebec has set the stage to reduce energy consumption by buildings. Homeowners and businesses, paying a low price per kWh, are encouraged to invest in efficient electric systems. Homeowners are switching to electrical heating systems (e.g. heat pumps and electric baseboards) instead of boilers thereby reducing natural gas consumption.

Simplify the business case

Cheap, clean, and reliable electricity has simplified the business case for consultants and service providers. They can easily show commercial clients how investing in deep energy retrofits will affect their bottom line and more accurately estimate payback periods. This has allowed energy performance contracts, in which retrofit services and investment are paid back from energy cost savings, to flourish.

By making energy retrofitting a viable business, it's easier for large organizations and corporate clients such as IKEA or the Canadian government to invest in efficiency measures. The market for technology is better, for one thing. For my client IKEA, I could choose an efficient off-the-shelf frictionless maglev heat pump and chiller that would pay for itself quickly rather than suggesting a custom technology solution that was harder to financially justify.

A place for fossil fuels

Fossil fuels like natural gas are unlikely to go away completely, they have a place in functions such as aviation, which represent a small percentage of overall GHG emissions. Shouldn't we, then, be conserving these fuels for their best application? Hybrid geothermal systems, for example, in which the heat pump handles energy needs most of the year and burns natural gas only when needed, are a great option for cold weather climates.

To make meaningful progress against our targets, we need to creatively approach carbon appetite reduction and find the best solution for each situation.

Set the stage for private firms to excel

It took at least thirty years and public investment. But Quebec set the stage for the private sector to get the jobs of electrification, energy retrofits, and carbon reduction done. Moreover, the progress in greening Quebec's energy landscape was not achieved at the expense of its natural gas utility, which prospered and diversified into renewable energy production. It's time for the rest of North America to take a look at Quebec and ask how can we do the same? D

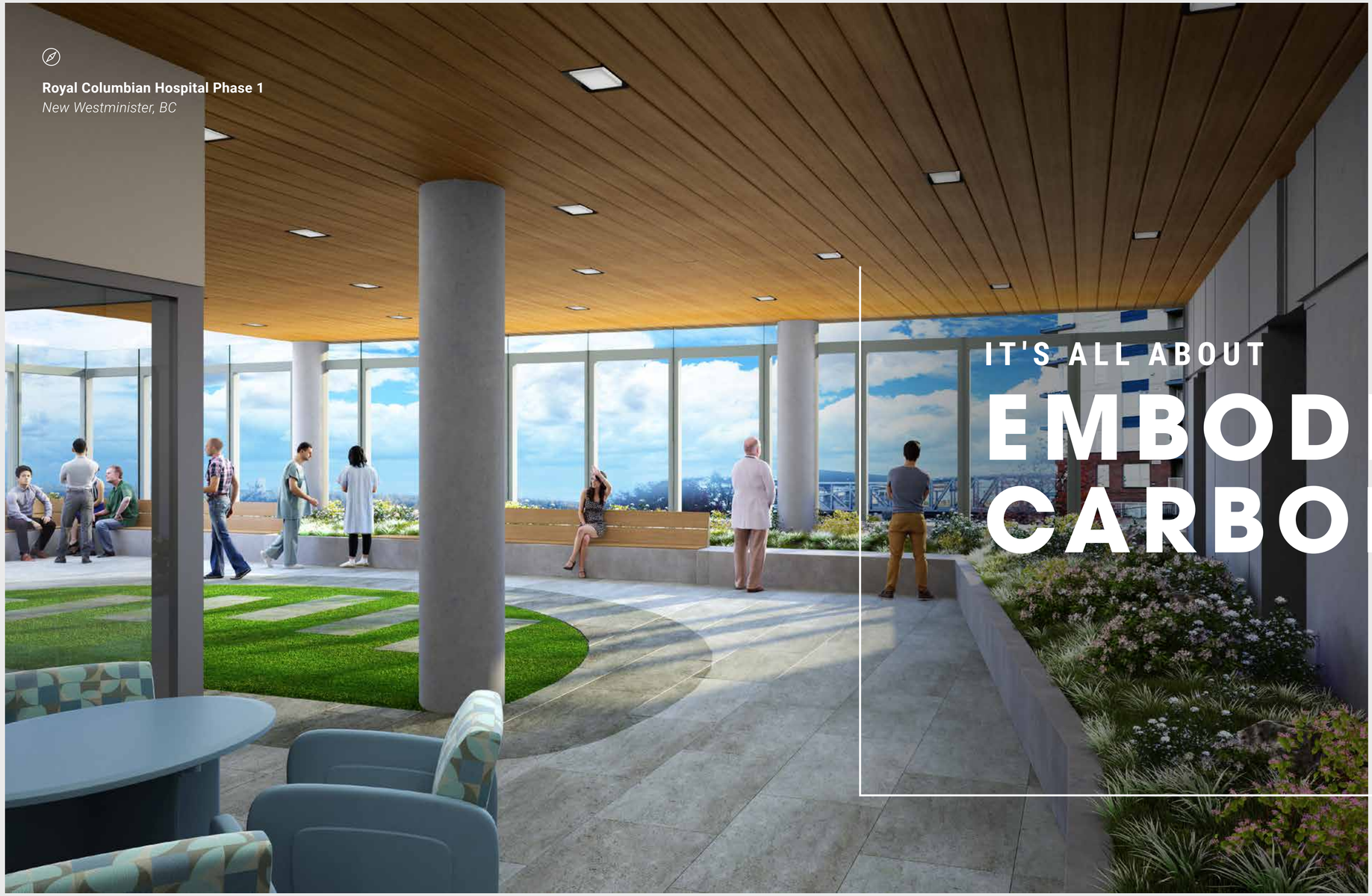
DID YOU KNOW?

5%

Quebec's demand represented 5% of total Canadian demand for natural gas in 2018.

Quebec's GHG emissions in 2017 were 77.9 megatons (MT) of carbon dioxide equivalent (CO_2e). Quebec's emissions have declined 9% since 1990.

In 2018, Quebec was the largest exporter of electricity to the U.S. of all Canadian provinces.



Royal Columbian Hospital Phase 1
New Westminister, BC

IT'S ALL ABOUT EMBODIED CARBON

A truly sustainable approach accounts for the materials that make up buildings.

BY JUDHAJIT (JUDE) CHAKRABORTY

Denver Water Administration Building
Denver, CO

CARBON BUDGET: TO STALL 1.5°C RISE, OUR CARBON BUDGET FOR THE PLANET IS 340 GT CO_2.

Until recently much of the conversation about sustainability in the buildings industry was centered around operational carbon, the carbon emitted by buildings or the energy buildings consume in their day-to-day operations. We approached sustainability as a matter of energy performance—of reducing that appetite. The goal was to design an energy-efficient building so that on day one that appetite was lower and so were the utility bills.

That approach shaped state energy efficiency codes such as Title-24 in California, Seattle Energy Code, the ASHRAE Standards, and green-building certifications such as LEED, Living Building Challenge, and Green Globes. The mantra was design or engineer a building so that from day one it uses less energy to operate.

What is embodied carbon?

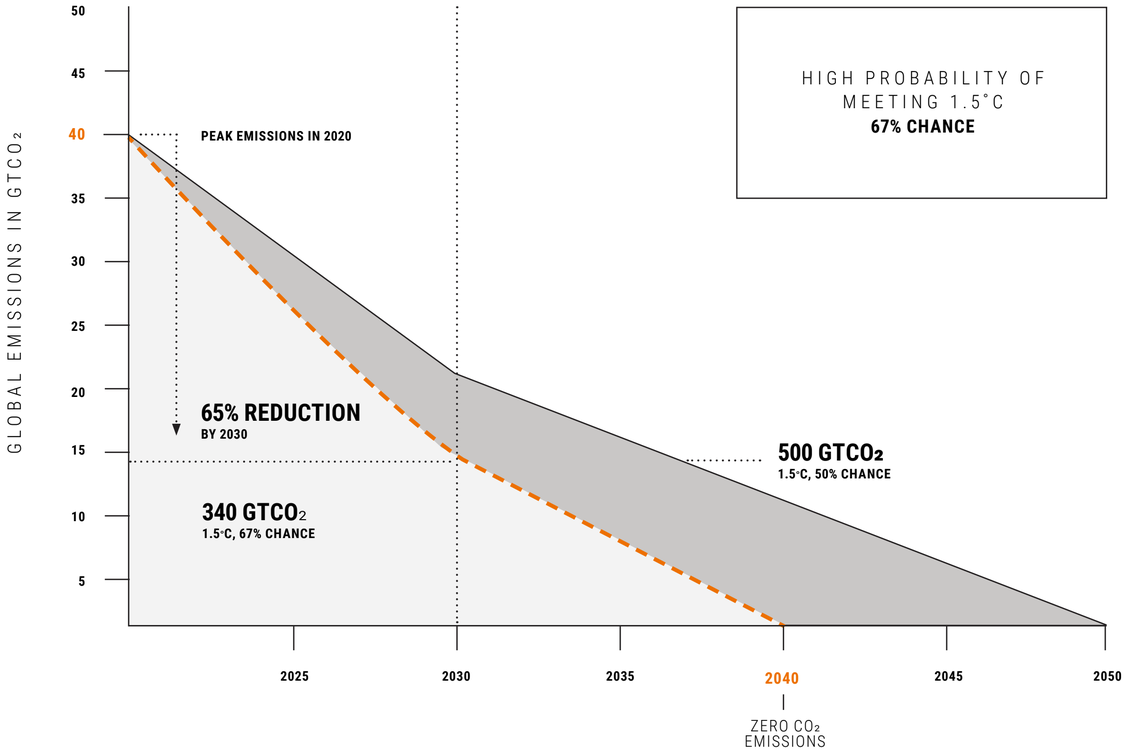
Reducing the operational energy needs of buildings makes sense and will continue to be an essential part of solving the climate change crisis. What we missed by only considering operational energy was the energy investment in the building that it inherits right from day one—its embodied carbon or embodied energy. Simply put, what volume of carbon emissions did that building contribute to the atmosphere, the air we breathe, before it even opened? Generally speaking, we define embodied carbon as the greenhouse gas emissions (in carbon dioxide equivalent) attributed **>**

to manufacturing and transportation of construction materials and the process of construction. Unlike the building systems which can be replaced with more efficient ones and improved over time, this embodied carbon amount is fixed once it's been spent. In essence, we (and the planet) live forever with the decisions that the whole project team, from designer to contractor to client make when designing the original building. A groundswell of interest in embodied carbon from the design industry and the public at large has resulted in the availability of more information about materials and their origin as well as an increasing range of alternative, naturally-derived materials.

