FORESIGHT – 09
Climate & Energy

Low carbon solutions to power clean cities

FORESIGHT Climate & Energy
AUTUMN / WINTER 2019

PUBLISHER
FORESIGHT *Climate & Energy*

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CIRCULATION
15,000

PRINT
Stibo Printing Solutions

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FORESIGHT *Climate & Energy* is the essential read from Denmark on the global transition to a decarbonised energy economy — objective reporting on what really matters by expert journalists and writers. Read more at foresightdk.com/about

FORESIGHT *Climate & Energy*
ISSN 2446-094X
Noerrebrogade 45C
DK-2200 Copenhagen

FORESIGHT ONLINE
Website: foresightdk.com / Twitter: @foresightdk
Instagram: @foresightdk / Facebook: /foresightdk
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ENVIRONMENTALLY AWARE MAGAZINE PRODUCTION
Using paper from sustainably managed forests. Postal deliveries of single copies in a 100% biodegradable wrapper

Printed matter 5041 0004

FSC MIX Paper from responsible sources FSC® C012075

This printed matter is carbon compensated according to ClimateCalc.
Offsets purchased from: South Pole Carbon
www.climatecalc.eu
Cert. no. CC-000001/DK

WHY CITIES HOLD THE KEY TO A SUCCESSFUL ENERGY TRANSITION

Utopian thinking in an age of dystopian headlines

Since Metropolis, Fritz Lang's 1927 tour de force, cities of the future depicted by the film industry tend to be places few of us would choose to live.

In Metropolis, wealthy industrialists enjoy shiny skyscrapers and elevated roads and railways, while the untermensch workers toil below ground. Hollywood offers similarly dismal visions. In Blade Runner, Los Angles in 2019 (imagined in 1982) is a dark, violent place, while the post-apocalyptic dome-city of 2274 in Logan's Run keeps down resource consumption by killing off people once they reach the age of 30. In today's rapidly warming world, the most prescient film may be Soylent Green, a 1973 thriller, where the year is 2022 and water, food and housing are all in short supply.

Cities are significant consumers of energy and big emitters of greenhouse gases, responsible for global warming and dangerously poor air quality. By the end of the century, few cities will be safe from the risks of deadly heatwaves, flooding and overcrowding. But while dystopia may not seem too far away, there is an alternative, more utopian scenario that increasingly seems possible as cities the world over position themselves as energy transition leaders with or without national support.

While urban density causes many problems, lots of people living closely together also makes it relatively easy to implement solutions through building renovation, improved infrastructure and planning, and better and cleaner transport links. Cities big and small are declaring climate crises, signing into law dates by which they will outlaw fossil fuel vehicles or make buildings energy efficient, and optimistically declaring when they plan to become carbon neutral.

But this is not enough to avoid climate and societal chaos. In a ranking of nearly 600 cities by environmental disclosure platform CDP, only 43 were awarded full marks for climate mitigation, adaptation and tracking of emissions.

How cities will fund their clean energy transition needs sorting out given that most taxes and other revenue sources generally go into the national coffers. Many cities are getting creative on climate financing. Best practice needs identifying and repeating elsewhere. All residents, including the poorest and most vulnerable, have to be involved in projects and decisions related to ditching fossil fuels in favour of renewables and greater efficiency. Research and experience both demonstrate how inclusive measures and actions help accelerate the energy transition and climate action in cities.

Cities hold the key to a successful clean energy transformation. Striving for utopia, rather than allowing urban living to become synonymous with dystopia, is a big step to avoiding climate catastrophe. It will also improve the overall resilience and health of cities and their inhabitants.

