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CLEARING CITY
STREETS OF
TRAFFIC CHAOS



PERFECT STORM
OF RISKS
FACING CITIES

FUTURE PROOFING CITIES

Creating Cities Fit for the Future

DISTRIBUTED IN
THE  TIMES

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Although this publication is funded through advertising and sponsorship, all editorial is without bias and sponsored features are clearly labelled. For an upcoming schedule, partnership inquiries or feedback, please call +44 (0)20 3428 5230 or email info@raconteurmedia.co.uk

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RACE AGAINST TIME FOR FUTURE CITIES

How much trouble are we in? What we can do about it? How long have we got? With quality of life at stake and no easy answers, the time is now for tackling the difficult questions being asked of future cities worldwide, writes **Jim McClelland**

OVERVIEW

■ According to data from the United Nations, in 2008 the proportion of the world's population living in urban areas passed the 50 per cent mark, heading for 70 per cent by 2050.

By 2030, the total for city dwellers globally is forecast to hit around five billion. City inhabitants already consume 75 per cent of the planet's natural resources and contribute to urban activities responsible for 80 per cent of all greenhouse gas emissions.

All this happens on a mere 2 per cent of global land mass. The numbers are daunting.

The future is not for the faint-hearted, nor is it for the disjointed or disconnected. Shaping cities is a team game, as Jon Lovell, director and head of sustainability at Deloitte Real Estate, explains: "Without a serious shift in urban thinking, the consequences of escalating climate change, pollution and resource depletion pose an ever-more serious threat to the resilience of cities right around the world."

"This requires much more than, say, integrating solar panels into buildings, and needs all elements

of the urban jigsaw – buildings, infrastructure, communities and institutions – to be much more integrated and better adapted to future challenges," he says.

In response, there is a spirit of co-operation and collaboration in evidence, with peace breaking out between public and private sectors. Austerity has heralded in a new pragmatism.

"Among more enlightened authorities and developers, there is now greater realisation that 'they need each other' – municipalities need the private capital and profit motive to drive projects forward to acceptable deadlines, while investors realise that suitably consented schemes will only come through full consultation with public agencies," says Hugh Roberts, urban and regional planning practice leader at SKM Colin Buchanan.

As public-private partnerships become increasingly common, so too do issues of hybrid governance. There are investment implications and reputational risk-benefit impacts for established urban centres to consider when entering into commercial contractual arrangements, in a bid for global competitiveness.

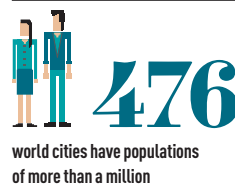
The dangers of "branding or blanding" of cities, either through overt corporate badging of service solutions or (inter)national homogeneity of offerings, can threaten or diminish cultural heritage and conservation of marketable local and community character.

Ultimately, though, the guiding principle for uses of the public purse remains constant and simple: improving the quality of life and wellbeing of citizens. Understanding how best that can be achieved, against the clock, calls for smart thinking, as much as smart technology.

There are well over 1,000 cities in the world with populations in excess of 500,000. The opportunities are limitless for experience to be shared and knowledge transferred between countries and even continents.

One of the key lessons coming out of new-build urban development in Asia, and especially China, is that energy is not the only game in town. H2O is rapidly becoming the new CO2 of future-city metrics. Wilder Associates director and BRE (Building Research Establishment) associate, Peter Wilder, explains: "Water quality is now a key indicator for all cities, not just eco-cities, mainly because the availability of drinking water is a limiting factor in a city's ability to grow."

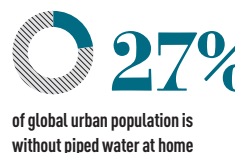
As well as too little water, he adds, cities increasingly have to deal with incidences and impacts of too much. Water-sensitive urban design offers a custom-



Source: United Nations



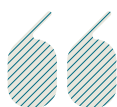
Source: World Health Organization



Source: UNESCO



Source: Department for Business Innovation & Skills



The future is not for the faint-hearted, nor is it for the disjointed or disconnected



Cities are the future, but must be sustainable

reduce the burden on already-overloaded piped networks," says Mr Wilder.

Whether investment is in blue (water-related) infrastructure or green, smart buildings and grids, or machine-to-machine technology through the so-called Internet of Things, connectivity is key. The figure involved could come in as many forms as the measures of improvement.

Urban green racing to the rescue?

Pages 06 and 07



It could be the £24 million awarded to Glasgow in the Future Cities Demonstrator competition, managed and funded by the UK government innovation agency, the Technology Strategy Board. Or it might be 6,700, which is the total number of traffic lights in Quito, Ecuador, covered by the real-time adaptive control system from Schneider Electric.


The true number crunch for cities though is time. What time-frame should be used when talking about the sustainability of smart development fit for the future? The longer, the better, would be the advice from Andrew Comer, managing director, environment and infrastructure, at international consulting engineers Buro Happold.

"The time frame to judge any development in terms of its true sustainability has to be over a long period," he says. "Investment in buildings should be viewed over 40 to 50 years. Similarly, many major infrastructure programmes being undertaken today will be impacting on the UK economy and its carbon footprint for the next 50 to 80 years. But how much attention is given to making the right choices or decisions on this basis?"

Back in 1963, the influential urban planning report and book *Traffic in Towns* was published by Professor Sir Colin Buchanan. Now, 50 years on, with Transport in Cities, SKM Colin Buchanan aims to revisit the issues, and produce a fresh vision and blueprint for the next 50 years.

To put that challenge into perspective, consider stories of the day from 1963: Martin Luther King announced having a dream; putting a man on the Moon still seemed like one; the first mobile phone was a decade away; and £1 would buy 60 loaves of bread. Things change.

Predicting the future calls for the art of the improbable, if not impossible. Cities are in the business of planning, designing, engineering and building the future, not to mention facilitating, transporting, generating, heating, cooling, draining, feeding, watering, greening and connecting.

All this so that 50 per cent and more of the world's population can get on with living sustainably – healthy and happy. 



of the world's population lives in cities



new city residents every month



of global land mass is cities

Source: United Nations



fit climate-risk strategy, readily transferable from new to old metropolitan settings.

"The approach to adapting the environment within our new cities to accommodate extreme events will need to filter down to our existing cities through integration of rain gardens, disconnection of homes from storm-water sewers and conversion of open spaces into storm-water wetlands to promote the recharging of abstraction aquifers and



The availability of drinking water is a limiting factor in a city's ability to grow

COMMERCIAL FEATURE

Manufacturing a high-value future for Wolverhampton

Starting in schools and working up through a supply chain of small businesses to first-tier global brands, a Black Country powerhouse is driving forward into the 21st century, building on a smart and sustainable city vision



Simon Warren, Wolverhampton City Council chief executive

"Advanced manufacturing, particularly in aerospace and automotive sectors, is a global business – there isn't much room for sentiment," says Wolverhampton City Council chief executive Simon Warren. "The investment from Jaguar Land Rover and Moog Incorporated isn't a nod to Wolverhampton's past achievements, but recognition of what the city can do for business today and in the future.

"If Wolverhampton has a tradition, it's a tradition of innovation. That's our evidence base – in a sense, dynamism is in our DNA."

The decision of Jaguar Land Rover to invest almost £500 million in a new advanced engine manufacturing facility and Moog's commitment to rebuild its existing components plant, form just part of a bigger, broader development picture.