Climate crisis, new look at carbon

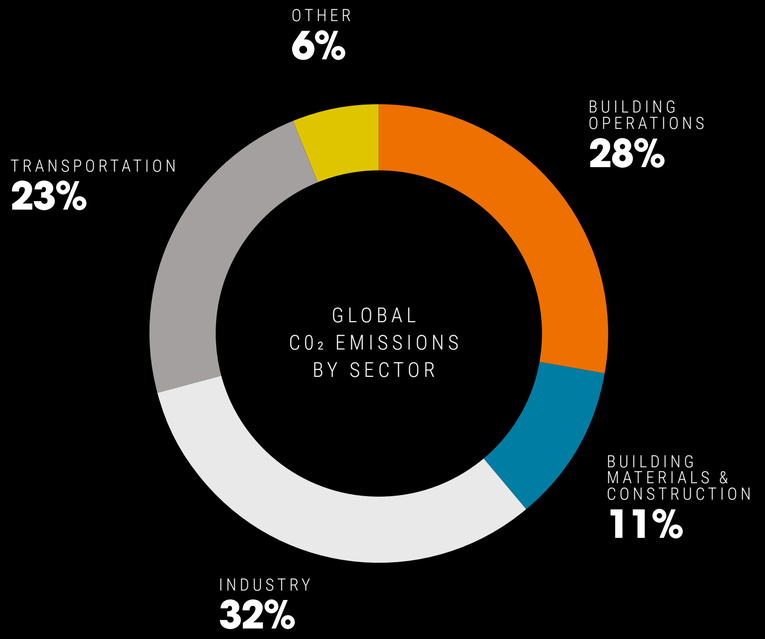
The climate crisis has forced our hands to act. Science tells us that if we keep on emitting carbon dioxide as business as usual then within the next ten years, the global temp will rise 1.5°C Celsius, and that rise will be irreversible. At the next milestone, a rise of 2°C Celsius, we'll see catastrophic changes in the climate. Recent reports from the Intergovernmental Panel on Climate Change (IPCC) sternly recommend zero carbon emissions globally by 2050 to stall temperature increase. To target zero emissions, we need a "carbon budget" for the planet. This budget is the max carbon that people can consume annually to keep us on track to phase out carbon emissions by 2050. The lower the carbon budget, the better our chances are of stalling temperature increases. To stall the 1.5°C rise, our carbon budget for the planet is 340 Gt CO_2. This carbon budget has a 67% probability to stall the 1.5°C rise and keep us on track to phase out carbon emissions by 2040. **>**

Accelerating to Zero



BY THE NUMBERS

When we begin to analyze buildings for their embodied carbon, it's clear there are opportunities to design differently.



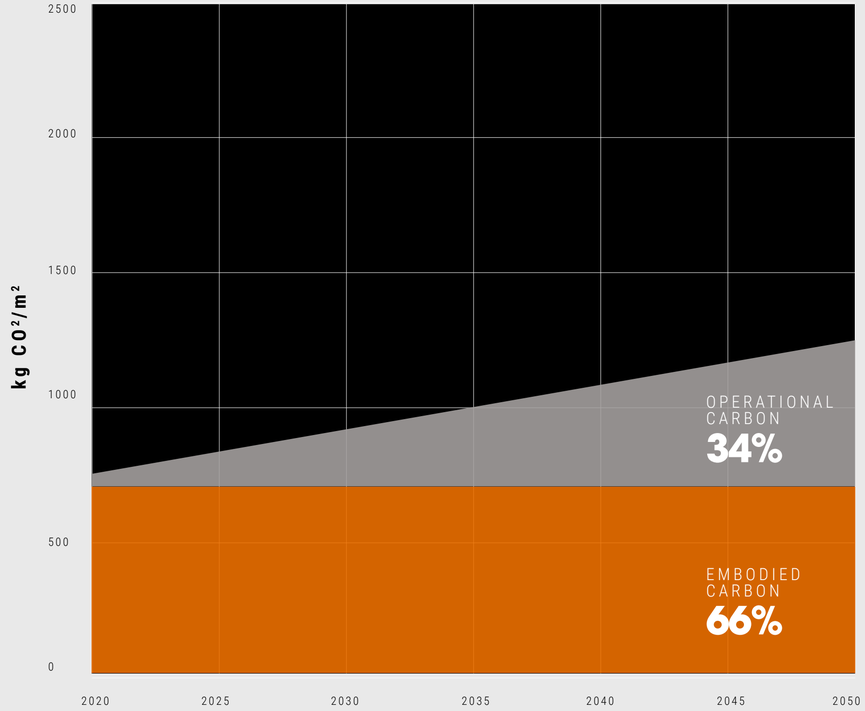
SOURCE:
ARCHITECTURE2030.ORG

Buildings operations accounts for 28% of the global carbon bill. Buildings infrastructure/ materials account for 11% total annual global emissions by sector. Making the steel, concrete, glass for buildings and transporting them to the site consumes a lot of energy. Our longtime focus on operational carbon has resulted in the possibility of a lopsided carbon footprint for an energy efficient building. Embodied carbon account might account for 66% of total carbon footprint of a new energy efficient building looking at a building life cycle of 30 years.

We've come a long way in terms of what's possible in operational efficiency. But looking at the lifecycle of a building, we now see that there's a lot more we can do. Something has got to change. When we begin to analyze buildings for their embodied carbon, it's clear there are opportunities to design differently. **>**

AN EFFICIENT BUILDING'S CARBON FOOTPRINT OVER 30 YEARS

Our longtime focus on operational carbon has resulted in the possibility of a lopsided carbon footprint for an energy efficient building.



CHECK OUT OUR **INTERACTIVE EXPERIENCE** HERE WHERE WE EXPLORE HOW WE USE *HEALTHY MATERIALS*

Take concrete, for example.
A whopping 8% of global emissions come from the fiery kilns that manufacture cement and concrete, of which Portland Cement Concrete (PCC) is the most commonly used. This is global phenomena. It's an extremely energy intensive process to make PCC and the world makes a lot of it.

Fly ash is a byproduct of the process of manufacturing cement and used to be thrown away. But in fact, it actually has similar binding properties to cement with the right aggregates. And it turns out if we add fly ash back into the cement mix, using 50-60% fly ash instead of 100% Portland cement with aggregates, we can significantly reduce the carbon emissions associated with cement manufacturing. Studies say adding fly ash reduces the water required to make cement and results in a more workable, pumpable and stronger concrete product.

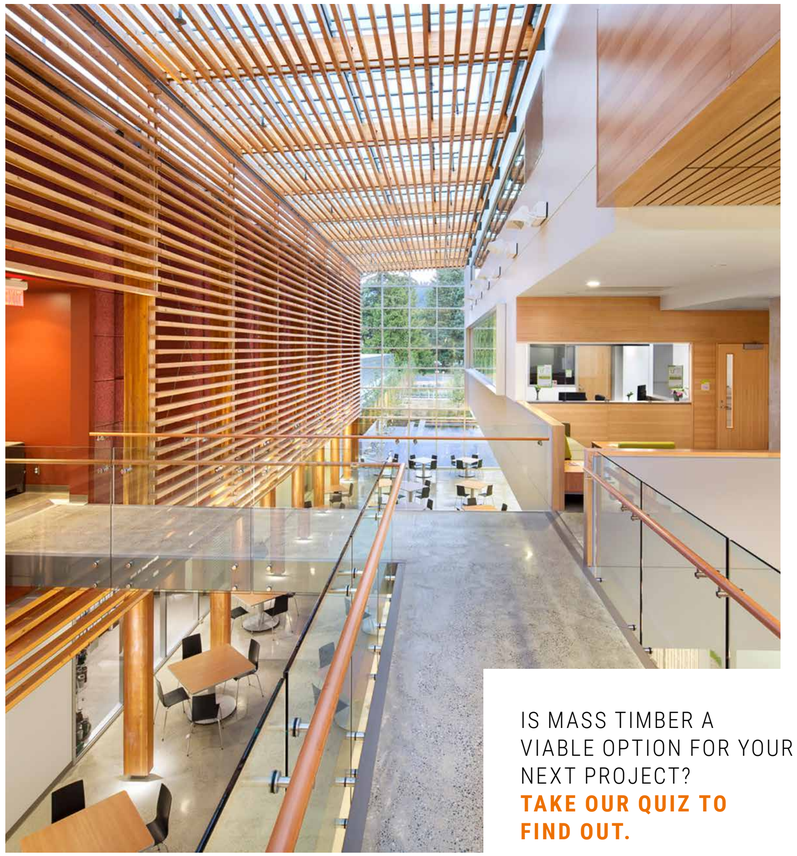
Common sense approaches like this, driven by an awareness of embodied carbon, are going to help us meet our carbon goals as an industry. Similarly for steel, steel manufactured from **Electric Arc Furnaces** (EAC) has much lower embodied carbon than that made from a Basic Oxygen Furnace (BOF).

Locking up carbon

Broadly speaking, we must be looking at various ways to sequester carbon—lock up CO_2 out of the atmosphere. Innovative technologies such as **Low Carbon Concrete, CarbonCure**—injecting carbon into the concrete mix—promise some sequestration. Another approach is **CLT (cross laminated timber)** in which pieces of wood are pressed together in a super strong timber building material. It's one of the most promising developments for those interested in designing with embodied carbon in mind. CLT is strong enough that we can use it in buildings over 10 stories. It is procured from managed, sustainable forests and leftover wood scraps. Even accounting for the glue, manufacturing and transport, CLT is a clear winner.

Just like CLT, **natural and biobased materials** can lock up CO_2. For interiors, this means choosing natural, renewable and biobased materials like bamboo, cellulose, cork, wood fiber board, insulation with waste denim, and linoleum. Even straw bale for insulation has benefits regarding embodied carbon. Hempcrete, an innovative product combining the hemp plant core with concrete is strong, elastic and sequesters carbon.

University of the Fraser Valley Canada Education Park Campus
Chilliwack, BC



IS MASS TIMBER A VIABLE OPTION FOR YOUR NEXT PROJECT? **TAKE OUR QUIZ TO FIND OUT.**

Going carbon negative

Building materials can be carbon negative. Plants that have sequestered a certain amount of carbon during their lifecycle are carbon negative. If the volume of this carbon outweighs that used in the processing, manufacture and transportation of the material, the building material can be considered carbon negative.