Philippa Nuttall Jones
EDITOR-IN-CHIEF

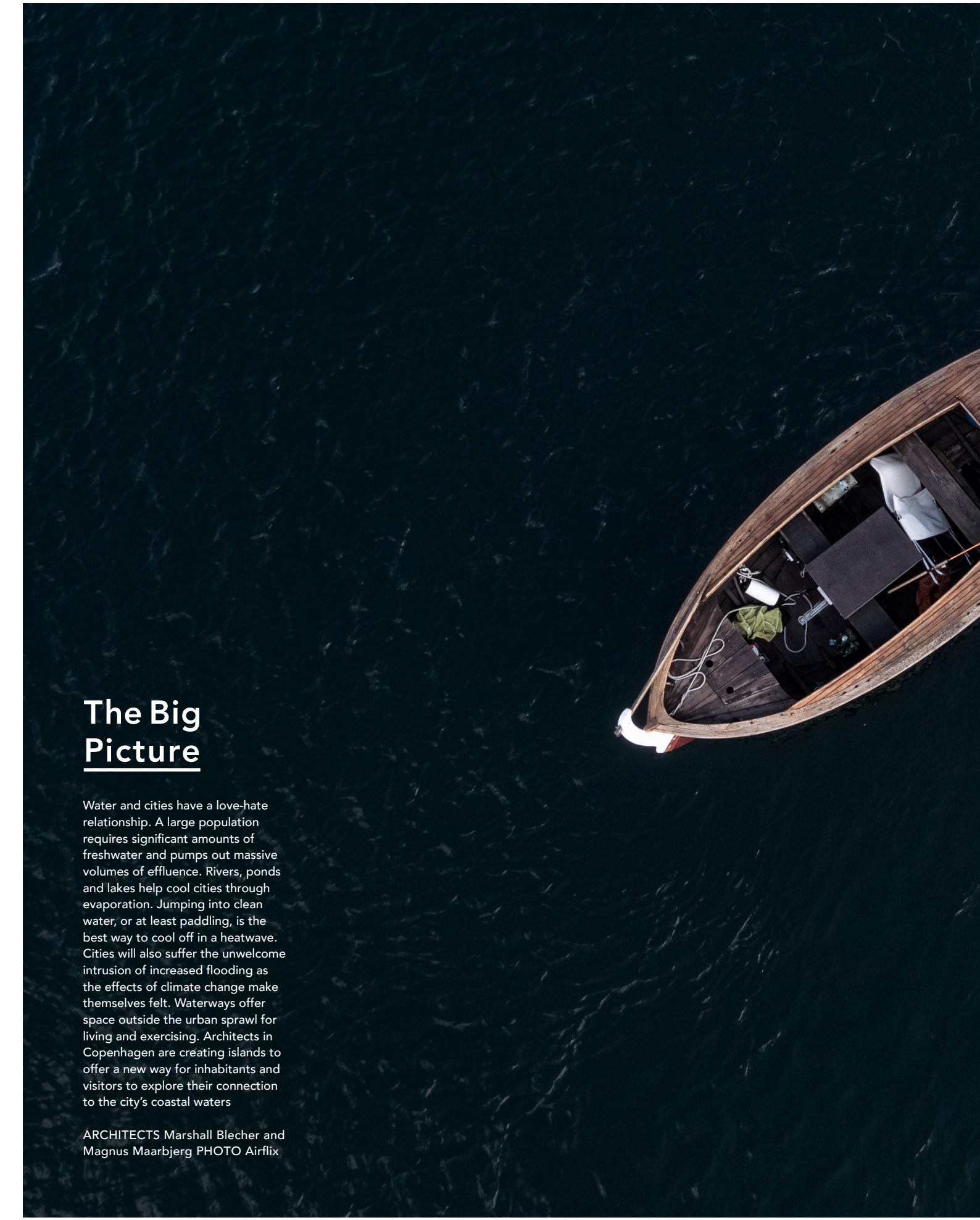
FINANCE

BUILDINGS

TRANSPORT

CARBON NEUTRAL

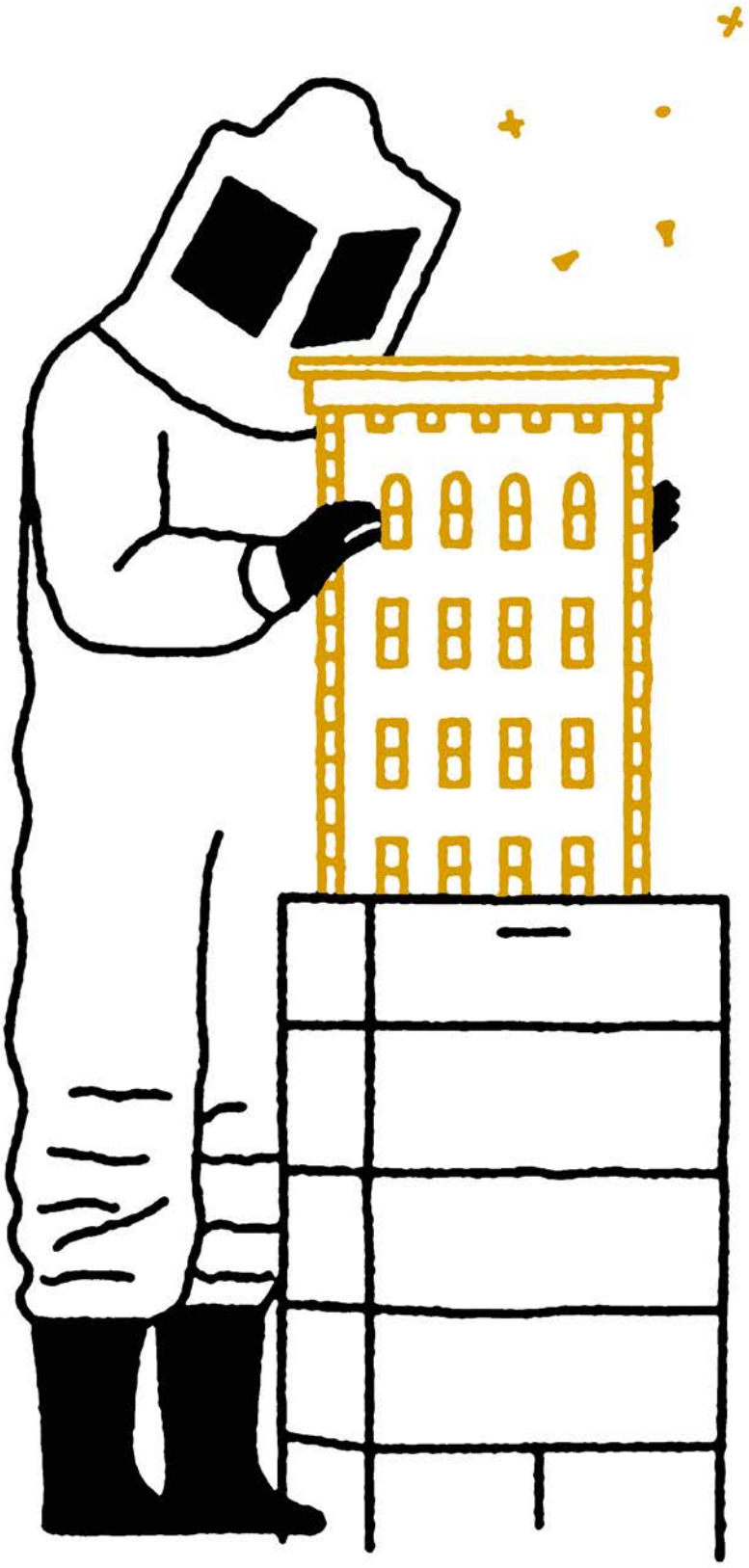
JUST TRANSITION



The Big Picture

Water and cities have a love-hate relationship. A large population requires significant amounts of freshwater and pumps out massive volumes of effluence. Rivers, ponds and lakes help cool cities through evaporation. Jumping into clean water, or at least paddling, is the best way to cool off in a heatwave. Cities will also suffer the unwelcome intrusion of increased flooding as the effects of climate change make themselves felt. Waterways offer space outside the urban sprawl for living and exercising. Architects in Copenhagen are creating islands to offer a new way for inhabitants and visitors to explore their connection to the city's coastal waters

ARCHITECTS Marshall Blecher and Magnus Maarbjerg PHOTO Airflix



TEXT Sonja van Renssen ILLUSTRATION Pablo Amargo PHOTO Joel de Vriend

Cities are exploring private and public options to help them develop and finance the sustainable infrastructure projects needed to lead the way to net zero emissions

CITIES GET CREATIVE ON CLIMATE FINANCING

Cities consume more than two-thirds of the world's energy and account for about three-quarters of global carbon dioxide (CO_2) emissions. They house over half the world's population. More than a third of the EU 2020 emission reduction target will be delivered by cities. Cities can "make or break efforts to tackle climate change", said Kyra Appleby from non-profit environmental disclosure platform CDP in connection with the release on May 13, 2019 of the organisation's first ranking of action on climate change by cities.

Of nearly 600 cities in the ranking, just 43, or 7%, made it onto a prestigious "A-list" that effectively gives them full marks for climate mitigation, adaptation and tracking of emissions. Top scorers included London, Athens, The Hague, Calgary, Cape Town, Melbourne, several Chinese cities and a longer list of American cities. CDP used the occasion to issue a call to action to cities worldwide: they are "more important than ever" because national climate plans currently put the world on track to about 3°C of warming, twice the 1.5°C limit agreed in Paris.

BIG MONEY

But cities face a tough job. Energy Cities, a European association of local authorities, estimates a city will need between €1 billion and €3 billion to reach net zero emissions by 2050. Where this money will come from is far from clear. C40 is a network of close to 100 megacities committed to mitigating climate change and adapting to its consequences. The network represents over 700 million citizens and a quarter of the global economy. Yet even these leaders of the urban world face a "universal challenge" to access finance. Only one in five C40 cities can borrow from its national government and only one in four can issue municipal bonds.

External capital, such as development finance and private sector savings, will be essential for cities to see through their climate plans. Many of the more than 9000 cities that have joined the Global Covenant of Mayors for Climate & Energy have already committed to net zero emissions by 2050.

Helping cities turn their energy transition goals into bankable investment proposals is the aim of the C40 Cities Finance Facility (CFF), launched just days before the Paris climate agreement was signed in 2015. It is funded by the German, UK and US governments and supports projects from new cycling infrastructure in Bogotá, Colombia, to an electric bus corridor in Mexico City to local waterway management in eThekwini (Durban), South Africa, to cope with increasing flooding due to climate change.

An analysis by CFF, CDP and the Global Covenant

F ***CASH SHORTAGE:*** *Estimates suggest a city will need between €1 billion and €3 billion to reach net zero emissions by 2050.* ***FIVE FINANCING ACTIONS FOR MAYORS:*** *1. Learn from earlier economic transformations; 2. Map out and understand the institutional landscape; 3. Support experimentation and flexibility; 4. Accept there is no one-size-fits-all; 5. Think beyond individual projects.* ***WISE WORDS:*** *The world needs an institutional revolution to finance climate mitigation and adaptation.*

Learning by example

Green policy makers and leaders of environmental organisations are often called out for not practising what they preach, particularly by flying to conferences or remote holiday destinations. It is a lesson city authorities can learn from. By renovating public buildings like schools, offices and hospitals to reduce energy wasted, cities can walk the talk and showcase to citizens the wider benefits of climate action

The need to walk the talk is at the heart of the energy transition. Cities aiming to lead on carbon neutrality have the perfect opportunity to do just that by renovating their own building stock. Actions to reduce energy use in hospitals, schools and offices owned by local government authorities mean fewer greenhouse gas emissions and are a good way for cities to showcase the benefits of the energy transition for people's wallet, health and comfort. The World Green Buildings 2018 report cites a "lack of public awareness" as one of the main barriers to energy efficient construction and retrofits worldwide. By renovating public buildings and shouting loudly to citizens about the gains, ignorance is a problem that can be overcome.

Three building types — hospitals, schools and offices, many of which are owned by the public sector — account for nearly half of the total floor area of non-residential buildings in Europe. The vast majority need to be renovated to reduce their energy use in line with the goals of the Paris climate agreement and to meet city targets for carbon neutrality. Investing in building renovation also greatly improves the health, well-being and productivity of European citizens, says a study by the Buildings Performance Institute Europe (BPIE), a not-for-profit think tank.

The study finds that a "holistic people-centric renovation" of an office building can increase productivity by 12%. Across the 28 EU member states, that increase could be worth up to €500 billion. Students studying in schools with optimal indoor climate conditions achieve the same results two weeks faster than their peers stuck in buildings that are too hot or too cold. Indeed, optimal temperature, lighting, noise levels and air quality can improve students' academic performance by 2-8%. Similar gains are seen in hospitals. Patients' recovery time can be reduced by 10% by improving indoor environmental quality and by 11% by providing optimal lighting. In short, the average length of stay in hospitals (currently over a week) can be reduced by around a day with a societal benefit of nearly €50 billion, says BPIE. All are co-benefits of renovating buildings to reduce their energy consumption.

"There is a tremendous potential for greater investments in efficiency in public buildings — investments which are absolutely necessary to help solve the climate crisis — but those investments will at the same time deliver significant improvements to people's quality of life," says Mirella Vitale from Rockwool, a Denmark-headquartered company producing building insulation.

CROSS-FERTILISATION

Energy efficiency and its benefits all sound very good in theory, but as BPIE concludes, the impact of buildings on people's health, well-being and performance is not well-defined, measured or monetised. C40 Cities, a not-for-profit organisation, and Rockwool have together created a tool to help cities demonstrate the impact and benefits of renovating portfolios of public buildings in terms of cost, emissions reductions and job creation, and the kind of renovation most effective from a cost and wider benefits approach. C40's Honorine van den Broek d'Obrenan explains one benefit of the tool: "It is useful for different city departments, such as health, energy and environment, which usually do not communicate with each other," she says.

The need for experts with different competencies

F ***GOOD FOR THE HEAD:*** *Renovating an office building to reduce its carbon emissions can increase productivity by 12%.* ***GOOD FOR THE HEART:*** *The average length of stay in hospitals can be reduced by around a day with a societal benefit of nearly €50 billion if the building is renovated to reduce energy consumption.*

TEXT Philippa Nuttall Jones PHOTO Laura Stamer

Back to school
Nr. Vium Skole won the Danish renovation prize in 2017 for its reuse of materials and insulation measures. Designed by Erik Brandt Dam Architects, colours by Malene Bach

to work together to ensure the best energy efficient measures for new and old buildings is vital, agrees Susanne Dyrbøl, public affairs director at Rockwool. "For cities to be able to plan for and maximise the multiple benefits from energy renovation they need to increase cross-department cooperation. The social or health impacts of retrofitting public buildings are rarely given much thought by technical departments focused solely on energy savings."

In the US, the City Energy Project, a joint initiative of two non-profit organisations, the Institute for Market Transformation and the Natural Resources Defense Council, partnered with 20 local governments across the US from 2013–2018 to design locally appropriate energy efficiency policies and programmes. A report published at the end of the project agrees that action aimed at reducing the energy consumed by municipal buildings benefits the city's government, residents and businesses. "In the short term, it showcases city leadership and a city's buy-in to the actions that are or will be requested of the private sector," it states. And in the longer term: "Actions taken by the city in its own buildings lay the groundwork for moving the entire community towards a more energy-efficient future."

PRIVATE INVESTMENT

Influencing the private sector is important for two reasons. First, the private sector needs to carry out the same renovations in its own buildings; seeing policy makers act first is no bad thing. Second, while some renovation in public buildings will be carried out with public sector support, in many cases there is an opportunity for the private sector to step in with investment.

The City Energy Project identifies three financing options for renovating buildings in cities. First, self-funding by the cities themselves. Second, via a revolving loan fund, a pool of capital from which loans are made and to which the loan repayments are returned and lent out again. Third, through energy savings performance contracts or guaranteed energy savings contracts where the costs are paid for by the guaranteed savings realised from energy efficiency upgrades. An energy efficiency service company (ESCO) identifies a portfolio of cost-saving investments, guarantees the savings, and finances and manages the project. The project is repaid from the savings.