More than £1.2 billion of public and private money signed-off in the last 12 months alone, starts to tell the story of the core role being played by the city council as enabler-in-chief for economic growth.

Collaboration and integration are key, says Mr Warren. "The promise we can make for the future is that the private and public sectors in Wolverhampton share the same vision," he says.

"Half a million people live just 20 minutes' drive away from Wolverhampton city centre and three million within 20 miles. That's a massive market for labour and goods. No one city can tap into that on its own and only through working with our neighbours can we make the changes we need to reach critical mass."

The wider Black Country region is set to seize greater control of how money is spent locally after its four councils and local enterprise partnership joined forces to bid for a "City Deal".

Based on the strapline of "Built in the Black Country: Sold Around the World", says Mr Warren, this deal lays the foundations for future home-made success. "While inward investment is crucial, organic growth is essential to attracting it," he says.

"The Black Country City Deal will help local small and medium-sized enterprises, in high-value manufacturing, up-skill their workforces and, through the Black Country Land Development Fund, gain access to major sites and modern premises.

"Our goal for the City Deal is the creation of 97,000 jobs across all sectors."

Apprenticeships represent a cornerstone of ambitions for the deal and are backed by £270 million invested in the Wolverhampton Building Schools for the Future Programme. Put simply, without a city-wide learning culture, no future vision is viable, concludes Mr Warren.

"If we want to make growth sustainable, we have to put education, training and skills at a premium," he says. "Regeneration is not just about creating high-quality job opportunities, but about making sure local people are able to compete for them. We also have to equip our young people for the skills they'll need tomorrow.

"It's not lost on us that 40 per cent of jobs that people have today didn't exist 30 years ago.

"Our vision of a city that capitalises on its gifts for enterprise and innovation, that makes things happen for individuals and business, is central to our future prosperity."

Wolverhampton is in the business of making – making a difference to citizens, making world-class products, making a new history for the region and making things happen.

"Made in Wolverhampton" is a badge of pride.



Our goal for the City Deal is the creation of 97,000 jobs across all sectors

PEOPLE AND SYSTEMS JOIN IN INTERCONNECTED CITY



Contactless cards, machine-to-machine communication and the “internet of things” are just the start of future city connectivity, as **Joe Peach** reports

INTERCONNECTIVITY

■ A popular car insurance comparison website recently conducted research using a smartphone application to monitor people driving 250 miles without music, then the same distance with music. The resulting data could potentially have offered valuable insight into the impact of music on driver behaviour. Instead, it was turned into a tweet-friendly report announcing *Hey Mama*, the 2004 single by hip hop group The Black Eyed Peas, as the most dangerous song to drive to.

“Music that is noisy, upbeat and increases your heart rate is a deadly mix,” says Dr Simon Moore of London Metropolitan University. “In addition, a fast tempo can cause people subconsciously to speed up to match the beat of a song.” Fans of The Black Eyed Peas be warned. This research is typical of developments occurring in cities across the globe, where technology is being used to understand better the connection between people and urban systems. From GPS-enabled school buses sharing locations with smartphone-owning parents, to sensors that monitor and report on building condition, cities and their systems are becoming increasingly connected with a promise of urban intelligence and sustainability like never before.

This network of connections is known as an “internet of things” (IoT) or machine-to-machine (M2M) communication, where objects are linked through ability to transmit and receive data. And who benefits from these connections? We do.

The value of interconnectivity is well-documented. A smart water meter trial in Dubuque, Iowa, offered households detailed information about water usage, feeding back into city databases. The trial resulted in a 6.6 per cent reduction in the average water bill, with leakages reported eight times as frequently.

London’s contactless Oyster smartcard, as well as reducing the need to queue for public-transport tickets, has been so successful that everything from fewer carbon emissions to increased ridership have been attributed to it. Transit users benefit from ease of use, but Transport for London (TfL) benefits by mining huge amounts of data generated by the cards to identify problems with the system.

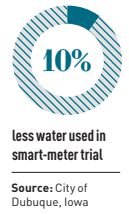
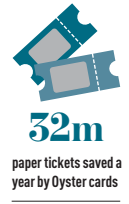
The Southeastern Pennsylvania Transportation Authority in Philadelphia is going one step further. Currently the only major US city still accepting tokens as transit fares, by late-2013 its payment system will undergo a significant upgrade, becoming one of the most advanced in the world by accepting its own contactless smartcard, contactless debit and credit cards, and smart devices equipped with near-field communication (NFC). NFC allows two-way communication using radio waves by bringing devices into close proximity. Mainstream use to date has been limited to media-sharing and contactless payment, though John

Baekelmanns, senior director of Cisco’s Smart+Connected Communities programme, envisions a future where “technology like NFC replaces the badge readers we use every day, from public transport to payments”. He says: “Tools we use to interact with urban systems could all move into the phone.” NFC could also act as the key to

your front door or digital identification. “So much is possible, but it’s early days,” says Mr Baekelmanns. “It’s at least a couple of years before we see next-generation capabilities.” Wireless communication between objects and city management systems is likely to become increasingly common. Starting in 2015, every new car sold in the EU will contain an integrated communications system which automatically contacts emergency services with information, including the



Cities and their systems are becoming increasingly connected with a promise of urban intelligence and sustainability like never before



vehicle’s location, if it senses an accident has taken place. The IoT and M2M market is expected to become the fastest-growing segment of the IT sector in the next three to five years. Marketsandmarkets recently predicted its value would increase to \$290 billion in 2017, up from \$44 billion in 2011. This growth is reflective of the emergence of what is essentially a new market, but with human-generated data as its foundation, privacy and security concerns are a hot topic.

Dubuque learnt from mistakes made when New York City undertook its smart water meter trial. Appearing at a press conference, announcing installation of hundreds of thousands of digital water meters, a New York City council member displayed his water consumption data, revealing a spike in usage one afternoon. Speculation ensued among the audience about the cause, with some possibilities more embarrassing than others. Keen to avoid similar issues (or worse), Dubuque anonymised data by using IDs in place of addresses, with management access restricted to viewing data in aggregate.

Location data doesn’t always need to be hidden and can encourage citizen engagement if integrated successfully. SeeClickFix is an application for reporting neighbourhood issues, such as graffiti or potholes, directing citizen feedback to government departments. Action is encouraged by initiating reports in the public domain rather than a private inbox.

Data from non-intrusive online interactions like this can easily be controlled using service privacy options, but security in a cloud environment, where data is more likely to be private, is more complex.

Cloud computing is when computer resources connect over a network with data stored remotely. Advantages include affordability and removal of the need to own hardware, though potential disadvantages include data loss, or data getting into the wrong hands after hacking or user error. Private organisations have recognised this risk and compete on strength of security, but Mr Baekelmanns suggests legislation would be a good idea.

Though risk can be minimised, as connections between citizens and urban systems become more integrated, an element of risk will remain. Some may decide it isn’t worth it, going off the grid as much as they can. Others may never even have been invited to the party – if everything needed to engage with the city is in a smartphone, what happens to those who can’t afford smartphones?

However, for the interconnected city to achieve its promise of an intelligent and sustainable urban environment, it simply needs enough people to be prepared to take the data plunge. As Steve Turner of New Economy, the economic development body for Greater Manchester, explains: “We need smart citizens to create smart cities. However, first they need to hand over their data so those managing our cities can create smarter infrastructure.”