Create a pathway

Today, if we do an embodied carbon centric design, the first thing architects have to do is a Whole Building Life Cycle Assessment (LCA) analysis. The LCA has been part of LEED rating system since LEED version 4 debuted in 2014. Since then a number of software tools have become available to help a designer accomplish the LCA.

In the LCA, we analyze and report the environmental impacts of a building or product using the metrics of GWP (Global Warming Potential), ODP (Ozone Depletion Potential), Acidification, Eutrophication, smog formation and depletion of non-renewable energy sources. The LCA quantifies the building's carbon footprint (and that of the site materials) which gives us both a benchmark and a pathway toward specifying materials that can reduce the embodied carbon of the project.

Targets needed

If we can make a case for substituting highly efficient concrete, CLT or carbon negative materials the result will be less carbon intensive buildings. But to do this we need to target a figure for embodied carbon. We need something like the EUI (energy use index) for operational carbon which gives designers and engineers something to aim for relative to other projects. We need a carbon budget for each project. To transform our industry we need more standards, more sophisticated tools for tracking and modeling embodied carbon and eventually we need baseline codes that capture and reflect the carbon intensity of materials choices.

Of course the most sustainable approach is to reuse and reposition our existing buildings. However, the desire for new construction is not going to end. With population growth and urbanization, we can predict that humans will require 2 trillion SF of new building floor area over the *next three decades.* That is the equivalent of building a new New York City once a month for 32 years. We need to make those buildings low or even negative carbon if we can.

Time to rethink

It's time for us to rethink the process of designing buildings. We need to rethink about materials and commit to using the results of embodied carbon analysis to drive design decisions. This means carrying out LCA early on the design process so we make better longterm decisions about building materials. As informed designers we have to educate clients about the repercussions of the choice of materials in their buildings. And we can't just talk about this in closed circles on the conference and lecture circuits. We need to bring the embodied carbon conversation to the public even if it means acknowledging the grim reality and how buildings contribute to it. D

Atlassian Sydney Headquarters
Sydney, Australia
Stantec/LCI | Engineering; SHoP
BVN - Architects

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MORE SUSTAINABILITY

Based in Stantec San Francisco, Senior Sustainability Consultant **Judhajit (Jude) Chakraborty** is an expert in whole building life cycle assessment and certification methods critical in net zero energy and carbon neutral design. He enjoys the challenge of applying the laws of physics to active and passive sustainable strategies.

Frederick County Public Middle School
Winchester, Virginia

5

STEPS TOWARD **EFFICIENT** BUILDING PERFORMANCES

An efficient envelope and LEDs are just the beginning.

BY TANYA DORAN

Overwhelmingly, people around world still rely on coal, natural gas and petroleum for their energy. Global energy demand rose by 2.1% in 2017 and *70% of that growth was met by oil, gas and coal.* In many parts of the world the grid won't be clean for years or decades. To lessen our carbon diet, we can't wait for energy transition, we must start to design more energy efficient buildings now. And good building design should not be based on the idea that renewables can swoop in late in the game and make an inefficient building carbon neutral. We can't solar our way out of climate change. Instead, we need to think about how good building design from the outset can reduce carbon dependence from the beginning.

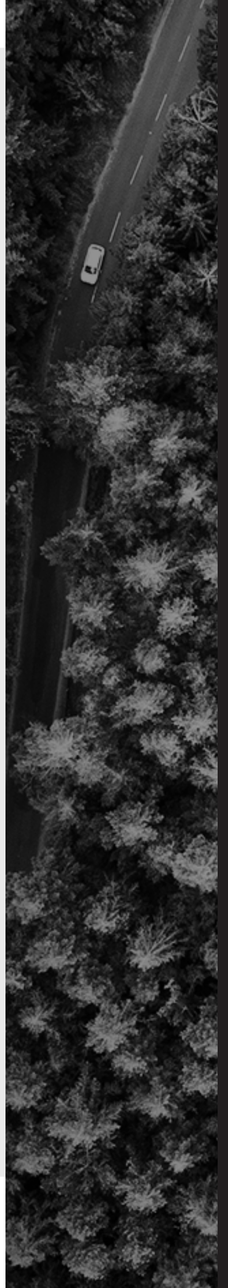
To make a great building, we need to look at consumption. That means thinking about building envelope from the early stages of building design. Envelope and insulation may not be the sexiest aspects or flashiest systems, but they're the most cost-effective means of reducing consumption for heating and cooling. Envelopes often remain as they were designed for the entire life of the building, while systems can be upgraded. By age 25, building systems often reach end of life, but not envelope. So that means we better get it right—the first time.

Fort Collins Utilities Administration Buidling
Fort Collins, Colorado

Let's talk briefly about five key strategies designers can use to reduce carbon impact.

Envelope
By incorporating passive design strategies (tight envelope, insulation, orientation, controllable natural light) in every building we design, we will deliver significant reduction in consumption (up to 30%) before we've begun to mull renewables or advanced energy efficient systems. Remember that *envelope design* and *assemblies* are *strongly connected to the building's embodied carbon,* which can represent up to **75% of its carbon footprint** over its lifespan. Building orientation (to allow for solar gain and breezes, for example) is a simple decision that we can make early in the design process that will significantly aid in carbon reduction.

LEDs
Advancements in the quality of LED lighting fixtures and quality of light have made LEDs one of the most cost-effective ways building owners can reduce energy consumption and carbon. LED lighting can save roughly 40% of energy usage. Naturally, LEDs are standard on our new building designs. The return on investment on an LED commercial retrofit is very good. An investment in LEDs will pay for itself, and soon. And because LED systems are cooler, they may also reduce the cooling load on commercial spaces resulting in further energy savings. >



ENERGY PERFORMANCE MODELING

What are **deep energy** retrofits?

Retrofitting a building with features such as high efficiency equipment and a high-performance envelope which dramatically reduce its energy appetite (and operational carbon needs) is a deep energy retrofit.

Today, a sustainability consultant or designer can make a strong business case for a deep energy retrofit, that is that the investment in energy efficiency will pay for itself in the short-term. While Stantec is not an energy performance contract provider, we can model building performance and help make the case for an EPC. We've even developed custom parametric tools that model building performance against payback time, helping inform our clients of a plethora of options and investment price points. If the payback can be modeled within 5 to 10 years, the building owner will see a bottom-line benefit to the retrofit.

Most of the building we see around us today will still be here in 40 or 50 years. In urban areas, existing buildings operations have an **energy appetite** that accounts for 40-60% of GHG emissions.

If it is investing more and expects the return over a number of decades, it is likely retrofitting for other reasons such as a commitment to being a responsible global citizen, corporate responsibility and talent recruitment and retention.

Energy Performance Contracts are one method for contracting for these deep energy retrofits. In this model, you hire a consultant to study your building and demonstrate how an investment would drastically reduce building energy consumption, save money, and pay for itself in an estimated amount of time, say seven years. The contractor offers to do the retrofit and the client pays them back over say ten years. If the model is not achieved, however, that's reflected in a reduction in payback. *That's the EPC model.*

Heat Pumps

Air-source heat pumps (ASHP) and ground-source heat pumps (GSHP) pull heat from outside the building to heat it inside. ASHPs use ambient air while GSHPs pull heat from the earth below the earth's crust. Heat pumps are a wise choice to replace boilers for clients in less heating intensive climates or in smallercommercial and residential buildings because they can significantly reduce emissions in areas with less heating demand.

Co-generation

Co-generation, also known as combined heat and power, can support fuel switching in markets with a carbon intensive grid or when grid connections are not practical. While there are many potential feedstocks for a co-generation plant, including biomaterial and methane, natural gas is often the source. And natural gas emits far less CO2 than sources like coal. Cogeneration plants can be 50-70% more efficient than conventional single source plants. Buildings that use natural gas-powered generators, for instance, can recover heat and save money on energy use while reducing their carbon footprint.

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MORE BUILDING PERFORMANCE

Based in Edmonton, **Tanya Doran** is inspired by connecting the natural world to the built environment, and creating energy conscious and efficient buildings.

117 Kendrick Street
Needham, MA

Well-being and comfort

Managing comfort and expectations of building occupants around temperature can go a long way in our efforts toward mitigating energy use. We need to reduce the carbon appetite in our communities by reducing the expectation that schools, offices, restaurants, and shops will be ice cold in summer and cozy and warm in winter. How cool do we need to make a room? How warm? Finding the right middle ground is the key to reducing wasted energy on overheating or unnecessarily cooling spaces.

Perhaps the greatest challenge to investing in buildings that use less energy and emit less carbon has nothing to do with design or technology. It is all about budget and perception. In many cases, capital or investment budget for a new building is often completely divorced from its operational budget, even though former largely determines the latter. If we can look at initial investment as a means to reduce energy consumption and operational budget over time, features like efficient building envelope and insulation would climb higher on the design priority list. D

DRIVING CARBON DOWN

Seven trends shaping the big picture for an energy transition

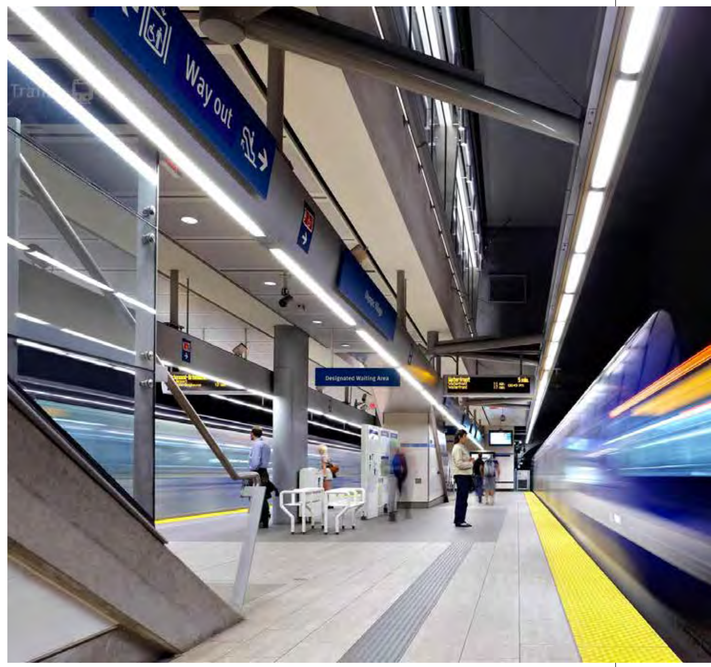
BY KEVIN ARRUDA, RACHEL BANNON-GODFREY, AND JOHN ORD

Railway Program Management
Multiple cities, nationwide

Both the UK and North America have begun to take steps towards distributed energy systems, away from the centralized systems they've had for decades. Why? The conventional power system, with its large power plants and vulnerable transmission lines, was built to manage the average demand and sized for peak loads. Ramping up and down these large generators is thermally inefficient. And a centralized system isn't particularly resilient, either.