> "For cities to be able to plan for and maximise the multiple benefits from energy renovation they need to increase cross-department cooperation"

This third way involving an ESCO is increasingly being used by cities to ensure the renovation of public building projects at scale. It was the model followed by the US city of Atlanta to conduct investment grade energy audits and develop packages of energy conservation measures across city-owned buildings greater than 25,000 square feet (2320 square metres). University campuses, office buildings and air-

China continues to urbanise rapidly. Buildings are now the fastest growing source of energy consumption and carbon emissions in the country. Capital city Beijing, one of 23 pioneering Chinese cities aiming to peak emissions by 2030, is leading action to reduce energy leaks and pollution from buildings

Beijing determined to slash energy use in buildings

Since the turn of the twentieth century China's cities have changed out of all recognition. Massive economic and population growth have led to the clearance of hutongs, traditional interlocking courtyard houses, to make way for soaring skyscrapers. The growth comes at a price, however. By 2016, China's building sector accounted for around 20% of the country's total primary energy consumption and 25% of its greenhouse gas emissions, with buildings in urban areas responsible for the lion's share.

Buildings are the fastest growing source of energy consumption and carbon emissions in China and could account for as much as 40% of total energy consumption in the next 15 years as the country continues to urbanise. In Beijing, buildings are already responsible for nearly 50% of total energy consumption. But change is on the way as cities work to stop the runaway energy consumption their growth has entailed.

The whole of China has experienced soaring economic growth and rapid urbanisation in recent years. The percentage of people living in urban areas increased from less than 20% in the late 1970s to nearly 60% by 2016, according to the China Statistics Yearbook. Urbanisation is set to continue with a further 255 million people expected to migrate to urban areas in the next 30 years. By 2030, over 70% of China's population will live in towns and cities, of which 173 are expected to contain more than one million inhabitants. A building boom accompanied the country's population growth, which has exploded to more than 1.4 billion out of a total world population heading for eight billion.

All these people need housing, offices, schools, hospitals, shops and much more. In 2001, the built area in China was 31.5 billion square metres (m2). By 2016 it had reached 58 billion m2, an eye-watering increase equivalent to adding 53 times New York's floor space. Even though China's infrastructure boom has lost some of its steam of late, annual new construc-

F ***CRAZY GROWTH:*** *Between 2001 and 2016, the equivalent of 53 times New York's floor space was constructed in China.* ***HEAVY BURDEN:*** *In the capital Beijing, buildings now consume nearly 50% of all energy used by the city after the departure from it of heavy industry.* ***CLIMATE ACTION:*** *Standards for energy efficiency in buildings have sparked 30 years of aggressive building renovation, with tens of millions of residential square metres being upgraded. The standards are getting tougher.* ***CLEAR GOAL:*** *Beijing's vision is to raise the performance of new buildings in the city to passive house standards, which consume no, or little, more energy than they produce.*

TEXT Philippa Nuttall Jones PHOTO Lui Chen

New York is the most populous city in the US and where it leads, others follow. Its decision to introduce the world's most ambitious legislation to force buildings to clean up and reduce their carbon emissions will send shockwaves far beyond the city's borders

NEW YORK LEGISLATES TO END ERA OF DIRTY BIG BUILDINGS

New York City (NYC), with its iconic Manhattan skyline, has passed the world's most far-reaching emissions legislation for existing large buildings. The plan is to cap carbon emissions and impose fines on laggards. Supporters of the law, which took effect on May, 17, 2019, hope it will become a model that can be exported to cities worldwide.

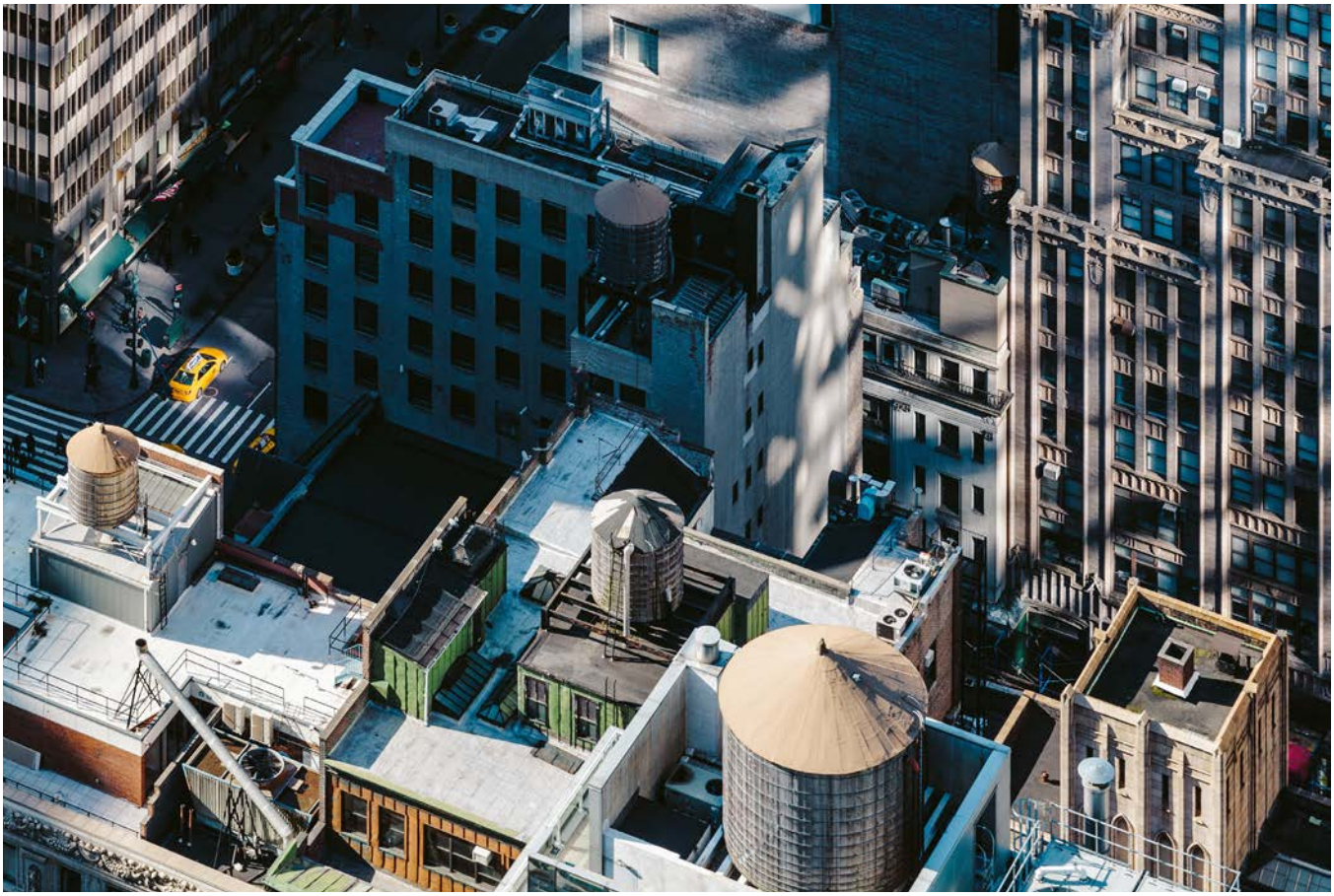
The ground-breaking dirty buildings law, more formally known as Local Law No 97 of 2019, is part of the city's Climate Mobilisation Act, a suite of ten bills that is a key anchor of the NYC Green New Deal and designed to help the city comply with the carbon dioxide reduction conditions of the Paris climate agreement. The new law requires owners of existing residential and commercial buildings of more than 25,000 square feet to cut aggregate emissions by 40% by 2030 and by 80% by 2050.

The law's benchmark year is 2005 so buildings that have already made strides towards modern energy efficiency get credit for their efforts. If they do not meet the caps, building owners will face significant annual fines starting in 2024. Fines will be $268 for each tonne of carbon dioxide (CO_2) emitted over a limit set according to ten categories of buildings.

"The era of dirty and inefficient buildings is nearing its end," says Mark Chambers, director of the mayor's office of sustainability. "Retrofitting buildings to make them cleaner reduces pollution, conserves energy and saves money." Costa Constantinides, the city council member who sponsored the bill, adds: "To real estate developers who think this is about setting up a new revenue stream, we don't want your money — we want your carbon." He continues: "Even though we have a reality TV actor in the White House, many of us live in the real world and realise the serious threats of climate change."

F ***AMBITIOUS:*** *New York's dirty buildings law requires owners of existing residential and commercial real estate of more than 25,000 square feet. (2323 square metres) to cut aggregate emissions by 40% by 2030 and by 80% by 2050.* ***FINES:*** *Building owners will face significant annual fines of $268 for each tonne of carbon dioxide emitted over the set limits if they fail to meet carbon reduction caps from 2024.*

TEXT Ros Davidson PHOTO Gianpaolo La Paglia / Ricardo Gomez Angel



Reaching for the skies
New York wants to lead the world in cleaning up emissions from large buildings

One high-profile backer of the law is the mayor of New York, Bill de Blasio, a Democrat running to replace Donald Trump in the White House in the 2020 election. De Blasio pulled no punches during a rally in May 2019 inside Trump Tower, a glitzy 58-storey skyscraper on Fifth Avenue in Manhattan and the site of Trump's private home and head office of his family's property empire. "These buildings are a big part of the problem and we're making it very clear — it doesn't matter who you are. Even the president of the US has to abide by the law of this city," said de Blasio.

The Trump Organization, which declined to comment, owns eight luxury skyscrapers in New York. The skyscrapers release about 27,000 tonnes of greenhouse gases yearly, equivalent to the emissions from 5800 cars, says de Blasio's office. The company could face $2.1 million in combined annual fines if it does not comply with the new law, the office says. The city has been calculating emissions from individual big buildings for several years.

NEXT LEVEL

In dense urban settings such as NYC, buildings account for as much of 70% of emissions from energy consumption including for heating and cooling. NYC, with a population of 8.6 million, produces more than 50 million tonnes of carbon dioxide a year, estimates the mayor's office.