Tun Razak Exchange
Kuala Lumpur’s new international financial district.
1 Malaysia Development Berhad

FUTURE CITIES WILL NEED MORE THAN JUST SMART TECHNOLOGY...

Buro Happold

Collaboration holds the key to smart sustainable cities



Charbel Aoun, senior vice-president, Smart Cities

Under pressure to deliver programmes for change, smart cities are looking to collaborate and integrate in an era of technological evolution.

"The most effective definition of a smart city is a community that is efficient, liveable and sustainable," says Charbel Aoun, senior vice-president, Smart Cities, Schneider Electric. "These three elements go hand-in-hand. It is a virtuous circle: as a city improves the efficiency of its infrastructures, it will be able to improve the public services it provides, which will make it a better place, enhance its attractiveness, help create jobs and increase its competitiveness."

For cities old and new, achieving this virtuous smart circle, however, is proving neither simple nor risk-free. In the modern global marketplace, cities cannot afford to ignore the need to compete. Economic conditions are tough, resources increasingly scarce, the pace of change is swift and stakeholder demands are on the rise. The pressure is on.

The question for many a metropolis is where to start? A city is basically a system of operating systems, for such as electricity, gas, water, transportation, telecoms, public services, buildings, hospitals and homes.

These legacy systems work more or less efficiently, but usually separately, in silos, under different city departments.

Historically, they have neither been designed nor managed to ensure resource efficiency and long-term sustainability.

This is where technological evolution can help – digitisation, the internet of things, cloud computing, big data and analytics, pervasive internet, convergence of energy and technology – all of this and more is the new reality, and new working environment for a smart city. So, although technology is not directly what cities are about or what citizens think about, clearly it has a part to play.



"This is why some cities are telling us that, while they believe that technology can bring value, they do not have the capabilities or capacities – human, financial, technical – to implement it," says Mr Aoun. "This is why the real change that is needed is in the business models."

Stakeholders, priorities and vision will be individual to each city, but any smart business model will effectively revolve around a single, common, shared fundamental: collaboration.

Collaboration will drive innovative financial mechanisms to help pay for the investments – through performance contracting, for example – promote citizen involvement and foster cross-business co-creation.

If collaboration is the guiding principle of smart working, then integration is a practical application. This means connecting systems and data coming from them – but only when it makes sense and delivers additional value to the city and its people – and continually improving to adapt to changes and leverage deliverables. The feed source for all this interconnected drive towards excellence is information – or data.

Recent advances in technology have greatly improved the ability to gather tremendous amounts of data about city infrastructure, affordably. Pervasive sensors enable collection, new low-cost communications protocols simplify and reduce costs, real-time management systems automate control and optimise performance, and advanced analytics translate inputs

into actionable intelligence.

This whole process is only made possible by the aggregation and integration of data, but the capability is readily available now and can already be seen working around the world.

Mr Aoun says: "Let us take an example. Our ICM (Integrated City Management) platform integrates mobility data, CCTV data, sensors, along with weather data, and so on. This makes it possible to simulate, with a high degree of accuracy and reliability, the impact of a storm, however large, on the city's transportation system. This allows the city to prepare and react, predict and proactively manage any situation."

"This is not a concept, this is a real solution that we have deployed in Dallas, Texas, for example."

Other integrated solutions include: Smart Grid Advanced Distribution Management Systems for energy, which is running every day in many cities in China; SCADA for water, which is in place in several cities in North and South America; plus Resource Advisor, a robust Software as a Service (SaaS) reporting dashboard that connects across energy procurement, energy use and carbon emissions – initially developed for companies, but now also available for cities. The technology not only exists, it works.

"Involving the business sector upfront helps a city 'translate' its needs into an integrated roadmap, combining technology and solutions," adds Mr Aoun, "and this is

why the answer lies in multi-company, multi-domain collaboration and multi-solution integration.

"This will help technology to play its enabler role and provide visible, measurable benefits to the people in the cities."

"Our firm belief at Schneider Electric, having worked on some 200 projects worldwide, is that no single company or organisation can solve a city's challenges alone. This means sharing information across city departments to break down silos, and involving global leaders, with world-class capabilities, as well as local providers and stakeholders."

"Success will come from combining public governance, people ownership and business collaboration, driving communication between groups by giving them a true stake in a smart city built out of their community."

Multi-sector, multi-company business collaboration can bring innovative ideas to smart city projects. Schneider Electric's participation with other major global players in the World Business Council for Sustainable Development's Urban Infrastructure Initiative is one such example. Bringing together 15 global industry leaders from all sectors, this programme offers their combined expertise to eight cities around the world, on all continents.

This degree of collaborative working and thinking is vital to tackle the challenges future cities face. Global megatrends cannot be ignored – urbanisation, digitisation, growing consumption of resources

and technology – the figures speak for themselves.

We must build the same urban capacity in the next 40 years as in the past 4,000 – 250 new cities by 2050, each with a population in excess of one million. These are required in addition to the 4,500 cities already in existence globally with populations above 500,000 people, plus hundreds of thousands of medium-sized cities.

Whether we are talking of new cities, growing cities or old cities, these urban environments are the future proving ground for sustainability.

"Change needs to happen in all of them. This is the global challenge and yes, there is no doubt, the battle for sustainability will be won or lost in the cities," Mr Aoun concludes.



This degree of collaborative working and thinking is vital to tackle the challenges future cities face

NATURE IS BACK IN TOWN AS CITIES GO GREEN

In the face of climate risk and population pressure, urban greening is helping to build resilience in cities and improve the health of inhabitants, writes **Jim McClelland**

URBAN GREENING

■ According to received wisdom, it is not possible to put a price on nature. However, with much debate, that is exactly what has been happening increasingly of late, as policymakers and markets strive to develop robust metrics to determine the value of living-planet assets and liabilities.

The UN has estimated world ecosystems deliver essential services worth more than \$70 trillion a year. In the UK alone, the National Ecosystem Assessment generated figures claiming responsible stewardship of green spaces could be worth at least £30 billion a year to the economy, in health and welfare benefits. With a view of green space worth up to £300 per person, provision of green access for every household in England could knock £2.1 billion off the annual healthcare bill.

Against this backdrop of efforts to draw up an eco balance sheet for the world, perception of climate risk has been rising dramatically, with fears for associated loss of species and habitat degradation; plus spiralling population growth viewed manifest in increasing urbanisation, both in terms of development sprawl and density. To have any prospect of being thought part of the solution, rather than part of the problem, the future city can only come in one colour: green.