For the sake of resiliency and reaching both local and global carbon emissions reduction targets, we need to transition the load from a conventional centralized system towards a distributed network of energy sources and loads. Over the past several decades, certain utilities in the UK and NA have gradually moved toward a more distributed system with wind, solar, and waste as energy sources at the district level. So, what's next for this distributed energy network? What new technology and applications are coming online and what are their advantages? What is holding back progress at the speed and scale we need to be more resilient today to our changing climate?

We talked to a range of experts in carbon, power, and design about the trends and challenges influencing energy. This conversation provides snapshot of the emerging relationship between architecture and power as we move toward a massive energy transition in hope of achieving a less carbon-intensive future. **>**



Skytrain Olympic Village
Vancouver, BC

Surrey Biofuel Processing Facility

Surrey, BC

One of the largest of its kind in Canada, the composting facility transforms household waste into biofuel.

WHICH TECHNOLOGIES AND TRENDS ARE DRIVING CARBON DOWNWARD IN THE ENERGY FIELD?

Buildings as energy plants

Designing new buildings, and retrofitting existing buildings, with minimal energy loads, coupled with on-site renewables, is the path toward a future where buildings generate more energy than they consume. As soon as you have on-site generation, the relationship with the utility grid changes from a linear energy flow to a dynamic relationship. Add in energy storage and the ever-changing equation gets even more exciting, requiring a blend of virtual and physical energy flows. There's a catch, however. The grid is, by and large, not yet ready for this new era of 'grid interactive' buildings. See "Out of date codes and regulations" below.

POLYMERS 2'S WASTE TO ENERGY PROGRAM WILL DIVERT

320,000

TONS OF NON-RECYCLABLE WASTE FROM LANDFILL AND GENERATE 32MW OF ELECTRICITY FROM IT ANNUALLY – ROUGHLY THE ENERGY TO POWER 44,000 HOMES.

Decarbonizing the gas network

Decarbonizing the gas network, which means replacing gas-fired heating for buildings with electrical and heat pumps is already underway in the UK. This promotes resiliency and a further decentralized system that can incorporate local wind, solar, and energy from waste in the heating system.

Biofuels as industrial power sources

Agriculture, industrial, and municipalities are emerging as markets for biofuels for power generation in the U.S. We're likely to see more of these clients turning to biofuels to lessen their carbon footprint as part of their energy transition. And they will look to biomass like sugarcane, which requires less processing than corn, as a source for ethanol generation. These industrial plants can also use the byproducts of ethanol production to power the plant, even selling power back to the grid.

Pumped storage

Battery storage technology is often touted alongside renewables for its potential to unlock even more clean energy. An even cleaner option however is pumped storage, in which wind turbines working at night fill pump storage reservoirs with water. Later, during peak demand hours of the day, the reservoirs open and the downhill flow generates power. **>**

Resource recovery

Plastics are refined hydrocarbons derived from oil. If we can recover and recycle more of these polymers, we can reduce our carbon appetite. At recycling plants like the £65 million Polymers 2, near Bristol, England, for UK recycling company Viridor will recycle plastics and sell them back to the industry. In year one, the UK's biggest multi-polymer plant will produce 60KTPA of recycled plastic a year from 81KTPA feedstock. This means Polymers 2 will transform 1.6 billion used bottles, pots, tubs, and trays into pellets, flakes, and other industrial forms of plastic every year as a viable and sustainable solution to virgin plastic.

Waste to energy, waste to fuel

Not everything is recyclable at present. But waste has a role to play in mitigating carbon appetite, too. In Europe and the UK, waste to energy technology is advancing rapidly. In the U.S., growth is hampered by public opposition (based on the lack of emission control for previous incineration facilities) as well as the low cost of landfill.

In the UK, Polymers 2's waste to energy program will divert 320,000 tons of non-recyclable waste from landfill and generate 32MW of electricity from it annually—roughly the energy to power 44,000 homes.

Elsewhere in the UK, plants are on track to turn unrecyclable wood and fuel derived from various types of commercial waste into renewable Bio-Substitute Natural Gas (BioSNG) that can be, for example, used in production of low-carbon vehicles.

Hydrogen fuel cells

While electric vehicles hold great promise for decarbonizing transportation, technology has yet to solve limitations such as battery charging time and range. Hydrogen fuel cells, however, hold great promise as a technology for electricity production in vehicles, expanding their range and use. In the UK, biomass gasification will be used to produce Syngas from waste which can then be used to make the hydrogen fuels cells. **>**

BARRIERS TO PROGRESS

1

Out of date codes and regulations

When it comes to carbon reduction, the conversation often trends toward emerging technology that increases efficiency in energy systems and reduce our reliance on carbon fuels. But when it comes to DC-powered microgrids, we already have most of the technology (battery storage, on-site renewable systems, smart meters) needed to deploy them in our buildings and our neighborhoods.

Direct current (DC) electrical systems can increase the efficiency of our power systems by reducingin efficiency of multiple AC/DC conversions in a typical building. DC systems can operate independently of our AC systems, adding a level of resiliency, and enable us to benefit more from innovative energy infrastructure options like microgrids, distributed power, and renewables. DC microgrid systems tend to be more efficient, less costly and smaller than their AC counterparts because fewer electronic converters are required.

A significant obstacle is the regulatory landscape. Outdated regulations hold back implementation of DC microgrid systems in North American buildings. Architects, engineers, and interior designers need to enter into a dialogue with the organizations that write codes and standards to start working with municipalities to build the political will and clear the way for this innovation. Stantec is already engaged in studies of the regulatory impediments to implementing smart cities and smart building technology, for instance.

2

Infrastructure investment, local solutions

Massive, renewed public investment in infrastructure, particularly the grid and systems for energy transmission, is overdue for UK, US, and Canada. Existing systems often date from the 1960s-70s and are now largely outdated in terms of efficiency and resiliency. We now have an opportunity to improve the systems and bring them to a 21st Century standard. We must remember, however, not to subscribe to the top down/ build for capacity model of the past. We should push for an evolution toward a distributed model that allows for more efficient local solutions and new technology such as heat pumps, smart grids, smart meters and renewable sources.

3

Economics

The market for waste to fuel plants is poised to grow globally, but these facilities are not well understood by the public. Wider adoption of waste to fuel locally is hampered by economics and local views on incineration. That could change, however, as alternatives such as creating new landfill modules and shipping recyclables abroad become cost prohibitive. With the right business case and investment, existing plants can invest in technology necessary to clean up their emissions and to burn more efficiently. D

High Sheldon Wind Farm
Sheldon, NY

DID YOU KNOW?

Phasing out coal

BECAUSE THE COST OF RENEWABLES IS DECREASING, THE SHARE OF UNCOMPETITIVE COAL PLANTS WORLD WIDE WILL INCREASE TO 60% IN 2020 AND TO 73% IN 2025. REPLACING UNCOMPETITIVE COAL WITH CLEAN ENERGY COULD SAVE GLOBAL ELECTRICITY CUSTOMERS $39 BILLION IN 2020.

SOURCE: CARBONTRACKER.ORG

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MORE POWER & DAMS

Based in Newcastle upon Tyne, UK, chemical engineer and expert on energy and resources opportunities **John Ord** is Stantec's UK Business Director of Energy & Resources. Recent successes include appointment as EPCm Integration Consultant for the world's largest and most advanced polymer recycling facility in the UK, and the award of design integration contracts for Shanghai Electric's first EfW projects in the UK.

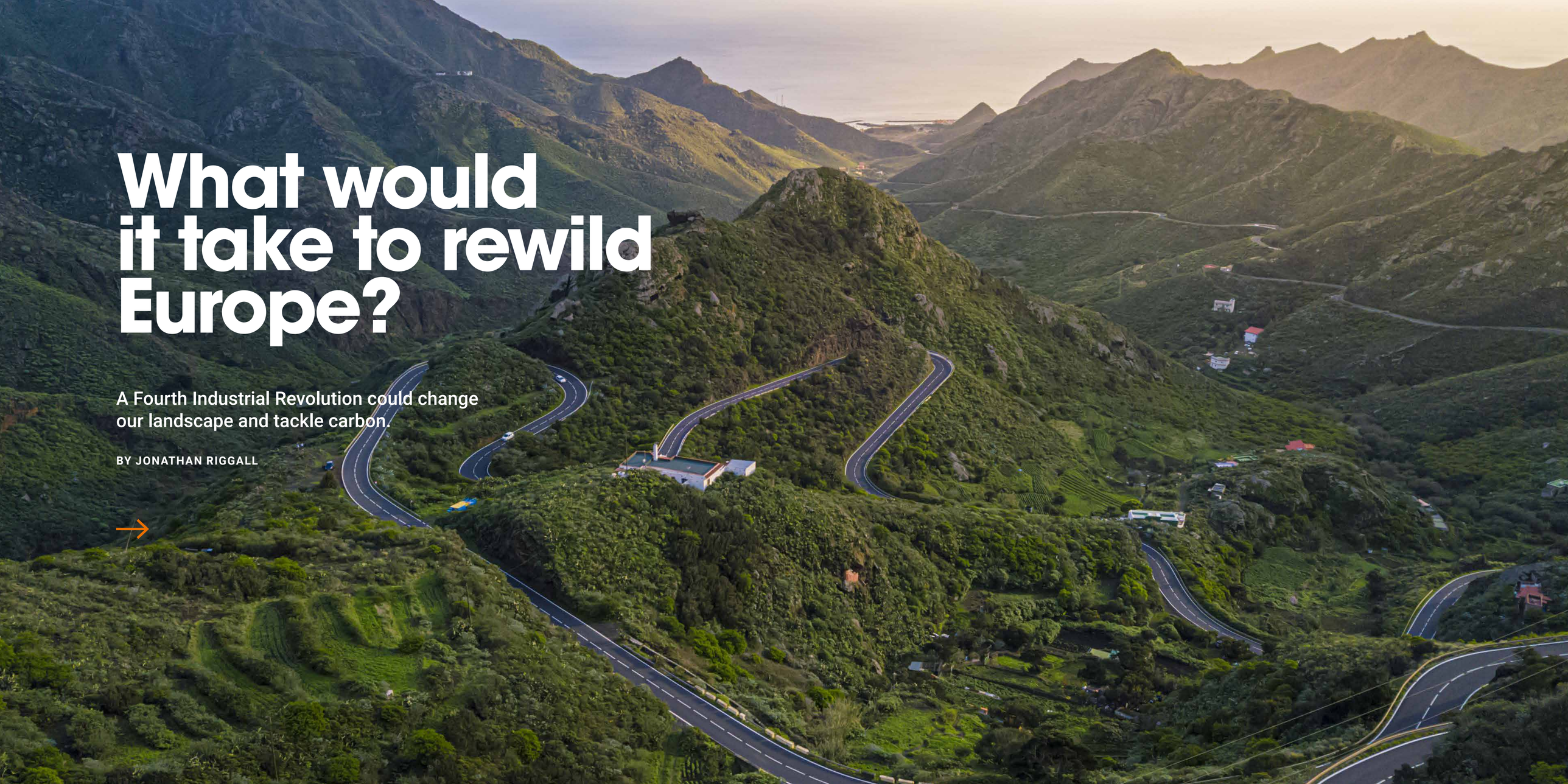
Kevin Arruda works on complex power projects from Stantec's Portland, ME office.