The new law covers an estimated 50,000 buildings out of 1.1 million within the metropolitan area. An estimated 44% of the buildings impacted are residential and 42% are commercial, says the Urban Green Council, an NGO, and a key player in convening stakeholders and making proposals for the new law. Hospitals, houses of worship, public housing and buildings with one or more rent-controlled apartments are not subject to the same caps. Instead, they will have to implement lower-cost measures such as installing temperature controls on radiators and insulating pipes and windows.

The law is the world's most ambitious, says C40 Cities, a London-based NGO. Tokyo was first out of the gate in 2010 with a more-modest climate regulation for existing buildings. The Japanese city's mandatory caps on emissions only apply to some 1300 of the most energy-guzzling buildings, says Frankie Downy, programme manager for private building efficiency at C40. "Tokyo pioneered this sort of legis-

The bumpy road to urban electric buses

The negative impact of diesel buses on our health and the climate are increasingly well documented. Most research demonstrates that electric buses are better for both. But upfront costs and concerns about the technology are slowing the switch to electric

Travelling through a big city on an ageing, loud, vibrating, smelly diesel bus is not an encouraging experience for citizens considering the switch from private car to public transport. Electric buses are a different matter. They give a smooth passenger ride with virtually no noise and vibration, no noxious emissions and a better working environment for drivers. Shenzhen in China, with its full blown fleet of over 16,000 electric buses serving its population of 12 million, daily demonstrates the advantages.

Shenzen leads the world in the electrification of public road transport in urban environments, but a multitude of cities around the globe are involved in pilot projects that test the performance of different bus models and infrastructure as they consider ditching diesel. While the advantages of the switch from diesel to electric seem obvious, concerns about the maturity of battery and charging technology, up-front costs and an unwillingness in some cities to shake up the status quo mean electric buses are still not a familiar sight on urban streets.

The deployment of electric bus fleets improves the urban environment by removing harmful tailpipe emissions produced by diesel combustion and reduces climate changing carbon emissions. Battery electric cars emit fewer greenhouse gases (GHG) and air pollutants over their life cycle than petrol and diesel cars, says a report published by the European Environment Agency (EEA) in November 2018. Based on the current EU energy mix, GHG from electric vehicles are about 17-30% lower than those from petrol and diesel cars, it concludes. Fossil fuels were responsible for 43% of all gross electricity generation in the EU in 2016, with renewables supplying almost a third and nuclear energy contributing around a quarter. These figures are projected to swing in favour of low-carbon renewables, meaning the life-cycle emissions of a typical electric vehicle could be cut by at least 73% by 2050, adds the EEA.

The economic argument for switching from diesel to electric is also gaining strength, says Transport & Environment (T&E), a non-profit organisation based in Brussels. An electric bus travelling on average 200 kilometres (km) a day and charging overnight (rather than during a journey) is cheaper, over an eight year period, than a diesel bus, when health costs from air pollution and noise are included, says the organisation. Ignoring these external costs, an electric bus costs no more than a diesel bus once the average daily mileage is 250 km, it adds. The economic case for electric vehicles gets still more convincing when climate costs from GHG emissions are factored in.

T&E agrees the upfront costs of electric buses often remain prohibitive, with purchase prices typically twice the cost of a regular diesel bus. It insists, however, that: "These higher capital costs are mitigated by much lower operational costs." Electricity is cheaper than imported fossil fuels and uses energy more efficiently — vehicles powered by electricity travel 2.5 times further than vehicles with internal combustion engines for the same energy input. Bloomberg New Energy Finance forecasts that costs for e-buses will fall as battery prices drop by 9-12% annually, on average, from 2016 to 2030, depending on demand in the European market. The decrease is equivalent to a 75-83% drop in the cost per kilowatt hour (kWh).

EU ELECTRIC PUSH

Europe is trying to push demand for e-buses with its Clean Vehicles Directive that introduces fixed quotas for the procurement of emissions-free public trans-

CLEANER: *Cities are encouraging a switch to electric buses, which are cleaner at the tailpipe and produce fewer emissions over their life cycle than those that burn diesel. But they remain more expensive to buy and are too often charged with electricity from fossil fuels.* ***REAL COST:*** *Over an operating span of eight years, electric buses become cheaper than their diesel counterparts once the cost of health and climate damage is factored in.* ***KEY FIGURE:*** *Battery prices for electric buses are forecast to decrease by 9-12% annually from 2016 to 2030 in Europe, a 75-83% drop in the cost per kilowatt hour.*

TEXT Sara Knight ILLUSTRATION Pablo Amargo

months the source for over 80% of supply will be biomass. Energy producers have signed a declaration that all biomass used is sustainable and the claim will be audited, says Abildgaard. It will mainly be wood chips or pellets from forest thinning, timber from sustainable forest management, or residues from wood products. “If we use something else, we ensure new trees are replanted,” says Abildgaard.

The remaining 20% of the fuel for district heating will mainly come from waste combustion, which because it includes plastic is not entirely free of fossil fuel. To reduce any climate impact, Abildgaard says the city is exploring how to reduce heating demand in peak periods to avoid the need for dirty power plants or to switch to a totally fossil-free source.

The next step could be to use large air-source heat pumps in district heating, powered by renewable electricity. If cheaper ways were found for storing wind and solar power, less biomass would be needed, too. Heat from geothermal sources could also be an option, if the cost of bringing it to the surface drops.

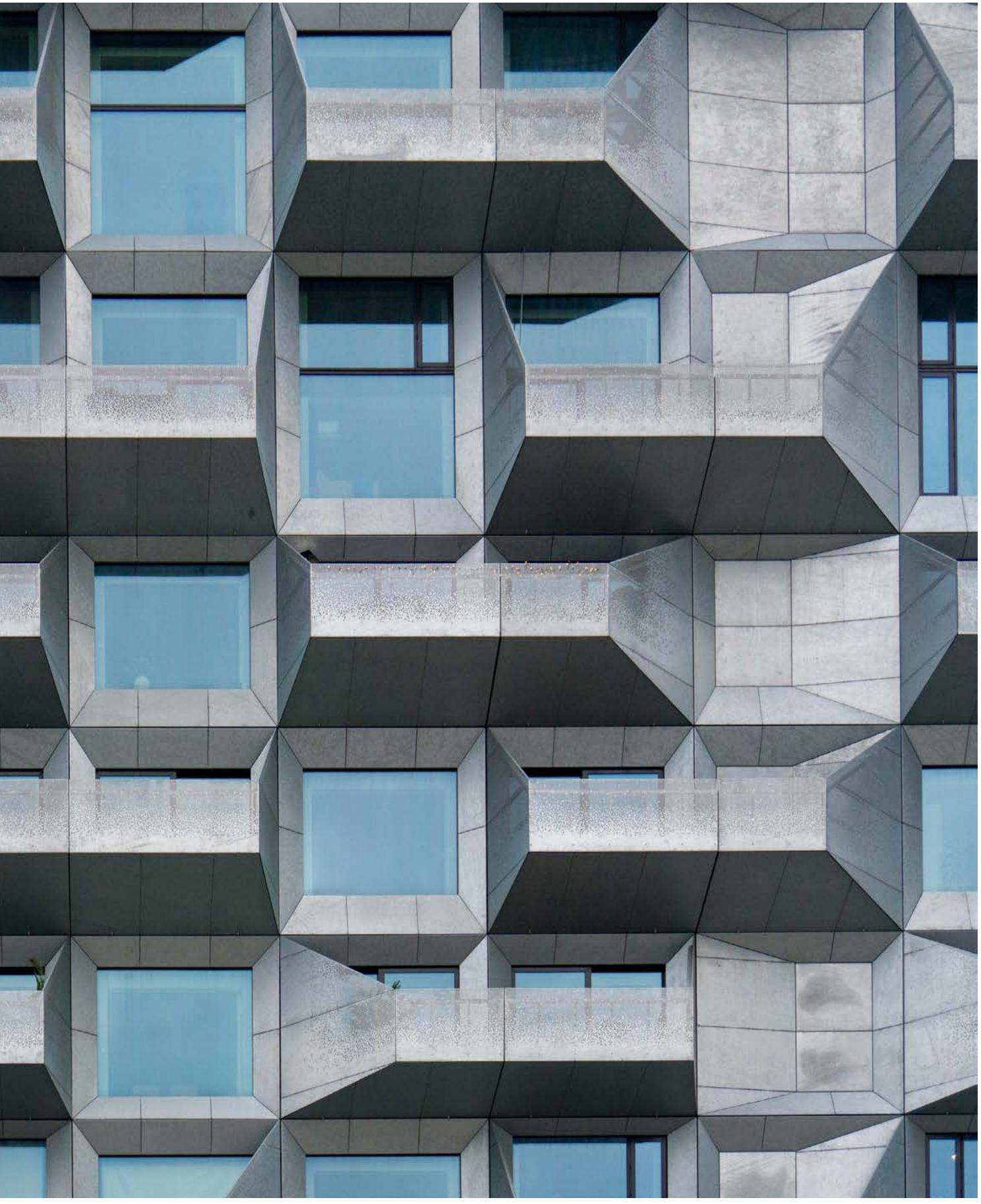
Wind power is the main player in Copenhagen’s climate strategy with other renewables, solar included, in supporting roles. City utility Hofor intends to bring 460 megawatts (MW) of new wind capacity online no later than 2025, 200 MW on-land and 260 MW offshore. “Obviously, you don’t see many wind turbines in the city, but Copenhagen has erected wind turbines in other municipalities,” says Concito’s Esbjørn. To date, a combined 114 MW of wind turbines have been contracted to supply Copenhagen with electricity and Hofor has won permission to analyse the feasibility of constructing two offshore wind power facilities, with a total capacity of 410 MW, in the Øresund strait between Denmark and Sweden. If all goes to plan, the turbines would be installed in 2023-24 with production beginning just before 2025.

ROAD BLOCKS

The third pillar of Copenhagen’s carbon neutral journey is mobility. The plan is for 75% of all trips in the city to be by foot, bike or public transport by 2025 — 10% above current levels — with public transport going carbon neutral.