The biennial World Green Roof Congress took place recently in Copenhagen and for the Danish capital, described as one of the five most sustainable cities in the world (along with San Francisco, Vancouver, Oslo and Curitiba), the future is most definitely

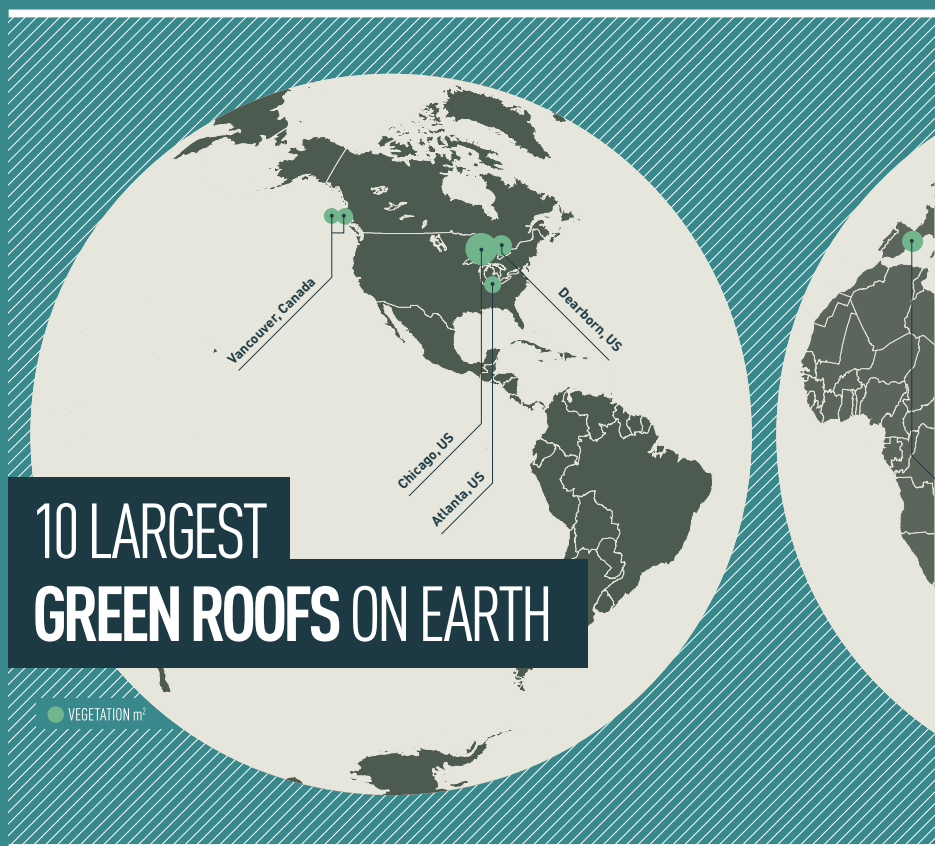
green. Lord Mayor Frank Jensen explains: "For quality of living and working environment, for social equity and economic prosperity, the smart cities of tomorrow will be green cities, in every sense. Across the globe, from Portland to Paris and Christchurch to Copenhagen, mayoral offices understand urban biodiversity and green infrastructure are essential elements of any city vision."

Copenhagen itself suffered badly in 2011 from torrential storms and the impact of extreme flooding. As a result, civic authorities are acutely aware of the need to invest in climate-change adaptation as a development priority, with urban greening a cornerstone of resilience planning.

For cities in general, risk is the dominant policy driver at present, as the author of *Ecosystem Services Come to Town: Greening Cities by Working with Nature*, ecologist Gary Grant, explains: "The most powerful argument for urban greening currently is dealing with climate change, which is leading to heat waves and flash flooding. There is money available for this because of the economic damage being caused. When all other benefits are considered, the argument becomes even stronger."

With enhanced amenity space and aesthetics, biodiversity and wildlife gains, plus positive contributions to health and wellbeing perhaps listed only in the "additional benefits" column, it is easy to see why urban planners might be persuaded by arguments for greening. Core benefits include reduction in

HOW GREEN IS THE WORLD?



10 LARGEST GREEN ROOFS ON EARTH

Dearborn Truck Assembly Plant Dearborn, Michigan, US	42,179m ²	Georgia International Plaza Atlanta, Georgia, US	28,243m ²
Vancouver Convention Centre Vancouver, Canada	24,282m ²	Rolls-Royce Plant Chichester, West Sussex, UK	32,000m ²
Village on False Creek Vancouver, Canada	26,664m ²	Frankfurt International Airport Frankfurt, Germany	80,000m ²
Millennium Park Chicago, Illinois, US	99,127m ²	Logistikzentrum Bondorf, Germany	50,000m ²



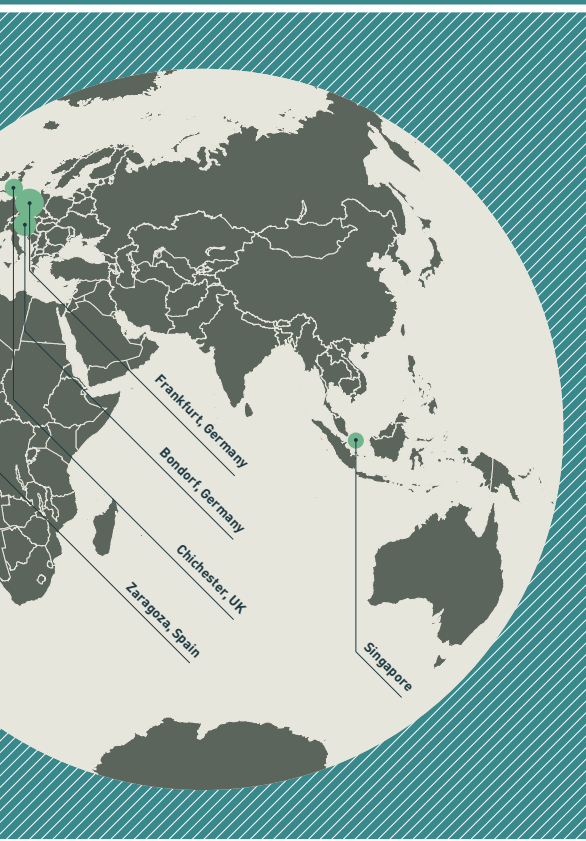
Provision of green access for every household in England could knock £2.1 billion off the annual healthcare bill

urban heat-island (albedo) effect, storm-water attenuation and run-off management, as well as cuts in costs of drainage. In addition, greening brings potential for noise and sound insulation, building energy conservation and fuel savings, not to mention improvements in air quality.

As evidenced by much-photographed smog in Beijing, air quality is proving more of a concern and factor in Asia than elsewhere, with urgent implications for development of green cities, as Wilder Associates director and BRE (Building Research Establishment) associate, Peter Wilder,

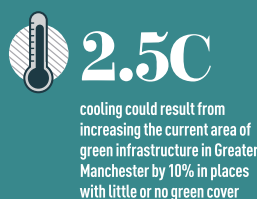
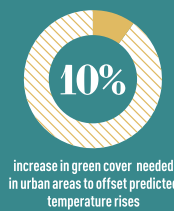
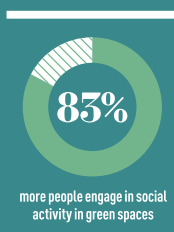
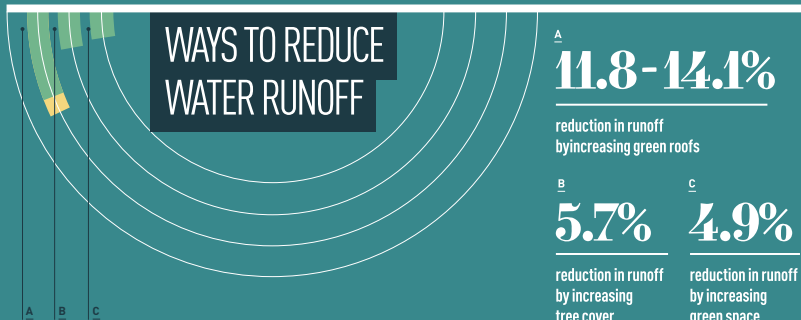
observes: "There is an immediacy to respond to the impact of flood and climate-change resilience, mostly driven by the investment sector, that requires action on the part of developers."