Discipline Leader **Rachel Bannon-Godfrey** leads Stantec's Buildings Sustainability team from our Denver, CO office. Her experience spans architectural design, building performance analysis, and sustainability consulting on high-performance and net-zero energy buildings across six countries and three continents.

What would it take to rewild Europe?

A Fourth Industrial Revolution could change our landscape and tackle carbon.

BY JONATHAN RIGGALL



Both Europe and the United Kingdom were once covered in dense forest. But for over 7,500 years, waves of technical and cultural revolutions have seen humankind exploit and remove the great European wildwood to meet, what Maslow describes as a basic physio-logical human need, food.

Nature and land use are clearly important variables in the geo-physical equation that defines global climate change. But how we go about feeding ourselves gets little airtime compared to other climate mitigation ‘fixes’ such as adopting renewable energy technologies.

AGRICULTURE + CLIMATE CHANGE
Greenhouse gas emissions and climate impacts of common agricultural practice

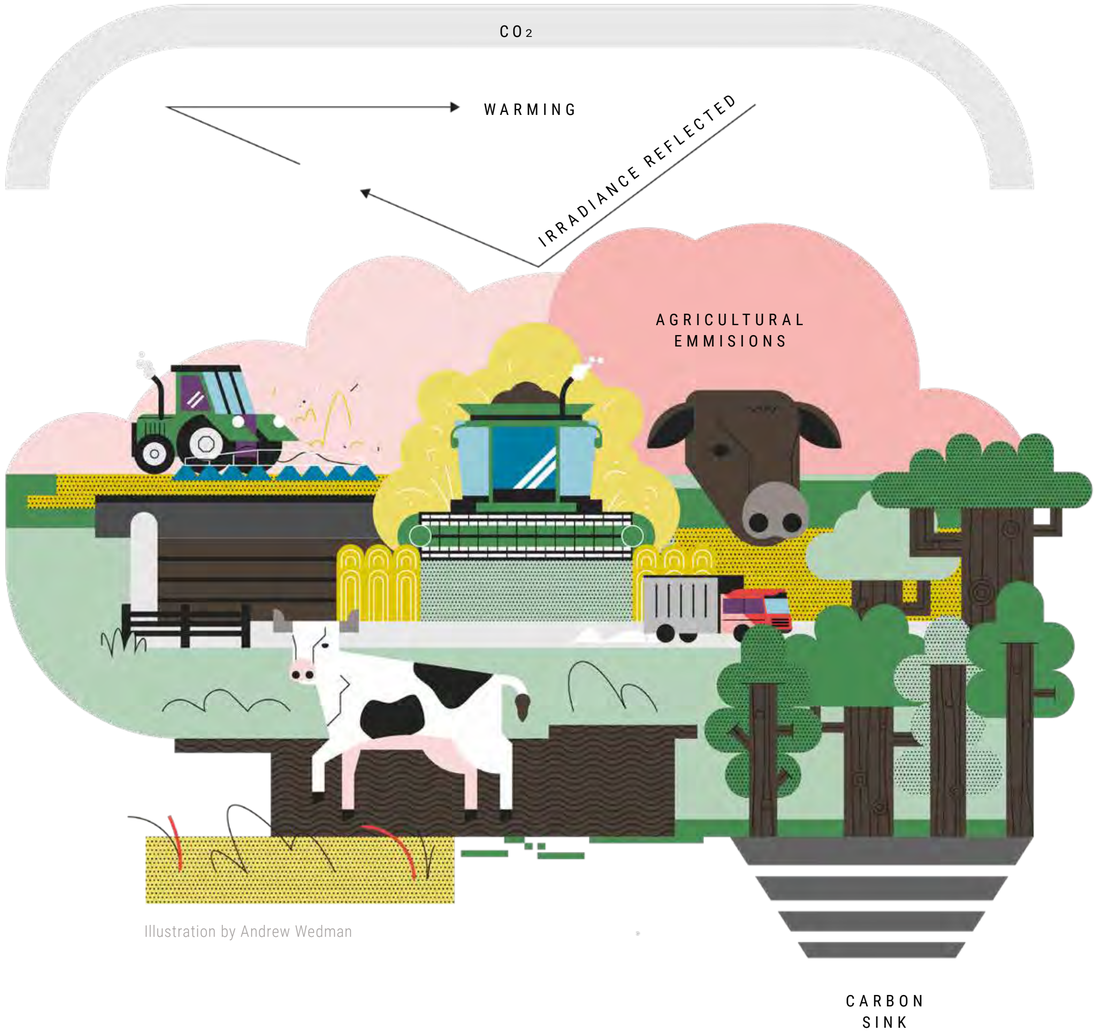


Illustration by Andrew Wedman

This is odd when we consider agriculture’s relationship to carbon emissions. More than 70% of the UK landmass is dedicated to agricultural use, contributing to around 40 million tons of the UK’s direct annual $CO_2(e)$ emissions. These figures don’t include the loss of the UK wildwood over the last 7,500 years which made way for food production. But a knee jerk reaction of planting trees across our agricultural landscape to compensate is not necessarily the answer. Especially considering we still need to eat.

To counter climate change on a grand scale, we need to start thinking big… and wild. What would happen if we could bring land, this vast space dedicated to agriculture, back to its previous state? Could we make it wildwood again? Could this wildwood be the giant carbon sink we need to rebalance carbon? To do that we must first find a solution to food production with zero carbon emissions. **>**

Agricultural Hyper-intensification: Vertical farming

Silently, the "Fourth Industrial Revolution" is underway and showing us just such an alternative possibility. Companies such as Fifth Season (operating in Pittsburgh, Pennsylvania), and Vertical Future (London, England) are using robotics, zero carbon energy, biosciences and automation to create vertical farms in our cities.

By doing so, they're also cutting food miles, creating food communities, and promoting localism while they feed people at affordable prices. These innovative urban farming ventures may be small, niche businesses at present, but they point to a possible future of food production that requires less land, a lot less. **>**

Illustration by Andrew Wedman

WHOLE SYSTEM THINKING
Integrating agriculture and urban greening to improve societal access to low carbon food production.

THE FUTURE BURGER

Robotic bakeries combine rapid short-rotation wheat farming, milling and baking into a single industrial process. Elimination of low density agricultural emissions, transport emissions and capture of lifecycle resources (heat, CO2) in the growing and manufacturing process.

Soilless tomato growing reduces water consumption and directs energy into quality and flavor.

Bioprinted beef patty reduces emissions from agriculture and increases food safety and quality.

Vertical green houses intensify space for lettuce production.

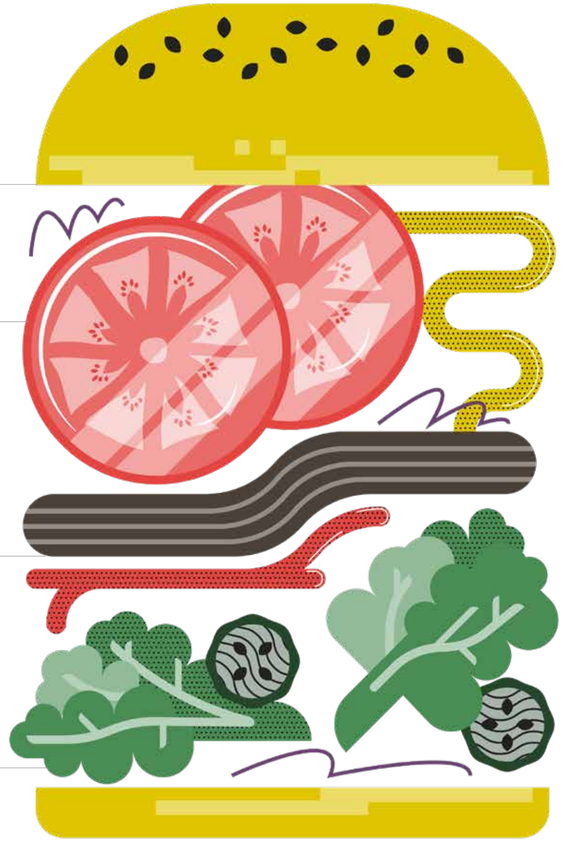


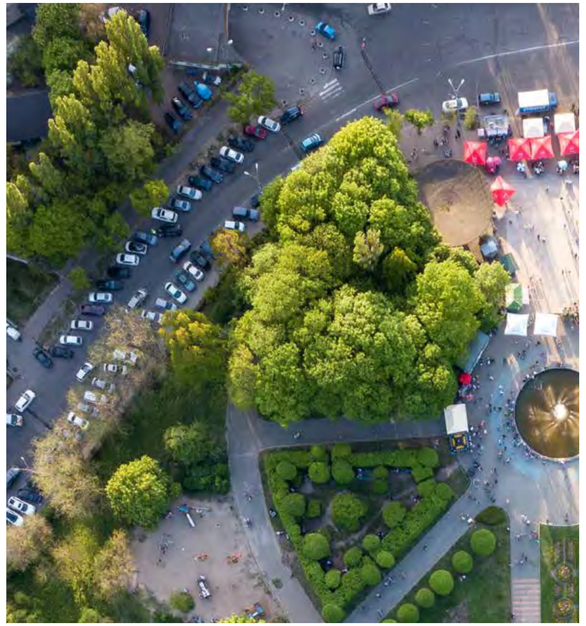
Illustration by Andrew Wedman

29%

of global GHG emissions are produced in the supply chain that takes food from farm to fork.