Copenhagen has already improved infrastructure for cyclists by building wider bike lanes. But the city is acutely aware it will not reach some of its clean mobility targets. To do so would mean 20-30% of light vehicles and 30-40% of heavy vehicles running on non-fossil fuel by 2025, currently an unrealistic objec-

New life A former grain silo in Nordhavn, a recently created, sustainable district in Copenhagen, has been turned into award winning, energy efficient apartments



Cities around the world are being badly hit by the effects of climate change as extreme temperatures and flooding threaten the living conditions, and even lives, of their citizens. Learning from each other about climate adaptation and mitigation is the best way forward, advocates Frank Jensen, mayor of Copenhagen

Mayors have a duty to respond to climate change

In early July 2011, Copenhagen was hit by one of the worst cloudbursts on record in Denmark, causing flooding, massive disruption to traffic for days and extensive damage to houses and infrastructure. Total costs were estimated at around DKK 7 billion (€0.9 billion). Scientific reports make it clear such events are becoming more frequent and more violent because of climate change. "People know climate change is not something we may encounter in future," says Frank Jensen, mayor of Copenhagen and member of the steering committee of the C40 Cities network. "It is happening right now and citizens in our cities will be hit as homes and workplaces are damaged."

In response, mayors have a "duty" to respond, says Jensen. He underlines that while city government authorities are on the front line in dealing with the effects of a warming world, they are also uniquely positioned to lead the energy transition and implement measures to proof their cities against extreme weather. Jensen gives the example of utility companies. They are often owned by local governments rather than the state and in a position to push the greening of heating and electricity supply. He adds, however, that such change is always helped by national governments agreeing enabling legislation.

Cities are also under increasing pressure from citizens to act, says Jensen, referencing a recent wave of climate protests. A general election in Denmark in June 2019 saw voting preferences move climate policy to the top of the agenda. "As a politician you cannot ignore the fact people want good answers to questions about tackling climate change," says Jensen.

He is pleased that mayors around the world are fighting for their jurisdictions to live up to the Paris climate agreement, even in countries lacking national political leadership on the issue. "In the US, where President Trump has decided to pull out of the Paris agreement, my colleagues in the larger cities continue to have it as their goal," says Jensen.

ROAD BLOCK

Cleaning up transport is a major challenge for many cities and a headache for Copenhagen's carbon neutral plans. Jensen says change is happening. He cites the decision to stop building new big roads — as under strategies initiated in the 1960s, "when the car was king" — and today's discussions about tearing down Bispeengbuen [a six-track expressway close to a residential area in Copenhagen]. Jensen says it stands as a symbol of failed city traffic planning. A historical focus on cars has shifted to bikes and public transport. "Today 63% of people living in Copenhagen use their bikes daily," says Jensen.

But too many motorists still commute into Copenhagen, he adds. For Jensen there is no quick fix to the car problem. In the short-term, he advocates making cars cleaner to reduce air pollution and carbon emissions, improving cycling infrastructure, continuing to expand public transport to make it more convenient

Urban forests
Under the leadership of mayor Anne Hidalgo, Paris is positioning itself as a climate action leader. Hidalgo has pledged to plant urban forests around the city in 2020

TEXT Karin Jensen PHOTO Sara Galbiati

The absence of consumption-based emissions from cities' carbon budgets will undermine their attempts to become carbon neutral. Data is urgently needed to better understand the problem of rising emissions from rising consumption and how cities can be a driver for the energy transition along the whole length of supply chains

PUT CONSUMPTION AT HEART OF URBAN ENERGY TRANSITION

Measure what you manage has long been a basic tenet for carbon reduction efforts. But a new report shows this is far from being reality, with cities across the globe leaving more than half of their carbon footprint out of the equation by failing to include consumption-based emissions. By only focusing on the carbon emitted within city boundaries from transport, buildings and industries and omitting the accumulated carbon footprint of everything imported, bought and consumed, the impact of urban residents and businesses on global emissions is being underplayed and undermining attempts by cities to claim carbon neutrality.

The report, published by C40 Cities in partnership with Arup, a consultancy, and the University of Leeds in the UK reveals that taking emissions from both production and consumption into consideration would force cities to more than double their reduction ambitions to meet the goals of the Paris climate agreement. The Future of Urban Consumption in a 1.5°C World shows consumption emissions in big cities are around 58% higher than production-based emissions. Until now, cities engaged in the clean energy transition have developed production-based greenhouse gas inventories and carbon budgets based on emissions from energy use and the treatment of waste inside their territories, ignoring energy consumption and emissions from the consumption of goods and services.

Including both consumption and production emissions will increase pressure on cities to up their climate action, but also offers opportunities for them to drive the low carbon transition globally.

SYSTEMIC CHANGE

Most cities are already struggling to reach the targets they have set to reduce production-based emissions. Manchester in the north of England is no exception. The city is aiming to stay within a 15 million tonne carbon budget between 2018 and 2100 and to reach net zero carbon by 2038. To reach this goal will require annual emissions reductions of 13%, yet today they are only around 7-8%. "The budget sets the bar for our ambitions and targets and allows us to measure progress about where we are and where we need to move," says Jonny Sadler from the Manchester Climate Change Agency. "The budget also bears testament to

F ***GREED LOOP:*** *The consumption of more and more is undermining gains made by cities in reducing emissions in buildings and decarbonising transport and industry. Rising emissions from consumption are not measured in cities' carbon budgets, an omission that needs to be rectified, says a new report.* ***DECREASING CONSUMPTION:*** *Consumption emissions in big cities are around 58% higher than production-based emissions. To meet the goals of the Paris climate agreement, emissions from consumption in high-income cities must decrease by two-thirds within the next decade.* ***GLOBAL IMPACT:*** *Decisions by big cities and their citizens can significantly impact the clean energy transition and emissions reductions globally by influencing supply chains.*

TEXT Anna Eriksen Fenger PHOTO Melanie Pongratz

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Global Resource Outlook 2019, published by the UNEP International Resource Panel, reveals that the use of resources globally has more than tripled and almost doubled per capita in the last 50 years. The report also shows that this development has reached its limit as our resource use is having dramatic impacts on the climate and nature

how difficult it is to reach these targets. We are not meeting the budget yet and we have to make sure we get up to speed within a very short time frame."

The inclusion of emissions from imported goods would increase pressure. "The impact of urban consumption is much bigger than we thought," says Tom Bailey, head of C40's sustainable consumption programme. He describes it as "a critical issue" requiring immediate and robust action. For Bailey, tackling consumption emissions will ultimately benefit cities, citizens and companies. But the journey will not be easy. "We are facing a huge task," says Sadler. "We have to make sure city carbon reduction goals and carbon budgets include everyone and everything. It demands radical change on many levels, which makes it very complex."

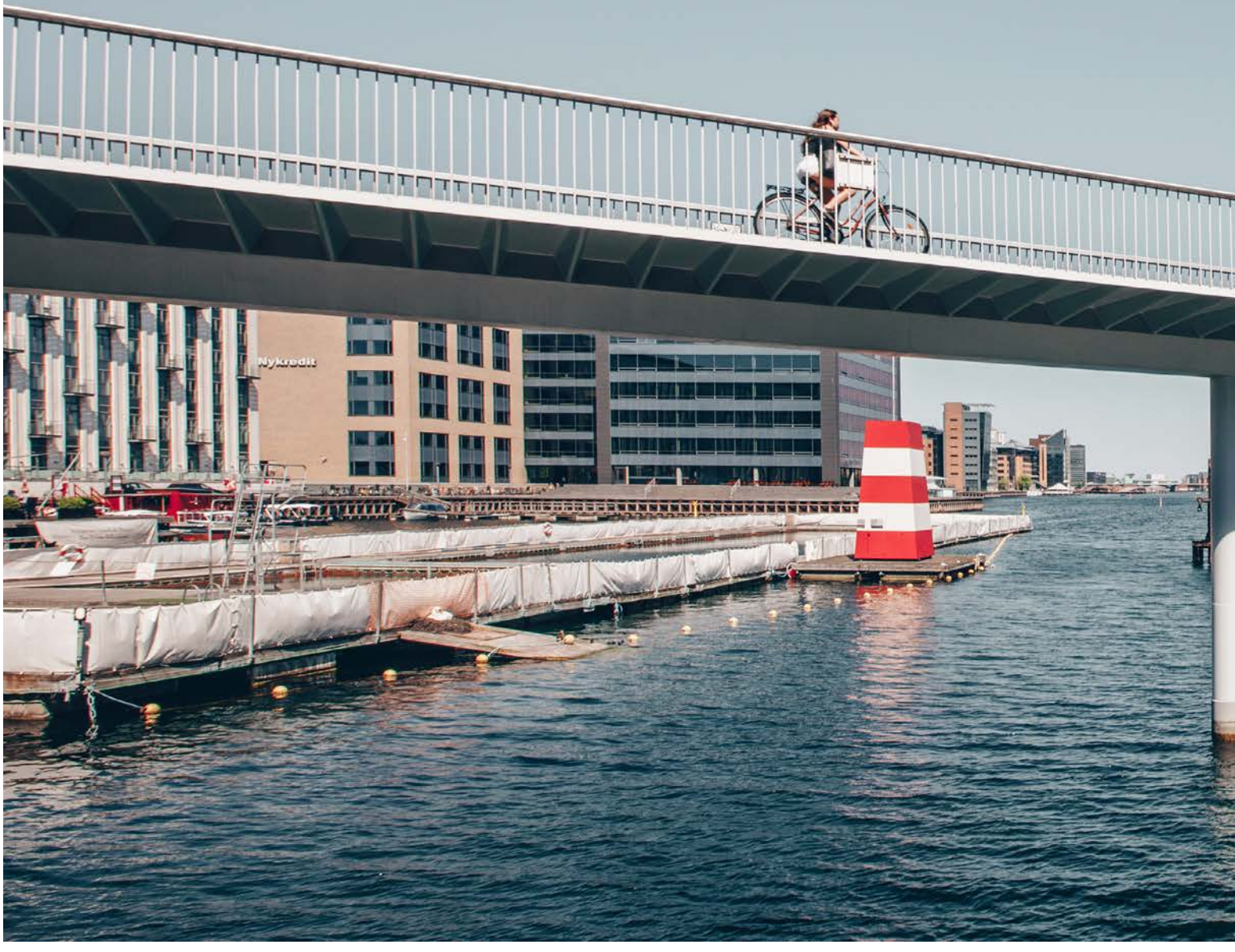
This should not be a reason for despair. Even if many cities are finding it a challenge to meet decarbonisation targets, they have made progress over the last decade and are becoming increasingly ambitious. Under C40's Deadline 2020 programme, more than 70 cities worldwide have committed to an early peak in emissions, to collectively halve emissions by 2030 and to achieve carbon neutrality by 2050. Some have pledged to go even further. Copenhagen wants to be carbon neutral by 2025. Oslo has introduced a carbon budget aimed at halving its emissions by 2020 (from 1990 levels) and becoming carbon neutral by 2030. London declared a climate emergency in 2018 and plans to become carbon neutral by 2030. Cities like Manchester and Uppsala in Sweden have introduced clear and measurable carbon budgets, and others are on their way with similar actions. And pressure from cities for less carbon intensive goods could also help speed up the energy transition at the point of production and encourage energy savings along global supply chains.