"However, in China, where development is often facilitated by central government, there is a growing concern over long-term effects of urbanisation on public health. In recent years, China has experienced a hike in the number of mental illnesses and respiratory diseases related to rapid growth of cities and breakdown of the traditional family unit. Healthcare and care for the



Republic Polytechnic Singapore	25,013m ²
Expo Zaragoza Empresarial Business Park Zaragoza, Spain	43,172m ²

Source: American Forests



Source: Forest Research (2010). Benefits of green infrastructure

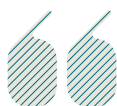
elderly is now a major focus for China and green space is being seen as a key performance indicator for sustainable cities."

Around the globe, for future cities evolving out of major existing urban centres, such as Beijing, Singapore, Delhi, New York or London, a vital selling point for ongoing investment in greening is its flexibility and suitability for retrofit scenarios.

"City farming and urban food production are getting all the headlines," says Mr Grant. "But the real excitement and growth is in retrofitting existing buildings with features like green roofs and

living walls, and in the greening of the ground-level curtilage of buildings with pocket parks and rain gardens. As more and more existing building stock is examined, we are coming to realise much more can be achieved than was first thought."

As a basket of benefits, the concept of green infrastructure (GI) for future cities highlights importance of the natural environment in decisions about land-use planning and brings together a mix of ecosystem services to support both the life of a future city and lifestyle of its residents. GI interconnectivity links environmental



The real excitement and growth is in retrofitting existing buildings with features like green roofs and living walls

concerns, such as soil and water quality, with social issues, such as recreation and amenity, plus factors including healthy economic growth and tourism.

Taken in the round, the green agenda is a marketable differentiator for world cities, as illustrated by its ringing endorsement from Mayor Vincent Gray, in Washington DC, at the launch of the long-awaited Sustainable DC Act of 2012. With packages such as the planting of some 6,400 trees to form part of a 40 per cent canopy-cover target, the stated ambition of the American capital is to become "the green-

est, healthiest and most-liveable city in the US".

A phrase employed in connection with plans for Washington DC has been "winning the future" and, for urban environments, it is plain to see there will be no victory without achievement of green goals, assisted by ecosystem services. There may not be consensus yet on the merits and methods of calculating the value of ecosystems, but the cost of investing nothing in green infrastructure is in no doubt. The only future city is a green city. Nature is back in town. **R**

A MODERN METROPOLIS MUST PROVIDE ITS OWN POWER

Circular systems will help cities become more self-sufficient in energy and tackle the challenges of carbon, cost and security, as **Mike Scott** reports



ENERGY

■ Cities produce some 80 per cent of the world's greenhouse gas emissions so their future energy supplies will have to be much more sustainable than they are today.

This will happen through a combination of changes to infrastructure, more energy-efficient buildings and changes in behaviour of city residents.

Neil Kalita, of the Europe energy team at engineering consultancy Aecom, says: "Key energy challenges for cities in future will be carbon, cost and security of supply. Energy prices are only going one way and that's up. And we saw the impact of being without power in New York during super storm Sandy last year, which cost the city billions of dollars."

The pattern of energy use in cities will have to change, Mr Kalita believes, from a "linear metabolism" to a "circular metabolism" involving closed-loop systems. Currently energy flows into the city from remote power stations, but in future cities will produce much more of their own from renewable sources, such as energy from municipal waste and sewage.

Thames Water, for example, has just announced a £250-million investment in a technology called thermal hydrolysis process (THP), which will allow it to improve efficiency of the anaerobic digestion process that it already uses to meet 14 per cent of its annual energy needs – pumping and treating water is an energy-intensive business – and which last year saved £15 million in energy costs.

Lawrence Gosden, Thames Water director of capital delivery, says: "This investment is good for the environment, our business and our customers. As well as being environmentally friendly, generating energy from waste reduces running costs by protecting us from the price fluctuations of the mainstream, non-renewable energy markets."

Many changes that will cut energy consumption in cities will come from buildings, which produce 40 per cent of all emissions and are under increasing pressure

Trams rolling through heart of the city
Page 11



from policymakers to become more efficient.

Policy measures include introduction of Energy Performance Certificates and efficiency targets under the EU Energy Performance of Buildings Directive. In Tokyo, 1,300 of the largest commercial buildings are subject to a cap and trade programme, while in the United States cities including New York, Austin, San Francisco and Philadelphia, now require disclosure of energy consumption data in commercial buildings of a certain size.

"We're going to see smarter buildings, more responsive to the demands of their occupants," explains John Alker, director of

policy and communications at the UK Green Building Council. "That means much better, real-time information about energy use through super-smart meters, but also buildings used differently to optimise energy use."

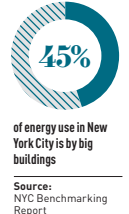
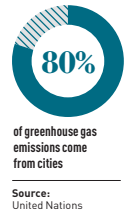
Such information will be a vital part of creating more sustainable cities, says Mr Kalita, citing the work of companies, such as IBM and Google, in creating the concept of a smart city. "Part of closing the feedback loop is to provide more data," he says.

This information will inform decisions about energy consumption and production at every level, from operation of national and city-wide smart grids to building management systems and smart meters.

"Energy efficiency is one of the biggest challenges for cities," says Mikele Brack, an adviser to the World Cities Network and the C40 Climate Leadership Group. "No matter how you look at energy generation and supply, the most important thing is to control the



The most important thing is to control the energy we are already using and reduce that first



energy we are already using and reduce that first."

Examples of this include Burj Khalifa, the world's tallest building, which uses solar water heating to heat 140,000 litres of water every day, saving 3.2 megawatts (MW) of energy, while One World Trade Center, one of the buildings that will replace the twin towers in New York, will have its own fuel-cell combined heat and power (CHP) plant producing up to 1.2MW of electricity, and using waste heat to provide hot water and space heating.

New technologies will in future help to turn buildings into mini-power stations; a group of UK universities is developing functional solar photovoltaic coatings on steel and glass to incorporate into existing and new buildings, enabling walls and roofs to generate, store and release energy.

This means the building can rely on a continuous sustainable energy source even when there is no sunshine. Sir David King, former government chief scientist and recently appointed to lead the Technology Strategy Board's Future Cities Catapult initiative, says: "My hope is that in future we will all be painting the outside of our houses with paint that has plastic PV particles in so the whole house can help to generate energy."

Future energy savings will also come from the Internet of Things, which will see transport, energy and buildings linked by a global network of sensors. Sir Richard Branson's Carbon War

Room suggests that this phenomenon could cut carbon emissions by more than nine billion tonnes by 2020.

However, all of these changes will have limited effect if building occupants do not change their behaviour.

Esmé Low, co-founder of the Climate Change Property Fund, which buys inefficient office buildings and improves their energy performance, says that one of the most effective ways to make buildings more sustainable is to tell people what you are doing.

"When we buy a property, we install an LED display in the building's reception, linked to the automated meter reading system for energy, waste and water," she says. "It helps measure performance and makes users aware there is a plan around energy efficiency and resource preservation that helps them buy into the whole idea and change how they behave."

It is not just at the individual building level that there will have to be changes; developments such as Liverpool ONE are setting out to create sustainable neighbourhoods. As well as ensuring all buildings incorporated energy-saving measures, developer Grosvenor also focused on sustainable travel, creating a new bus station, cycle and walking routes, and a bio-diesel plant that uses cooking oil from onsite restaurants to fuel development vehicles.