Coupled with innovation in biosynthesis, this revolution will potentially grow to include new, highly efficient methods of industrial food production including digitally printed meat substitutes and hyper industrialization of arable farming in ‘sheds.’ By concentrating food production in vertical structures in urban centers, we would purposefully engineer a shift in land use that would allow Europe, the UK, even North America to ‘rewild’ farmland and deliver nature based solutions to remove CO2 from the atmosphere.

Naturally, there will be ethical considerations to this transformation and a need for public guidance and assurance on meat substitutes, genetically modified crops and other aspects of industrial food production. But ultimately, the vertical farming approach has great potential to feed us and turn around the planet’s carbon-related prospects. **>**



The urban biosphere

A future that sees whole continents rewild presents a really interesting urban design challenge. In the UK urban areas typically create a frontline against greenfield farmland. If this greenfield farmland was restored to wildwood, how would our towns and cities respond to a new frontline of parklands and forests?

The speed of change becomes an interesting challenge, too. In the UK, experts suggest that a mixed woodland requires 30 to 50 years to establish itself. It takes around eight to ten years to see the positive effects of rewilding. After around 20 years of rewilding/reclamation at Oostvaardersplassen Reserve in Holland, for example, it was declared a wetland of international importance for nature. We can, on the other hand, transform urban areas for food production fairly rapidly. To plan, design and coordinate for this transformation remains for us to solve. We've previously looked at how this urban environmental adaptation can be supported through *digitally twinning nature*. There is an opportunity, however, to get a head start by under-standing the existing urban biosphere and planning for a better one. .

Urban lungs

Today, we associate dense urban environments with smog, respiratory illness and air quality issues. As we build a better under-standing of how urban environments function through data, however, we are in the position to design nature into these settings. If rewilding can turn rural areas into a carbon sink, we can experiment with similar big ideas to mitigate the carbon output from dense cities. **>**

A NEW URBAN BIOSPHERE

1. A new urban biosphere
2. Roof gardens and hanging gardens
3. Woodland parks in lost spaces between buildings
4. Rooftop leisure with verdant fringe
5. Tree-lined avenues

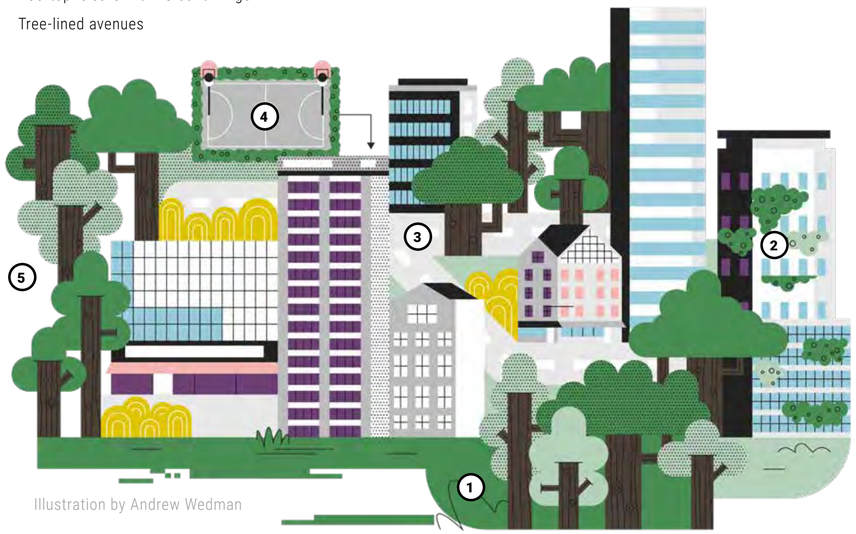


Illustration by Andrew Wedman

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MORE SUSTAINABILITY

Based in the Reading, UK Stantec office with a diverse background in environmental impact, carbon management, and sustainability advisory Energy and Natural Resources Director Jonathan Riggall works across a range of sectors.

Sky gardens, vertical farming, and artificial air scrubbing are all part of a new urban biosphere that can improve quality of life, reduce emissions, and support our planet's ecosystems.

Could we even create buildings that act as urban lungs? Picture a highly vegetated building that is technologically advanced and acts as the lungs for the city, pumping in air, removing particulates, capturing carbon, and releasing cleaner air.

CURRENT GLOBAL FOOD SYSTEMS IMPACT ON THE PLANET

(All data UN Food Systems Summit)

FOOD WASTE

35%

of all food produced per year is wasted. 1b tons = $936 billion

ENVIRONMENTAL IMPACT

80%

Food production accounts for 80% biodiversity loss, 80% of deforestation, and 70% of all freshwater use.

AGRICULTURE & FOOD

$2.4T

Global Value.

JOBS

1.5B

Roughly 18% of the world's population works in agriculture.

Blurring the boundary with nature

Could extensive rewilding of the UK's currently intensively farmed 'greenfield' land coupled with the adoption of urban biosphere principles become core to urban design and placemaking of our cities and towns? With soil-less urban farming, vertical forests and vertical agriculture integrated with buildings, can we blur the boundaries between rewilded countryside and urban biospheres? Could the urban-greenfield frontline be softened, such that eventually we return to humans living within nature, rather than humans versus nature? D

Aerial-view of Community Gardens

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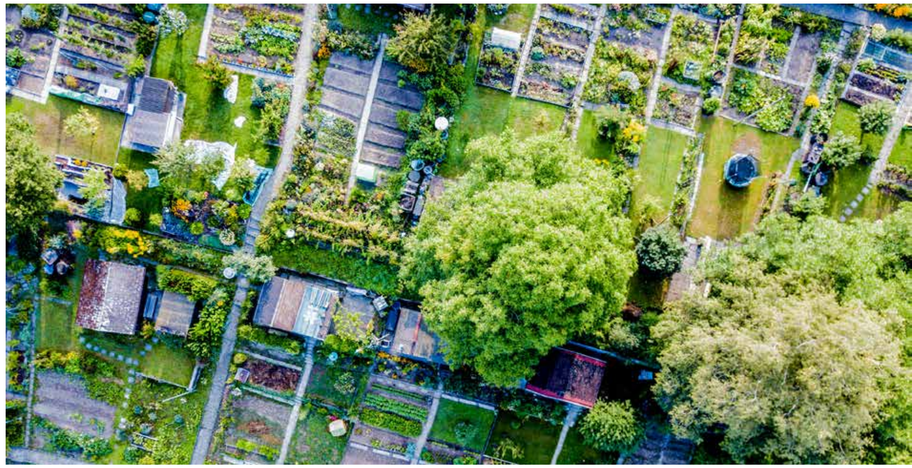

The BEAT
Dorchester, Massachusetts

8 REASONS TO CONSIDER ADAPTIVE REUSE & RETROFITTING

Reducing your building's carbon footprint and saving money are just the beginning.

BY BLAKE JACKSON AND CYRUS JEEJEEBHOY

51 Division Police Station
Toronto, ON

To reach Net Zero Carbon, we're going to have to design new buildings with carbon appetites (embodied and operational) of slim to none. But before we build another building, there's one carbon-reducing practice that's worth trying for many clients—taking a serious look at existing buildings.

Broadly speaking, when one takes life cycle and embodied carbon into account, there's nothing greener than a building that already exists. Even for those still getting up to speed on carbon and climate change, there are good reasons to look at existing buildings.

REASON 1

EMBODIED CARBON & WASTE

→

The BEAT
Dorchester, Massachusetts

Architecture 2030 research shows the Building Materials and Construction Sector represents 39% of total global greenhouse gas emissions. That 39% breaks down into operational emissions (heating, cooling and lighting buildings) comprising 28% and embodied carbon emissions in the materials themselves contributing the other 11%. The reuse of existing buildings offers an immense opportunity to curb these emissions by prolonging the useful life of materials, already in place, especially those with long-life durability and high embodied energy, such as steel, concrete, etc. The BEAT (a reuse of the former Boston Globe building in Dorchester, MA) incorporates existing structure and envelope elements into the updated structure to allow these materials to continue to store their embodied carbon in place without the need for new virgin materials and their associated embodied emissions, while also curbing landfill waste. >

REASON 2

BUDGET

815 CONNECTICUT AVE
Washington, DC

Demolishing a building is rarely cheap. And quite a lot can be done with retrofitting and reuse on a budget. For some clients, choosing re-use and retrofitting is fiscally wise. If energy costs are skyrocketing for a building operator, there is an incentive to reduce the operational budget by investing in efficient systems upgrades, especially if energy systems are nearing the end of their lifecycle. Advances in digital technology mean we can quickly model the payback time for these upgrades against business-as-usual energy usage to make this an informed decision.

Just how efficient can we make a retrofitted building? We recently undertook a renovation project for a mothballed facility in the Greater Toronto Area from the late 1980s/early 1990s with out-of-date building systems. While mothballed, the facility's lighting had been shut off and the temperature set back to minimum levels. As part of the reactivation we designed and implemented extensive energy upgrades for the facility. Due to the energy upgrades completed, the client noticed only a small uptick in energy consumption for its facility when it went from mothballed to reactivated. >

REASON 3

SMART LAND USE PLANNING

Reusing existing buildings alleviates demands on new land development, particularly that of greenfield, or previously undeveloped sites. Existing buildings already have sewer, utility, and transportation infrastructure connections to the broader community, greatly lowering infrastructure costs. They also offer an imaginative opportunity to enhance their surrounding community with improved access-ibility in and around their sites. The BEAT is an example whereby new public through-passages connect communities around the facility to newly programmed cafes, new green space, new bike lanes and more direct/desirable pedestrian pathways to the existing multimodal transportation hub. The project has even taken over stewardship of the adjacent Pattens Cove conservation land, proving these upgrades can and should enhance the community in which they exist. >

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Confidential
Technology Client
Chicago, IL

REASON 4

CONTINUING OPERATIONS

If a major renovation or replacement isn't possible, many operators prefer that their buildings continue operating while they undertake significant upgrades. Some building types (hospitals, clinics, recreation centers, civic buildings, residential buildings with a social housing component) must remain operational as much as possible, even during a major renovation. Thus, it becomes important to strategize phased renovations and retrofitting to allow for continuing operations.