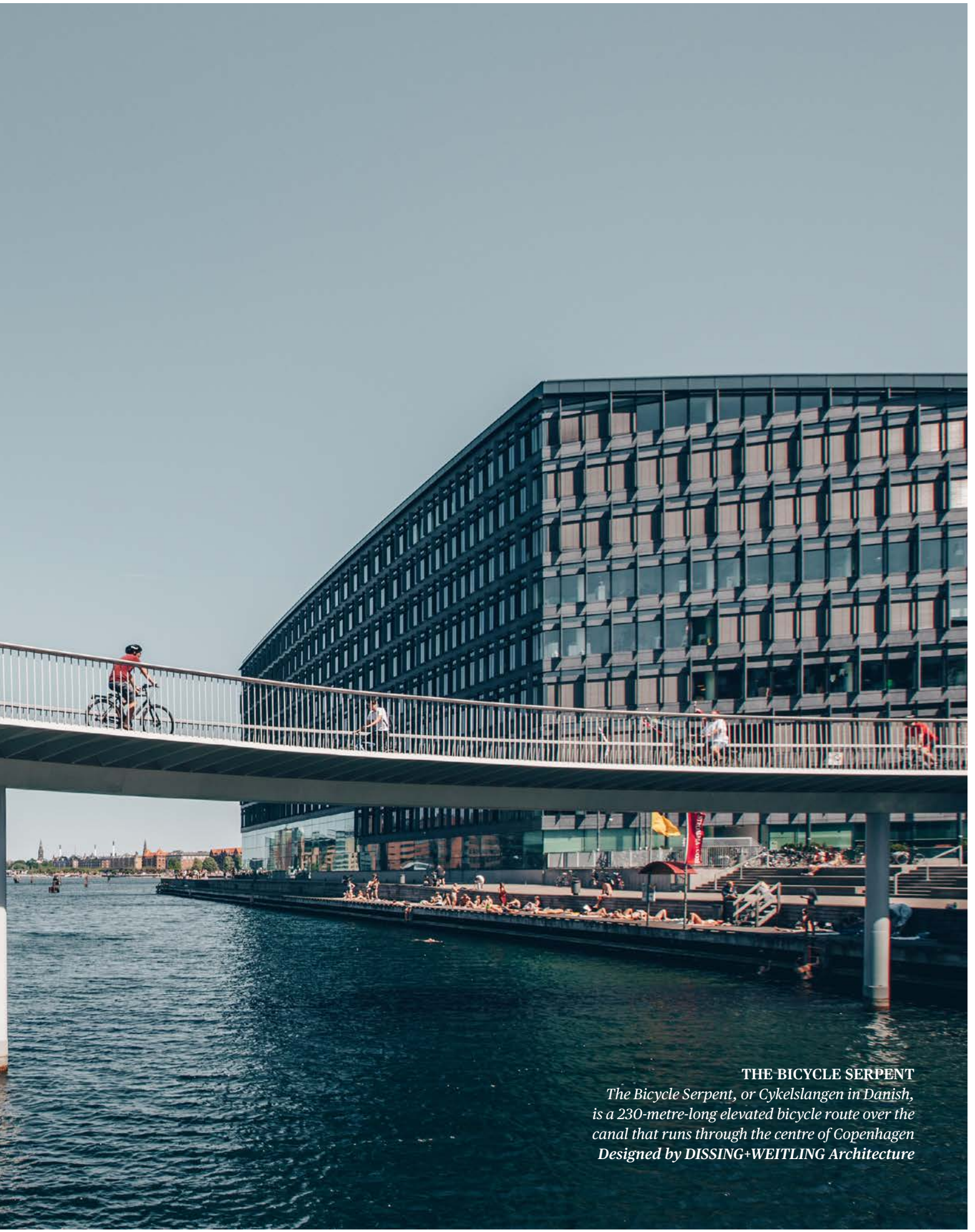
"Cities are increasingly focusing on reducing carbon emissions and how they can play their part," says Andrew Grant from the Carbon Tracker Initiative, a London-based think tank. "Carbon reduction has risen up the agenda for local policy makers and local governments have developed decarbonisation targets." But there is a growing awareness that this only makes sense if consumption emissions are included. Frank Jensen, mayor of Copenhagen, says it makes no sense to talk about carbon neutrality if the indirect emissions of citizens are not included. To maintain a

PHOTO ESSAY

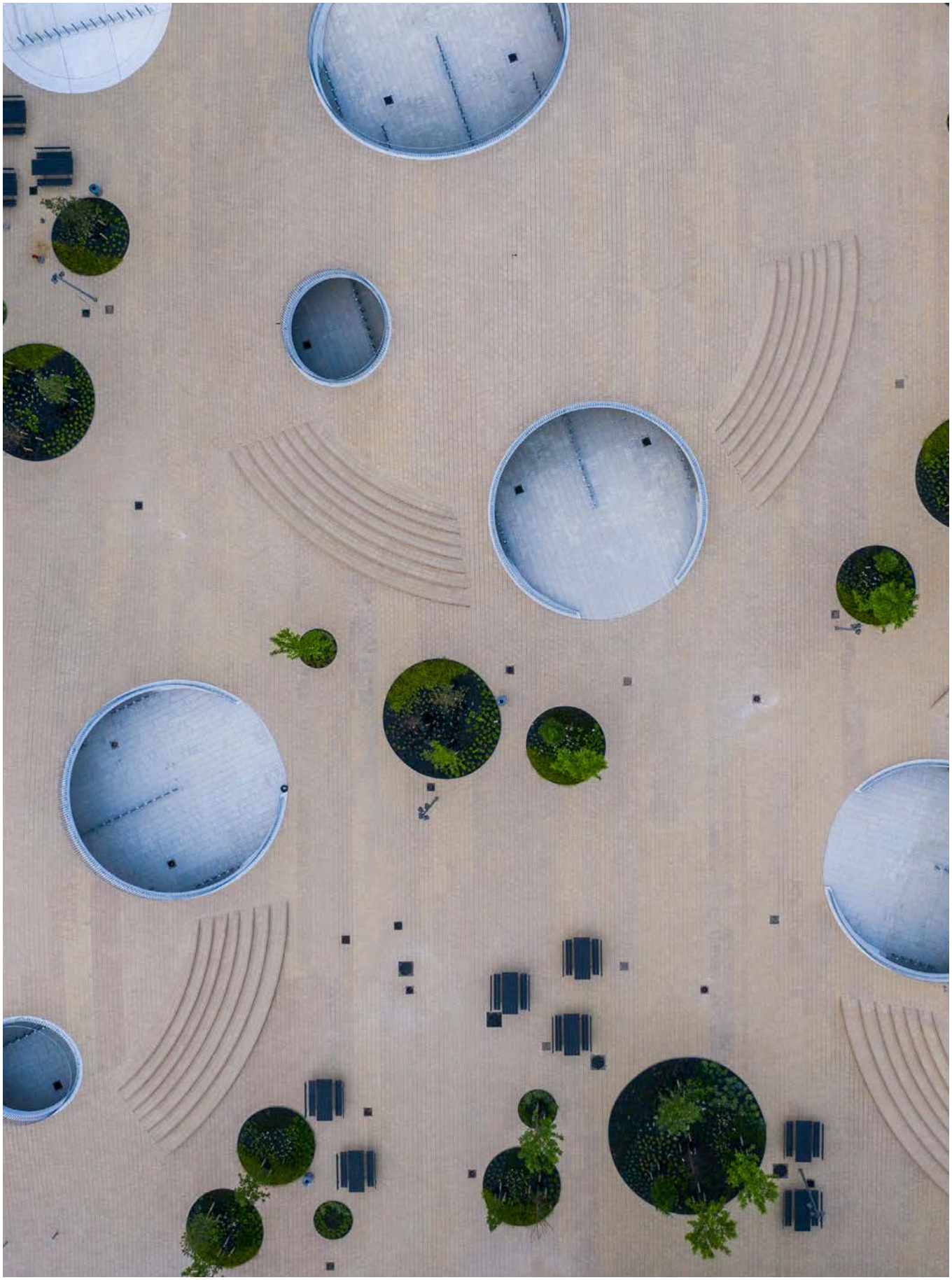
PEDAL POWER

PHOTO — Astrid Maria Rasmussen





THE BICYCLE SERPENT
The Bicycle Serpent, or Cykelslangen in Danish, is a 230-metre-long elevated bicycle route over the canal that runs through the centre of Copenhagen
Designed by DISSING+WEITLING Architecture



European cities top the global charts as being the most bike friendly. Copenhagen is in pole position followed by Amsterdam and Utrecht in the Netherlands, Antwerp in Belgium and Strasbourg in France