Such holistic thinking will be needed to ensure that cities live up to their potential without exhausting our energy resources. **R**

HOW SOIL CAN HELP SAVE THE EARTH

Cities cannot be truly sustainable unless they are “living” and connected to nature, says **Dr Rachel Armstrong**, who explores the relationship between compost and architecture

OPINION



Dr Rachel Armstrong, senior lecturer and 2010 senior technology, entertainment and design (TED) fellow at the University of Greenwich, School of Architecture, Design and Construction, is a medical doctor who focuses on the wellbeing of communities in the built environment

■ The greatest challenge to our near-future cities is in how we can grasp the full potential within our buildings to create a new relationship with the natural world, so we are not merely depleting resources and polluting our environment with toxic waste, but purifying and enriching it.

If we are to embody truly sustainable environments in our cities, then we need to establish a positive, new relationship between soils and architecture. This is not a call for more primitive lifestyles, but to establish the need for modern infrastructures and processes that promote regenerative and life-giving systems.

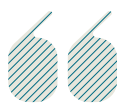
This may sound like a far-future scenario, but this kind of functional transformation already exists in the natural technology of the soil.

While solutions do not need to be invented, their specific context requires architectural consideration. Indeed, soils may actually be artificially produced and incorporated within the fabric of our buildings, and many of these approaches are, almost universally, applicable across a breadth of architectural styles, property types and geographic locations. So, communities may adopt them without sacrificing historical traditions and cultural identities.

While we have recently been wooed by ideas of “green” architectures, our growing penchant for greenery is provoking crises in conservation, since they cannot be sustained without harvesting rare bog soils from irreplaceable ecosystems.

The near-future transition we need to make in sustainable thinking is to reconnect with the complex technology of soils, which act as integrating infrastructures on an architectural scale that enable the free flow of elemental systems such as air, water, heat and matter through their bodies. Applying the technology of soils within buildings may make better use of our waste water and organic matter, and enable us to grow native, not transplanted, greenery.

Such activity could take place invisibly in existing architectural spaces that are under-imagined. Currently, cavity-wall insulation is filled with inert materials, such as fiberglass and foams, which perform no useful functions other than to trap insulating air. Yet, Astudio architects are researching how these same spaces may become sites of soil production through domestic composting practices.



The near-future transition we need to make in sustainable thinking is to reconnect with the complex technology of soils

Earth can act as filters for purifying waste water, transforming organic matter into heat and passive spaces into physiologically active sites, fitted with units that recycle organic waste and water. For everyday situations, composting produces comfortable, slow-release chemical energy that could be controlled by simply letting

more or less air into the system. In an emergency, these units may increase our survival should our grid systems fail, as well as increase the city’s resilience to withstand and recover from potentially catastrophic assaults.

Composting is growing in popularity. Armed with “red wrigglers”, a species of worm, New Yorkers have started a composting revolution where organic waste is turned into nutritious soil.

Yet waste matter may be transformed and applied in different ways too, using different techniques and technologies. The winners of the Bill and Melinda Gates concept challenge to redefine the toilet have developed systems for transforming human waste into electricity with microwaves, recycling urine to flush or turning excrement into charcoal.

In case you worry about what these innovations will look like, the Philips Microbial Home Probe project proposes a series of luxurious products where the house of the future is viewed as a biological ecosystem capable of filtering, processing and recycling what would normally be considered as waste.

Rather than following the modernist obsession for sterility, Philips proposes a new relationship with micro-organisms to run our homes and invite them in to produce methane fuel for cooking and lighting. For example, a bio light is proposed using bacterial bioluminescent lighting, an urban beehive to combat the decrease in insect pollinators, a bio-digester island, biological larder, a plastic waste up-cycler and a filtering squatting toilet.

Our near-future cities will have a much richer infrastructure than today. They will sustain living communities of biological and chemical agents that will function like soils and be monitored through “smart” sensors. They may be beautiful items or invisibly woven into the building fabric to make more efficient use of resources. Yet these radical solutions are also compatible with our diverse needs and lifestyles. Ultimately, they will transform our biologically desert-like urban environments into fertile, bio-diverse ones. **R**

COMMERCIAL FEATURE

Barcelona: where protocols and people meet



Many world cities talk of strategic ambitions, especially for investment, growth and prosperity, but the emphasis in Barcelona is different: Barcelona wants to become a smart people-oriented city.

The aspiration is for technology to contribute to the achievement of a greater degree of welfare and quality of life, as well as economic progress. The future of Barcelona has a human face and social sustainability at its heart.

The vision of Barcelona City Council seeks to build a healthy city model founded on the integration of the environment, urban planning and IT infrastructures. This Smart Barcelona strategy will create a city of productive, human-scale neighbourhoods within a hyper-connected, high-speed and zero-emission metropolis.

There are six key strands to the Smart Barcelona future-city framework – built environment, transport, energy, water, interconnectivity and governance. Their systemic integration is the challenge.

For housing and commercial property, green building solutions target energy self-sufficiency, based on extensive installation of solar panels, plus combined heating, cooling and hot-water recycling systems.

Movement of people in, out and around the city is promoted by the use of electric vehicles, combined with the orthogonal urban bus network. This new approach is part of the new Mobility Plan.

In energy infrastructure, smart management strategies for street lighting, for example, are helping to reduce city consumption and carbon emissions. Centralised remote management of automated irrigation systems is further minimising civic resource use for water.

Interconnectivity will support development of a new, unified communication network, integrated in a city-management data platform. Creation of a city operating system (OS) will decouple individual technological solutions from their providers and build on cross-platform sensors.

As Mobile World Capital, Barcelona is also committed to delivering innovations in mobile technologies, with the Barcelona a la Ruzca Plan (Barcelona in

your pocket) being one of the most immediate outcomes, which will promote and spread contactless payment systems using near-field communication (NFC).

All of this progress is made by constantly and transparently communicating openly with citizens, business and key community stakeholders. Active engagement with more than 800 civil society organisations is underpinned by an Open Government project making public data available.

This spirit of collaborative working and knowledge-sharing for the common benefit is also evident in the role Barcelona plays as lead promoter and original host for the City Protocol Society.

The society brings together more than 200 members, including representatives from 35 cities worldwide, academic and research institutions, as well as multinational corporations and global partners. The goal is to co-operate at an international level for the definition of protocols that accelerate sustainable transformation of cities.

In its bid to deliver the quality of life desired for its people, Barcelona is a city prepared to reach out to others and share experiences, skills and learning. This healthy and positive approach to the future mirrors the attitudes and behaviour of its citizens. Like its people, Barcelona aspires to be smart and happy.