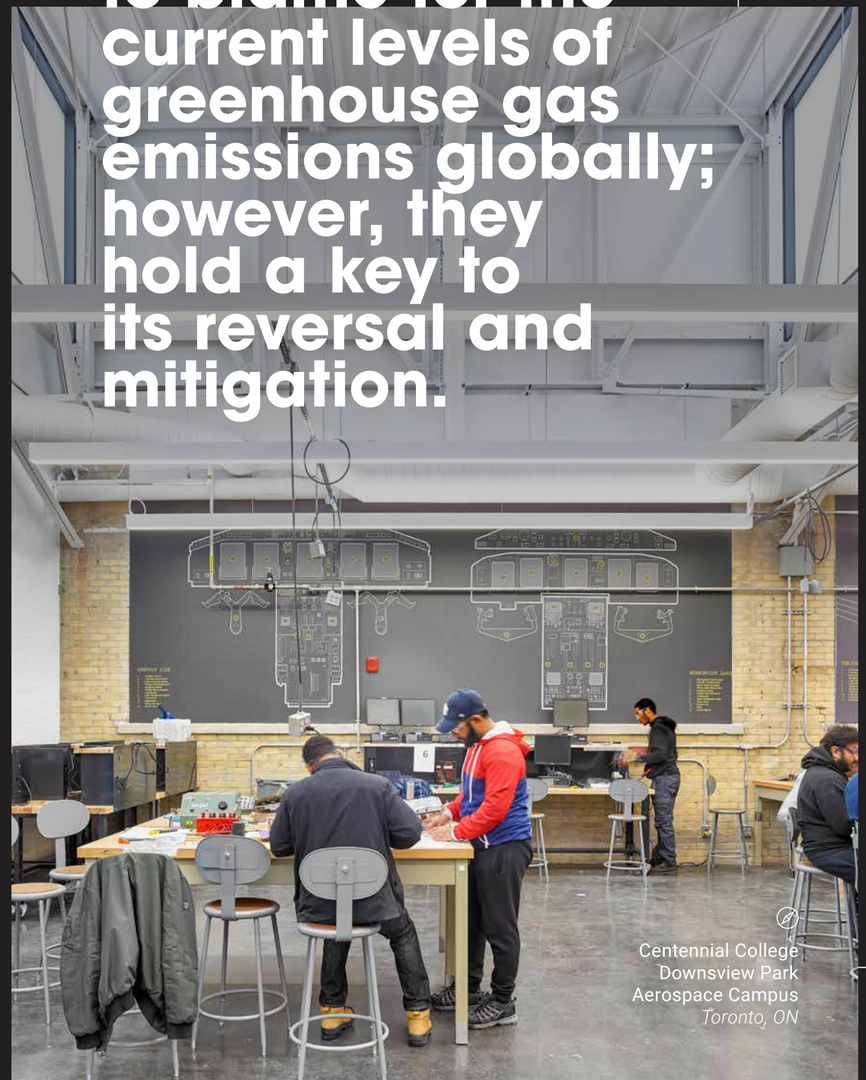
In these piecemeal renovations, integrated asset management comes into play. By wisely scheduling the replacement of related or adjacent components. For example, if it's time to replace a building's roof, it makes sense to replace your rooftop HVAC equipment at the same time to get the best value for your money and time. >

REASON 5

UTILITY EFFICIENCY, ACCESSABILITY & RESILIENCY

For North American municipalities to hit their 2050 carbon reduction targets, existing buildings will have to be rethought, in conjunction with ultra-efficient new construction. Existing buildings are only partly to blame for the current levels of greenhouse gas emissions globally; however, they hold a key to its reversal and mitigation. When we reimagine existing buildings for new uses, it will trigger the need for compliance with modern codes. This offers an opportunity for us to enhance energy efficiency through architectural and mechanical upgrades, enhance water efficiency through upgrading plumbing fixtures and water-using equipment, enhance resiliency through hardening and raising critical equipment and program in floodprone areas, and enhance equity through accessibility upgrades that promote universal access.

Existing buildings are only partly to blame for the current levels of greenhouse gas emissions globally; however, they hold a key to its reversal and mitigation.



Centennial College
Downsview Park
Aerospace Campus
Toronto, ON

REASON 6

PHASED RENOVATIONS

Practically minded, budget conscious clients can plan renovations over multiple budget cycles to slowly transform their building. The phased approach allows organizations to spread their capital investments out over time. For example, Seneca College's phased renovations have focused on certain priority areas within the building for modernization and repurposing, while undertaking a phased retrofit of lighting, HVAC, and interiors over several years to stay within budget. For the most recent phase, the college replaced its conventional chillers and boilers with a geothermal exchange system, which stores waste heat from the chiller in the ground and pulls it out in the winter to offset heating load of the building. Converting to the geoexchange system significantly decreased the GHG emissions associated with building operations. >

REASON 7

MEMORY, URBAN FABRIC CONTINUITY & CREATIVE JUXTAPOSITION

Existing buildings play a vital role in the history of a place and the memory of its people; thus, their preservation is more than just the retainage of its physical form; it is equally the retainage of the collective memories, experiences and events of the community. When we think of preservation, we often think of “very” old buildings, and/or historically significant structures. But all buildings deserve a second (or third) chance. Bridgepoint Active Health in Toronto is designed to maximize connections between the hospital and its community, the city, and with nature. A former jail, originally constructed in 1864, is restored and re-purposed as the hospital’s administrative center. A variety of jail cells, gallows and a central rotunda were preserved, restored, and made publicly accessible for the first time. Interpretive plaques outline the history of the jail and site and demonstrate how the campus has transformed from a place of isolation and incarceration to a place of healing and rehabilitation. >

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Bridgepoint Active Healthcare Redevelopment
Toronto, ON
Joint Venture: KPMB

REASON 8

TAX CREDITS & INCENTIVES

Where buildings do exhibit historic significance, depending on the location, they can generate very generous tax credits when adapted for modern use, given their historic attributes are maintained, to incentivize developers to take on the risks of their redevelopment. Often, this is the only way such buildings achieve economic viability. case in point, the Nursing Education Center in Providence, RI—a project whereby Stantec provided LEED consultation —was one such project whereby 50% of the investment became secured through available historic tax credits, which transformed the ruins of the historically protected former Narragansett Electric Lighting Company building into a modern nursing education facility for three local institutions of higher learning.

Government incentives make renovations and retrofitting for energy efficiency more palatable to clients. On a recent renovation at Toronto Pearson International Airport, our client was able to tap into government incentives for energy efficiency to stretch its renovation budget further and accomplish more. This is in addition to the substantial long-term energy and cost savings the project is designed to achieve.

While most of us think of renovation as messy and slow, there are many benefits to reap. Before you embark on your next new building project, consider adaptive reuse and retrofitting first—the benefits to you, the community, and our planet are worth a second thought. D

Toronto Pearson International Airport
Toronto, Ontario

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MORE RETROFITTING

Based in Stantec Boston, Sustainability Design Leader **Blake Jackson** speaks Fitwel, WELL, and LEED certifications fluently and brings a passion for stewardship and a holistic approach to carbon reduction in buildings to every project. Professional Engineer **Cyrus Jeejeebhoy** is the team leader for Stantec's Building Performance team in the Greater Toronto Area and Southwestern Ontario. Cyrus helps clients develop customized solutions for their energy management needs.

Midtown District Plan, Confidential client
New York, NY

FINAL THOUGHT

Designing a car-lite future

What the pandemic has taught us about city streets, vehicle emissions, and public space

BY APRIL SCHNEIDER

Stay-at-home orders during COVID-19 have led to at least one welcome side effect: cities around the world saw dramatic decreases in traffic. As cities work toward carbon emissions reduction goals (80% reduction by 2050 in New York, carbon neutral by 2050 in Los Angeles and Boston), they will need to effect substantial change within the transportation sector.

Transportation is responsible for nearly 30% of carbon emissions in the US, and passenger vehicles account for more than half of those emissions. However, the COVID-19 pandemic has also allowed us to imagine–more vividly than ever–a car-lite future. What COVID has shown us is that without traffic, city streets are *nice*–and that has big implications for livability, sustainability, and carbon emissions.

What does fewer cars give us?

Cleaner air
Photos from around the world showed Los Angeles, Beijing, and New York without the ever-present layer of smog.

Quiet
People in New York were taking videos of birds singing, having never been able to hear them before.

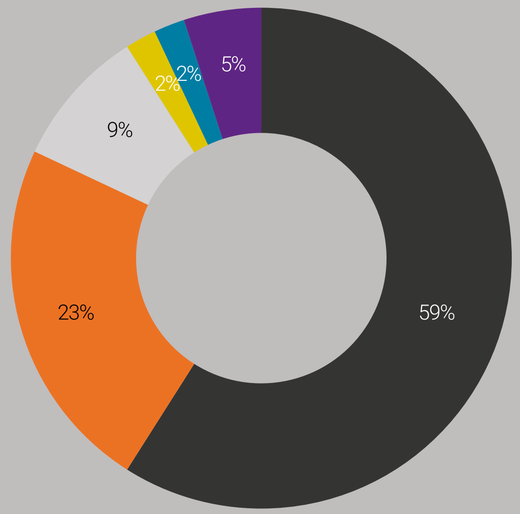
Space
Formally and informally, people were taking back streets to jog, play, sit, and dine.

Cooler streets
Heat waves aside, fewer cars means less waste heat from engines.

Safe micromobility
Feeling safer, more people were riding bikes and walking for transportation in the city.

Less carbon
To achieve a 5% reduction in carbon emissions from vehicles in New York City, we must reduce vehicle miles traveled by nearly 250 million miles. >

Global Greenhouse Gas Emissions Transportation Sector



- Light-Duty Vehicles
- Medium- and Heavy-Duty Trucks
- Aircraft
- Rail
- Ships & Boats
- All Other Transportation Sources