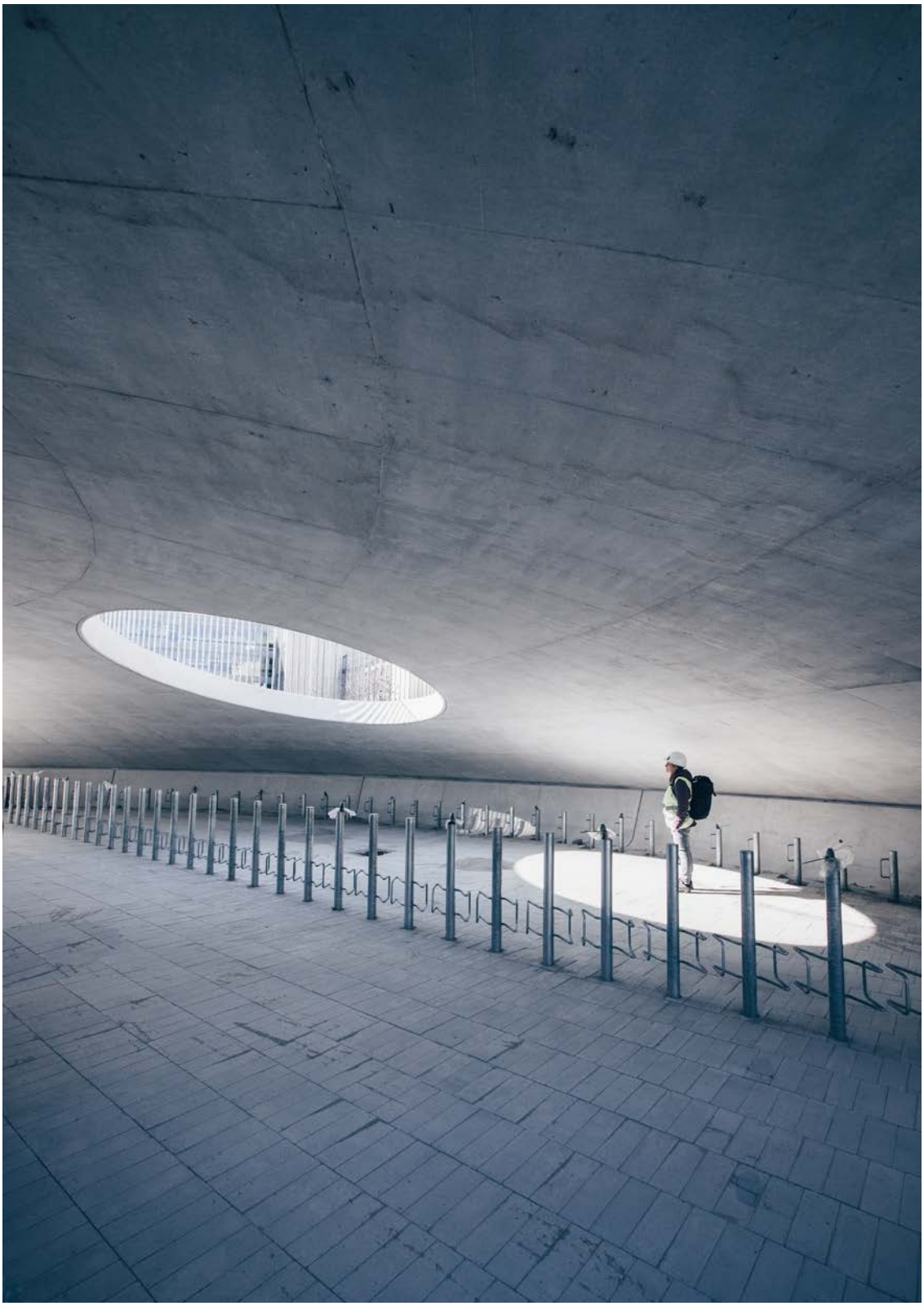
No surprise then that in Europe the Dutch and the Danes are the cycling champions, with 43% of Dutch people and 30% of Danes cycling daily. At the other end of the scale, only 3% of commuters cycle to work in the UK

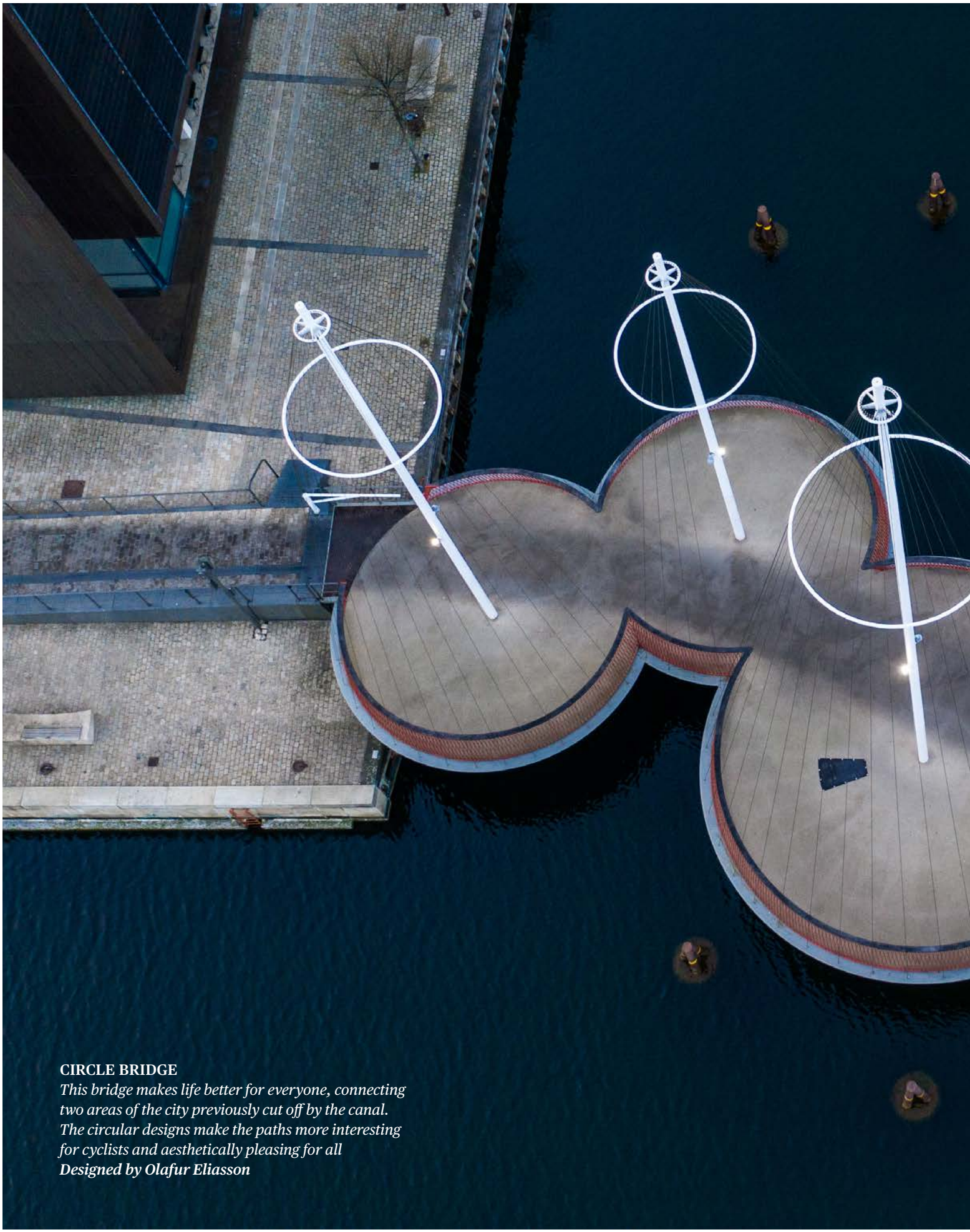
← **KAREN BLIXENS SQUARE (The university of Copenhagen)**
Karen Blixens Plads is a concrete park of man-made hills and valleys, under which there is parking space for 2100 bikes
Designed by Cobe Architects

Sixty-two per cent of people living in Copenhagen cycle to work or school, pedalling 1.44 million kilometres every day. The city has invested more than €40 per head in bike infrastructure, including 167 kilometres of new regional cycle highways and four bicycle bridges