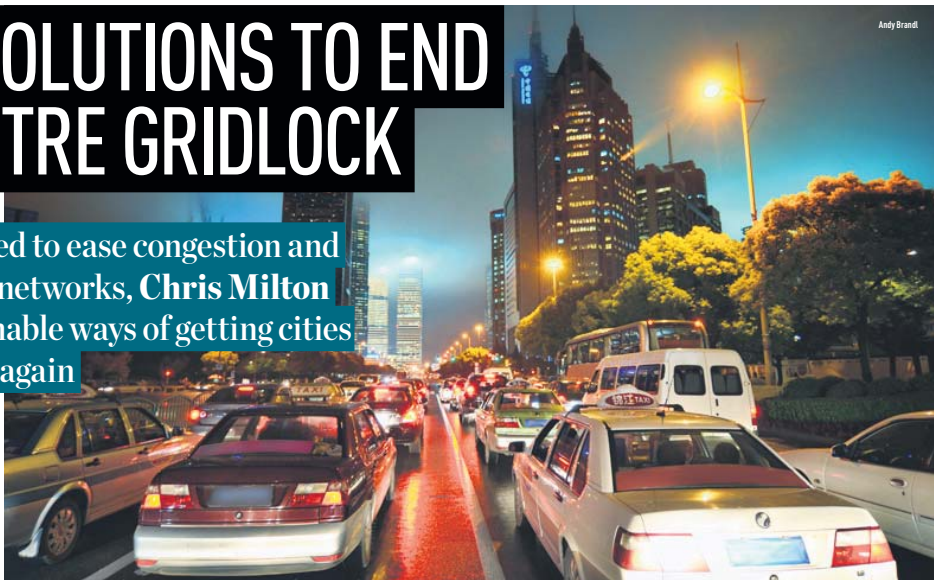
This strategy will create a city of productive, human-scale neighbourhoods within a hyper-connected, high-speed and zero-emission metropolis



Ajuntament de
Barcelona

SMART SOLUTIONS TO END CITY-CENTRE GRIDLOCK

With the urgent need to ease congestion and decarbonise travel networks, **Chris Milton** investigates sustainable ways of getting cities and people moving again



ROADS

■ The biggest problem facing transport in cities is capacity. Road systems envisioned and built for a different transport mix are creaking under the strain of cars.

Department of Transport figures show that more than 60 per cent of all commutes are undertaken by car, with 85 per cent of these journeys having just one person in the vehicle.

As Paul Campion, industry executive for transport at IBM UK, explains: "Even if we wanted to, we couldn't pour enough concrete or bend enough steel to accommodate people. We have to create more capacity across all modes."

The modes he refers to are the different ways by which people travel. Cars are one, but as their use has increased, others such as walking, cycling, buses, waterways, rail and trams have been pushed to the sidelines.

The key to freeing traffic in cities is, therefore, to ensure capacity exists across all forms of transport to allow people to travel as they please within an integrated and sustainable network.

The first step in achieving this is to reduce the number of one-occupant cars on the roads. Several websites exist to help people share journeys and many businesses, such as BT Group, RWE nPower and BAA Heathrow, operate car-sharing schemes for employees.

Car clubs are a new trend in urban driving. They allow vehicles to be hired for short periods from parking spots around a city in a solution which provides mobility while reducing incoming traffic. This approach has proved so successful in Europe that Ford and Mercedes Benz have launched their own services.

More than 30 per cent of all urban traffic is caused by people searching for a parking space, according to IBM, so another miti-

gating solution is smart parking. This uses sensors to detect when a space is free and relays that information to a person's smartphone. The person can then pay for the space using their phone, drive to it and park.

Smart parking has recently undergone its first European trial in London at Westminster, which is looking to roll it out to manage both parking spaces and delivery bays.

There are also plans to allow people to reserve special parking spaces next to electric-vehicle (EV) charging points. These are spreading across Europe quickly, Estonia being the latest country to launch a network, and the UK will have more than 7,000 charging points by the end of 2013.

Many are concentrated in urban areas and EVs are seen as an integral part of efforts to promote healthier urban lifestyles through reducing air pollution while decarbonising the transport system.

Reducing traffic on the roads is only part of the solution, however. In many places, roads form barriers which prevent other modes of transport from accessing an area. Changing this by enhancing bikeability and walkability of cities will also increase transport capacity, according to David Carter, a market director for transportation specialists MVA Consultancy.

He uses the Nottingham ring road as a prime example of how introducing speed bumps, replacing underpasses with raised crossings and planting trees can improve accessibility and make the environment more attractive. "This has made it more permeable," he says, "which makes the town centre seem bigger, generates connectivity and increases footfall for the local economy."

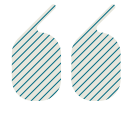
The experience is echoed by Bristol, which has used its status as a Cycling City to significantly increase numbers of commuters both walking and biking.

Blending the different forms of travel together into a seamless transport solution is possibly the greatest challenge of all. There are lots of travel planning services available, but many of them, according to Mr Campion, do little more than relay existing timetable information.

He envisages a new form of service enabling people to pick and alter their journey depending on prevailing transport conditions, whether they want to cycle one day, go the fastest way the next or take the most environmentally friendly route.

These solutions will rely heavily upon the supporting traffic management system and its ability to monitor people's movements in real time. This is already possible through smartphones, digital CCTV cameras and a new breed of cars which exchange data with their surrounding area, so very little new infrastructure will need to be installed.

Critically, such traffic management systems will not only be able to monitor current usage, but also predict where spikes may be about



Blending different forms of travel together into a seamless transport solution is possibly the greatest challenge of all

to happen, advising people to make different transport choices before congestion occurs.

These systems could also see where user preferences are not being met, enabling planners to introduce extra capacity proactively and giving people the opportunity to travel in the way which is best for them, best for the environment and best for the transport infrastructure.

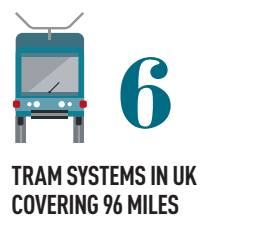
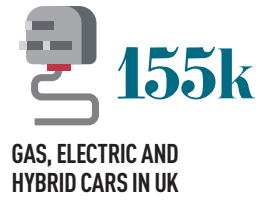
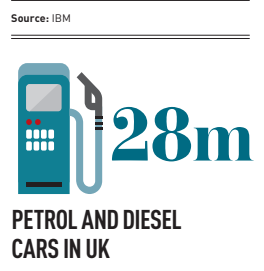
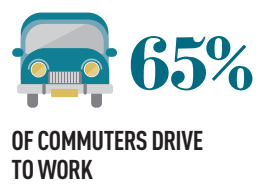
The final part of creating this vision of a sustainable and seamless transport system is changing people's behaviour. A large part of this relies upon businesses encouraging and embedding changes to their transport use within everyday activities.

Many recognise this and are introducing incentive schemes. One example is PHA Media in London, whose staff collect points for walking to work, hand-delivering letters and using bicycle couriers. Anyone with a consistently high score over 12 months receives a free annual Barclays cycle pass.

"People are now more in tune with the transport available," says Cameron Hall, account manager at PHA Media. "There is a higher level of consciousness and staff think before they act."

So the unfolding network of EV charging points and drive towards reducing pollution is only the start of sustainable transport in cities of the future. Road networks will be able to absorb increasing levels of traffic by changes in use, while technology will ensure the network is as flexible as possible in enabling people to choose travel options.

Many of the solutions already exist and are either in place or in the process of being rolled out. Now it is just a question of changing people's habits, so they are able to maximise the healthier, quicker and more sustainable options available to them. ■



Source: IBM

Source: Department of Transport

ROLLING THROUGH HEART OF THE CITY

From the hills of San Francisco to the boulevards of Melbourne, the tram mixes traditional appeal with modern green credentials, writes **Chris Milton**

RAIL

Freeing up road space and developing a flexible transport management system are vital to providing sustainable travel options in growing urban environments.

However, trams hold a key place in the development of cities' wider transport infrastructure, according to David Carter, a market director at transportation specialists MVA Consultancy.

"Trams are very good at getting large numbers of people into city centres," he says. "And there's something about trams which is more attractive to people."