SOURCE: *EPA.GOV "US Transportation Sector Greenhouse Gas Emissions 1990-2018"*

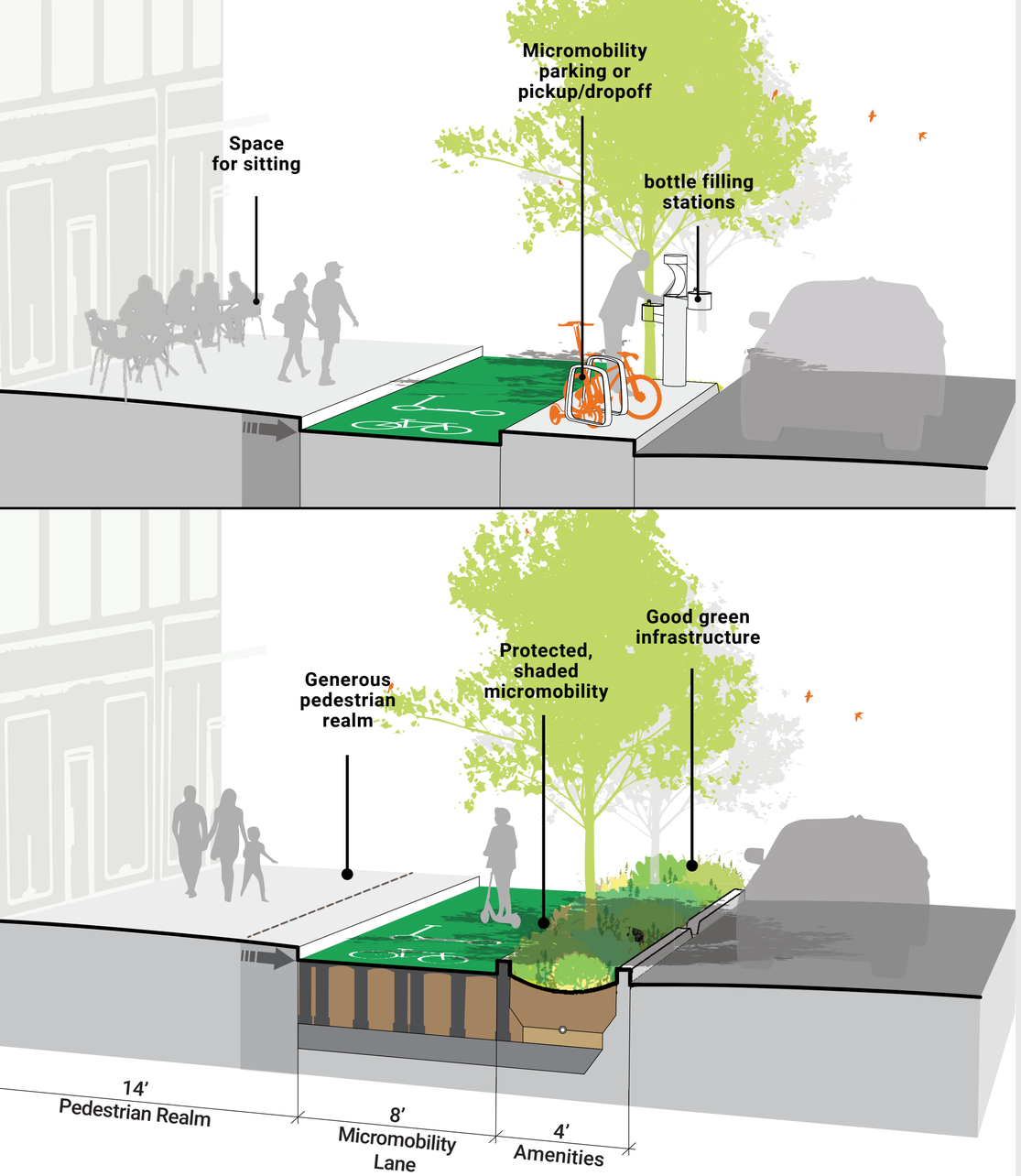
←

Birmington City Center Plan
Birmingham, Alabama

So how do we sustain this new paradigm in cities that are not on stay-at-home orders, and what is our role as designers in that future?

Design for the mode shift.
We need not wait for a big technology-driven transition such as wide adoption of electric vehicles to reduce carbon. We can shift modes–swapping cars for buses, bikes, or walking–which will help us achieve carbon reductions now and foster the pleasant street life we have seen over the last few months. But right now cities are designed around and for the car; to make mode shifts happen at the scale we need, we must prioritize other modes and make them the safest, most fun, most efficient, and most desirable way to move. This is exactly what we as engineers, planners, and designers can do for our cities. >

Downtown Revitalization
Elmira, New York



Designing for the mode shift.
By reallocating urban street space for non-car uses–pedestrian realm, micromobility, and green stormwater management–we facilitate the mode shifts that are necessary to meet carbon reduction goals.

Electrification is important, but not the panacea.

When discussing carbon and transportation, we must address electrification upfront. Vehicle electrification is an area of important investment right now; manufacturers are developing new electric models and charging stations are proliferating. A new MOU signed by 15 states in the Northeast seeks to advance electrification of trucks and buses. But while electric vehicles and a clean electric grid will reduce carbon emissions, we still have a basic geometry problem of too many cars that make our streets feel unpleasant and unsafe. Shared mobility, whether it be electric or automated, is the future and we must work toward it through policy and design. Furthermore, electrification does not fully eliminate emissions as it relates to public health; particulates from brake pad and tire wear are equally responsible for the health problems that mushroom around congested highways and heavy traffic areas.

Invest in transit.

With transit ridership down across the US, transit agencies are facing critical revenue gaps. The tendency in many municipalities is to cut service to plug the hole, but that only serves to drive more people away from transit as it becomes inconvenient or unreliable. To increase ridership, decrease car dependence, and reduce carbon emissions, we need to invest in transit–buses, subways, rapid transit–not cut service. Transit has been essential to the ongoing functioning of our cities through this pandemic, with no clear evidence that it contributed to the spread of infection in New York or elsewhere. Many essential workers have relied on continued and reliable transit service; cutting service only serves to negatively impact the people who need it the most. Professionally, we can help our clients build the case for and justify investments, and personally we can advocate for change at local, state, and federal levels. >

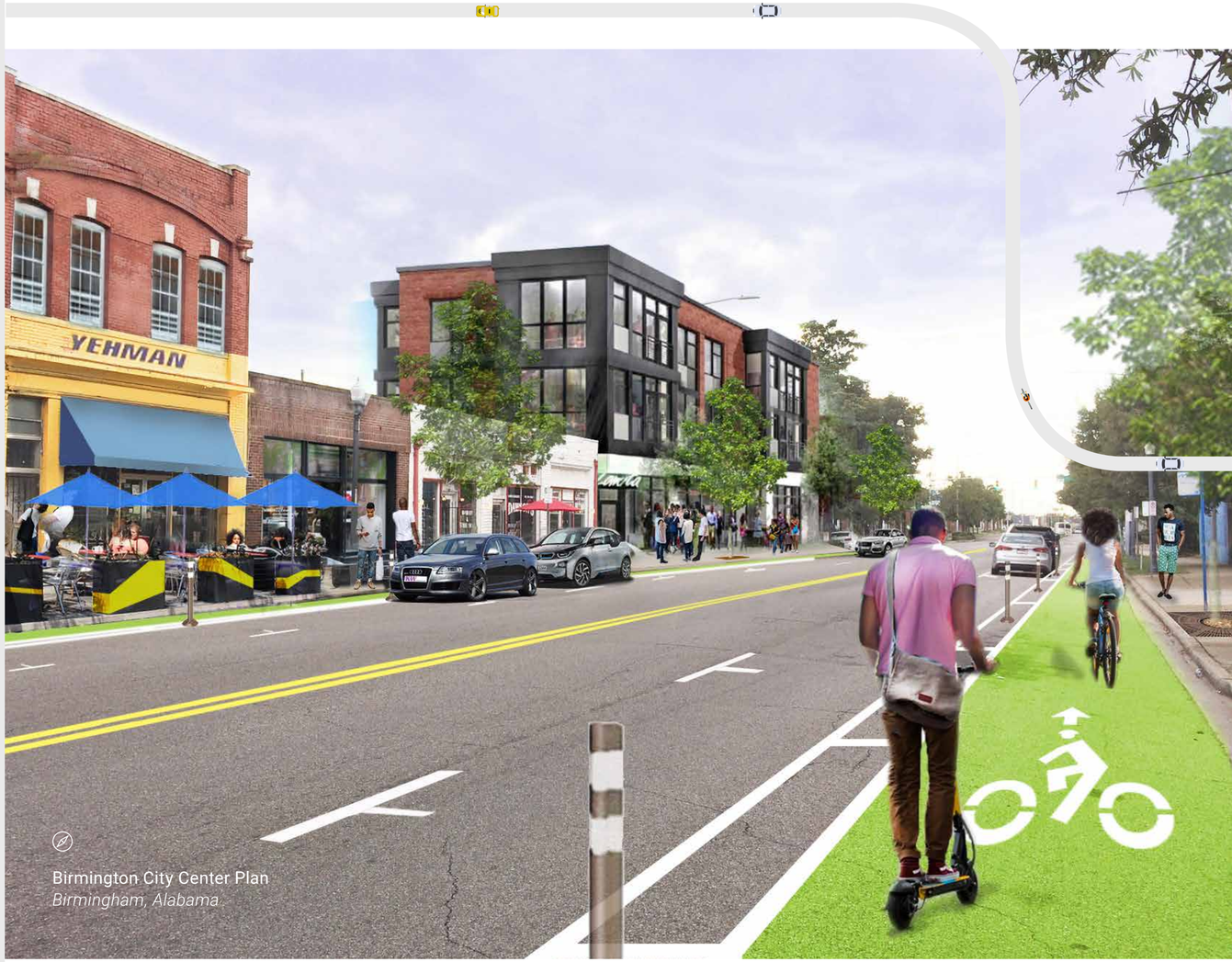
Design streets for the *car-lite, mobility-rich* future we can now easily imagine.

In addition to more and better transit, street design plays a significant role in mode shifting. American city streets from New York to Phoenix are designed primarily for vehicular throughput (level of service) at the peril and detriment of other modes. Wide travel lanes, intersection signals, and vehicle storage (i.e. parking) prioritize private vehicles and leave little room for rapid transit, bike lanes, and the pedestrian realm. And prioritizing cars also creates unsafe conditions for biking and walking, discouraging the use of these modes for people who would use them if they were safe. When we begin to view walking and biking as real transportation options, not just recreation, we begin to see the importance of reallocating street space to accommodate the mode shifts we need at the scale we need.

Space is one issue, but it is also about the experience. As engineers, planners, and designers, we have a role to play in creating an atmosphere that makes car-free modes not just feasible, but attractive and enjoyable as well. Everything from building facades and frontages to street trees and green infrastructure contributes to a public realm that will stimulate more carbon-free or carbon-lite options such as biking, walking, or other forms of micro-mobility.

Final thoughts.

The pandemic has been devastating for so many, especially our most vulnerable communities. We must use this tragedy to accelerate progress towards a better life for all. Part of our job as designers is to help our clients envision the future, and COVID-19 has given all of us a sneak peek at a future with fewer cars. It has also shown us how quickly we are capable of change. The challenge moving forward is to realize a new vision that takes cues from these lessons: walkable, bikeable, transit-rich cities as equitable cities. As resilient cities. As healthy and accessible cities. And this vision is as applicable to big, dense places as it is to small cities and suburbs. Many people fear a car-lite future because they feel it takes away their autonomy. But a car-lite, mobility-rich city is a place where more mobility options and nice, safe streets create true autonomy, equity, and freedom. D



Birmington City Center Plan
Birmingham, Alabama

MORE RESILIENT CITIES

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