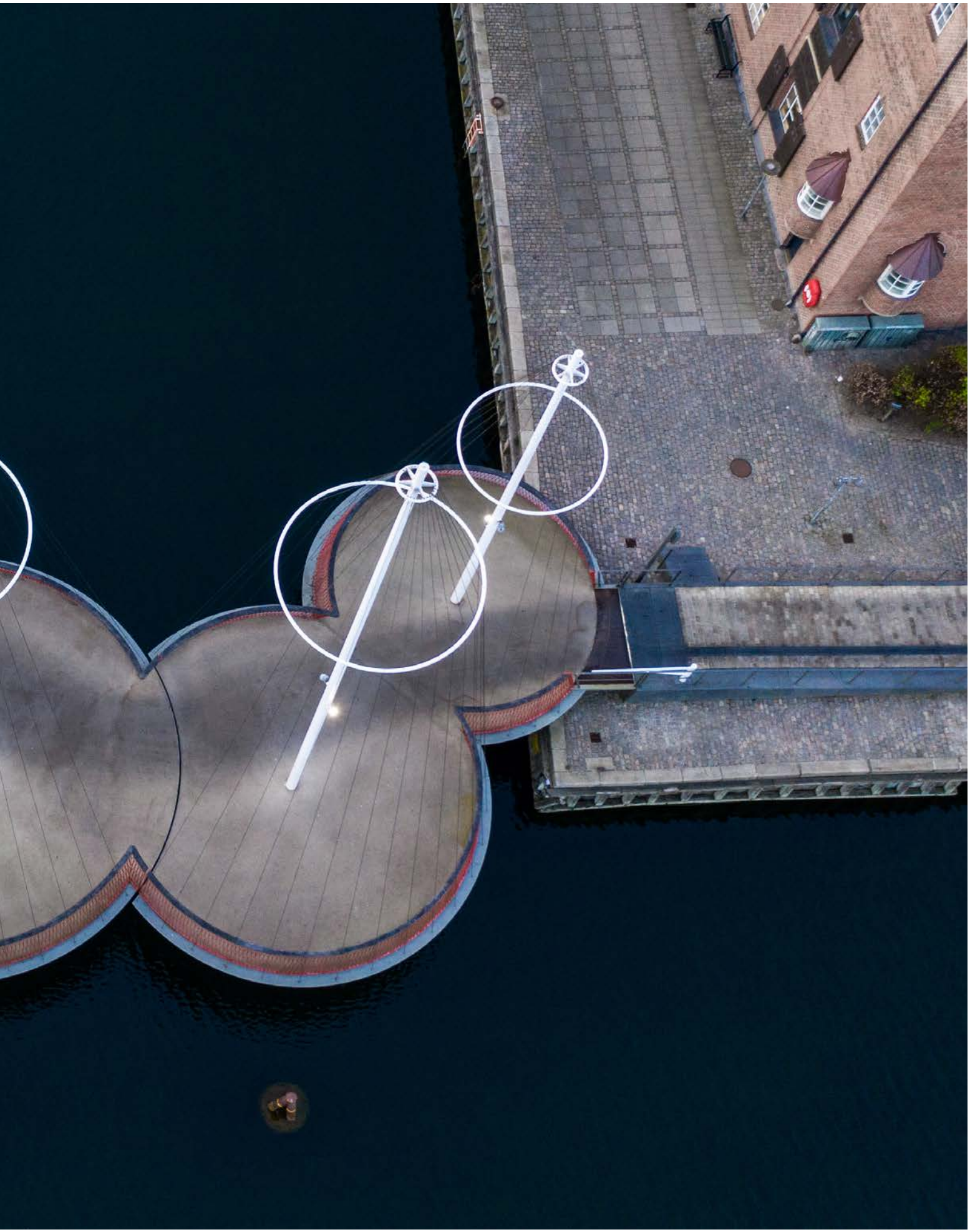
The leading non-European city for cycling is Bogotá, capital of Colombia. “In 2015, cycling had a 6% share of daily trips. We are hoping that by 2020 it will be 10% — that would be one million trips per day,” says David Uniman, the city’s bicycle manager

KAREN BLIXENS SQUARE ⟶
Underground bike park





CIRCLE BRIDGE
This bridge makes life better for everyone, connecting two areas of the city previously cut off by the canal. The circular designs make the paths more interesting for cyclists and aesthetically pleasing for all
Designed by Olafur Eliasson



of the largest cities in the US. It showed the average low-income household energy burden was 7.2% of income, compared to 3.5% for a median household and 2.3% for higher-income families. Low-income households also pay more for energy per square foot because they tend to live in less energy efficient households, ACEEE found. Measures to improve the energy efficiency of apartment buildings and houses can contribute to tackling fuel poverty.

EFFICIENCY FOR ALL

Reducing energy waste in buildings is an area in which city mayors are well positioned to take action with stricter building codes, says C40's Sarfatti. Although, it is important that ambitious building codes do not worsen the situation for low-income people, she adds. Affordable housing quotas are a possible tool to avoid pricing poorer people out of the market. There are also discussions underway in some cities about channelling the use of energy efficiency incentives towards those who need them most, Sarfatti says.

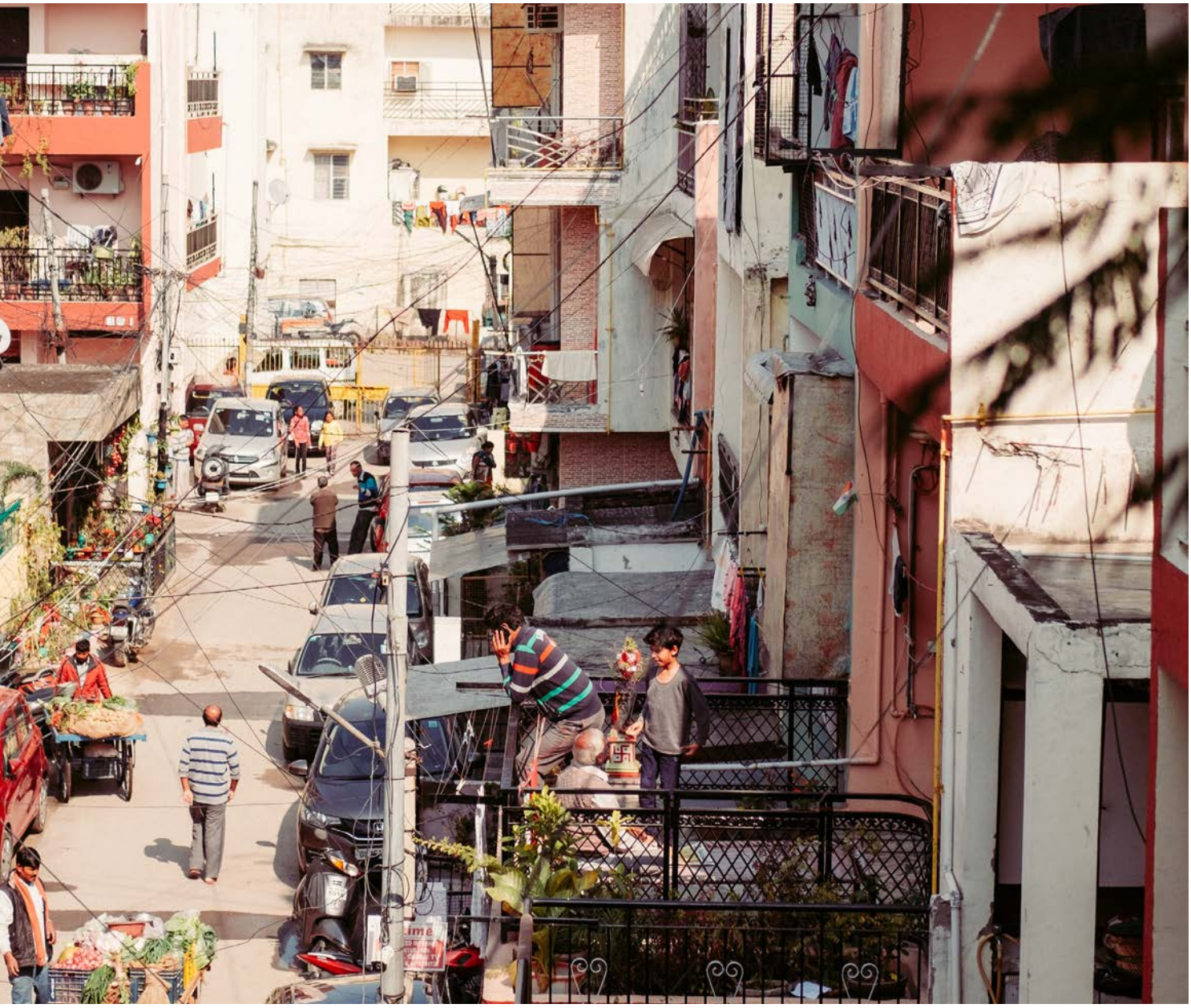
Affordable solutions for energy retrofitting older houses and apartment buildings with poor energy performance and financially stretched occupants are increasingly being explored. In one project back in Europe, in Vlaardingen in the Netherlands, EIT Climate-KIC worked with the Waterweg Wonen social housing association on an affordable zero-energy retrofit solution using a lightweight façade known as Second Skin. Developed by the Technical University of Delft, it was initially used by start-up BIK Bouw in a pilot demonstration involving 12 apartments. The retrofit also included improved insulation, a geothermal heat pump system to provide heating, cooling and hot water and photovoltaic panels to generate electricity. Second Skin was then applied to some 180 more apartments in the complex, with the aim now to scale up and industrialise, says Marietta Chatzinota of EIT Climate-KIC's Building Technologies Accelerator programme.

The retrofit needed to be affordable, since social housing resources are limited, and able to be carried out while people were still living in the complex, says Chatzinota. Acceptance was also essential since 70% of tenants need to approve projects in social housing in the Netherlands before they can move forward.

"We spent a lot of time talking with occupants about how it would be living in a zero-energy house and without natural gas," says Chatzinota. She points out that people in the Waterweg Wonen and other similar projects did not really relate to the concept of energy neutrality, but were more interested in other benefits from upgrades such as a reduction in mould and dust, accompanying health benefits and features such as a balcony. "What we have found is that the language being used to communicate about climate change does not resonate with a lot of people," says Chatzinota. "It reaches those that are already converted", but not those that may struggle to pay the bills.

HEALTHY BUILDINGS

Energy issues are inextricably linked to health and well-being and policymakers would do well to highlight those benefits. Having to use significant amounts of energy to heat or cool a home "can cause very real mental and physical health problems", found the ACEEE report, highlighting problems associated with being too hot or too cold, inadequate lighting, and constant financial and social stress. "Studies have found that living in homes that are not properly heat-



New Delhi
India is poised to become the world's fifth-largest economy with the building sector representing over 30% of its energy consumption

ed or cooled increases cases of asthma, respiratory problems, heart disease, arthritis and rheumatism."

An increasing number of programmes in the US are explicitly seeking to improve both energy efficiency and health. One of these is the Bronx Healthy Buildings Program in the city of New York. The initiative first analyses data to target multi-family residential buildings in the Bronx with high incidences of asthma-related emergency room visits and hospital admissions tied to the built environment. In this way it identifies potential candidates for participation. Alongside other measures, programme administrators work with the Northwest Bronx Community and Clergy Coalition to carry out energy audits and analyse household fuel use, undertaking energy-efficiency upgrades as needed.

URBAN SLUMS

In Cape Town, under national subsidised housing rules for South Africa, some 40,000 houses in low-income neighbourhoods built between 1994 and 2005 were not equipped with insulated ceilings. The result was that individuals living in these houses were more susceptible to tuberculosis, colds and other illnesses. In 2015, the city began a ceiling retrofit programme seeking to redress energy use and health issues, which has so far resulted in upgrades at about 8000 of these houses.

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