As an example, he points to the new Birmingham City Centre Extension. This will allow Midland Metro to bring passengers into the heart of the city and provide an unbroken link with the main railway hub at New Street station, as well as regional centres like Wolverhampton.

Outside the city centre, trams have the advantage of being able to use existing rail infrastructure. In the Netherlands a class of tram has been developed which can travel on the same lines as long-distance trains.

In addition, many tram networks have reused existing railway infrastructure once it has reached its end of life. The line between Manchester, Oldham and Rochdale was used in this way when the local authority decided to redevelop it as an extension to the Manchester Metrolink. This provided a more frequent service for a lower overall cost than recommissioning the railway.

Many iconic cities have been greatly enhanced by tram systems, from the hill views of San Francisco and wide boulevards of Melbourne, to the Baroque architecture of Vienna and futuristic skyscrapers of Hong Kong.

However, there have been objections to tramline overhead power cables on aesthetic grounds. In Bordeaux they were frowned upon because they obscured historic buildings. So a revolutionary "moving rail" was developed, which is only electrified when a tram is over

it and is now being rolled out in other French cities.

Similarly, plans to extend Munich's system led to concerns that cables would spoil the atmosphere of the city's main park. So a battery-operated tram has been developed, with a prototype that travelled nearly ten

miles without recharging, setting a world record which could change tram travel forever.

These innovations aside, most trams need a constant supply of electricity to operate, offering ideal opportunities for decarbonising transport infrastructure in a number of ways.

For example, rolling stock manufacturer Bombardier has developed trains with components up to 30 per cent lighter than previously and which generate up to 30 per cent of the electricity consumed using energy-recovery systems in their brakes. The company expects savings from its trams to be even higher.

"We're also making it easier to get people on and off, making acceleration faster and improving

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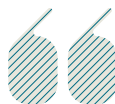
signalling," says Richard French, Bombardier's division lead for research and development. "All of which will increase capacity by enabling trains to pass through the system more quickly."

Another difficulty many metropolitan districts face, says Mr Carter, is having areas physically cut off from one another, often with barriers, such as major roads or industrial zones, interspersed between them.

Other transport methods, such as bicycle networks, come to a halt when faced with these barriers, leading to a fragmented network and loose regional cohesion.

In these circumstances, trams can open up new transport corridors and areas for economic development.

When this is combined with their ability to get into the heart of city centres, attractiveness to the general public and potential to reuse railway lines, trams are fast becoming a favoured form of transport to bring together metropolitan areas and deliver passengers between key urban centres.



Many tram networks have reused existing railway infrastructure once it has reached its end of life

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FUTURE PROOFING CITIES

\$418 million

Cost per year of replacing the ecosystem services (e.g. water provision, flood prevention) provided by Durban's network of green open space, 38 per cent of the city's total budget.

5 million

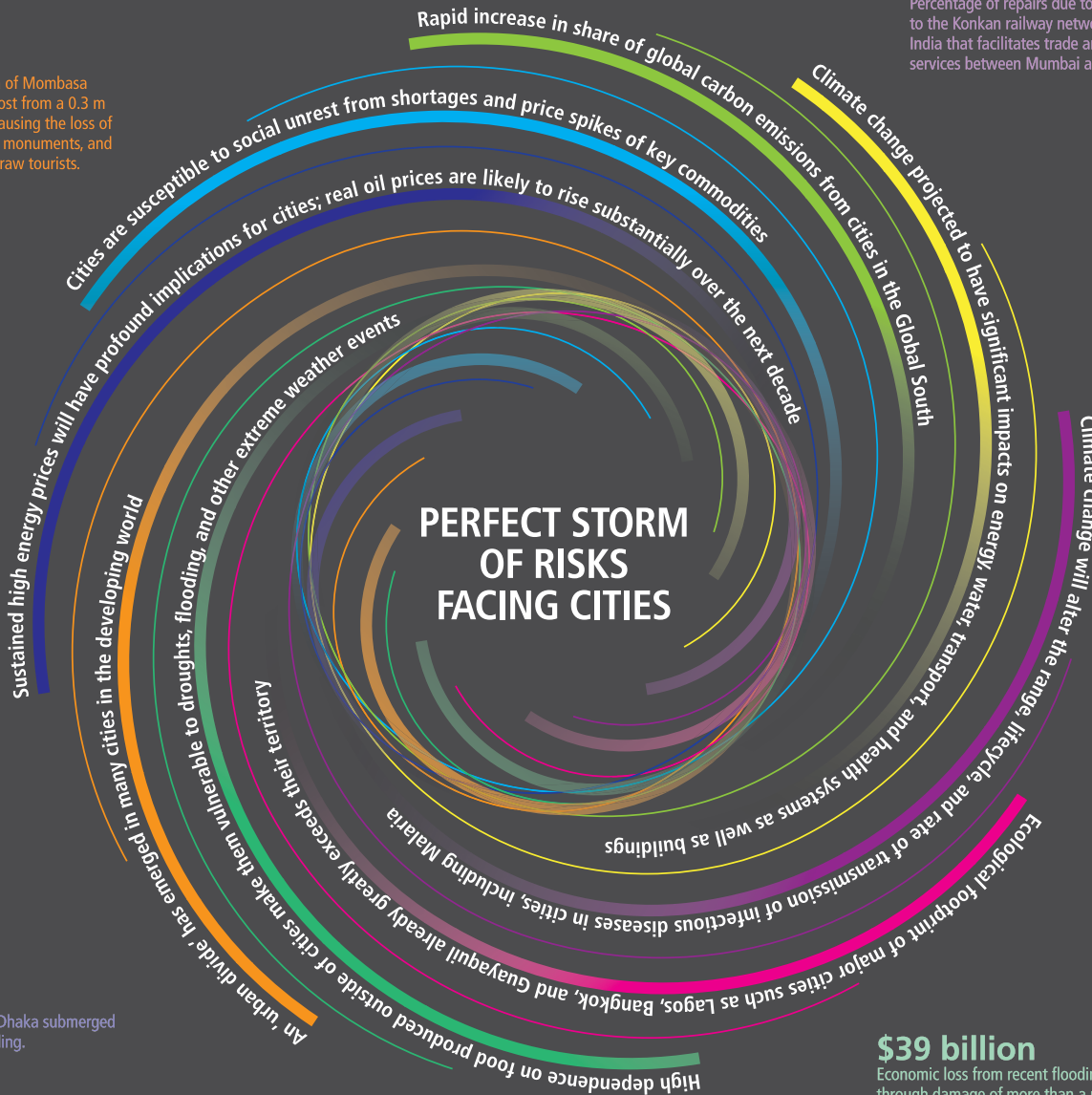
Number of people in Bangkok that could be at risk of flooding by 2070.

20%

Percentage of repairs due to climate change to the Konkan railway network in western India that facilitates trade and energy services between Mumbai and Mangalore.

17%

Estimated area of Mombasa that could be lost from a 0.3 m sea level rise causing the loss of hotels, cultural monuments, and beaches that draw tourists.



85%

Percentage of Dhaka submerged by recent flooding.

44 million

Number of people pushed into poverty by increases in food prices in the second half of 2010, many located in urban areas.

1.9 million

Number of people affected by recent flooding in Manila.

\$39 billion

Economic loss from recent flooding in Bangkok through damage of more than a million buildings and impacts on commerce and industry.

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