

FTurban ingenuity

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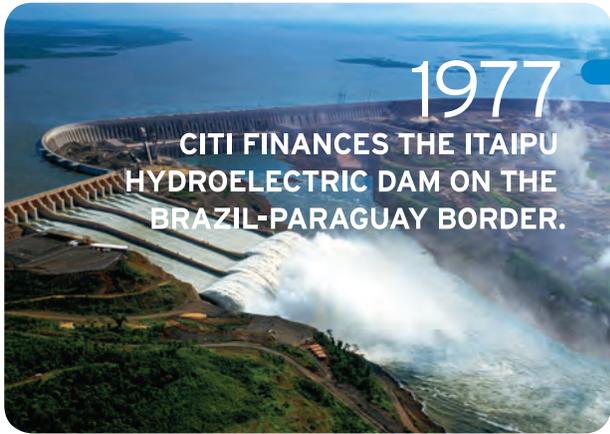


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Ideas in action



Today, more than half of the world's 7bn population lives in cities. By 2030, the number of people who are city dwellers will have risen to more than 5bn, according to the United Nations. The explosive growth of cities not only marks one of the most significant demographic trends of the 21st century, it also raises exponentially the pressure on urban areas in every continent to provide the necessary services and amenities to make modern communities work.

These economic, social and political challenges provide the background to the decision by the Financial Times to publish a series of three magazines on urban ingenuity to accompany a global awards scheme run jointly by the FT and Citi, the US financial services giant. The FT/Citi Ingenuity Awards: Urban Ideas in Action programme will recognise ingenious individuals or organisations that have developed solutions to urban challenges in the fields of education, healthcare, energy and infrastructure. Insead, the international business school, is the research partner for the awards.

This, the first Urban Ingenuity magazine, focuses on energy and infrastructure, featuring profiles of some of the strongest candidates for the awards. The FT has also invited opinion formers and other experts to make their own contribution to the debate on how best to address the 21st century urban challenge. Videos, published on FT.com, accompany this magazine.

A second magazine and set of videos will be published in September. Their focus will be on education and healthcare, the essential services without which cities can neither function nor thrive. Finally, the FT will publish a third magazine, with accompanying videos, to provide the backdrop to the awards, which will be announced in December.

I am delighted that the FT is bringing its global reach and reputation to support this important publishing initiative, on one of the most important themes of our age. ■

Lionel Barber
 Editor, *Financial Times*

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Let us know your thoughts

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INTRODUCTION



Streetwise

Look beyond the concrete jungle and you will find urban centres have always been incubators of innovation, writes **Edwin Heathcote**

What is the city," asks the tribune Sicinius in Shakespeare's *Coriolanus*, "but the people?" Cities are mankind's greatest creation and they are also, it seems, a kind of human destiny. The fate of homo faber is to become homo urbanus. And that destiny is on a roll. Two centuries ago, only 3 per cent of the world's population lived in cities. Now it is 50 per

cent and, if current trends continue, in a couple of decades it is forecast to rise to 70 per cent.

In many ways cities have stayed the same for millennia. The basic infrastructure, the markets, the security, the concentration of talent, the density of population at which it becomes efficient to organise into a civil society, the institutions, the schools and healthcare, the mechanisms of governance – these have all remained recogni-

sably the same factors that have attracted people from country to city for centuries.

A walk around the ruins of Pompeii is a reminder of just how little cities have changed. The houses and courtyards, the tight streets and squares, the bars and bakeries, the brothels and workshops reveal an urban landscape that is extraordinarily familiar to us today.

But in other ways cities have to continue innovating

to survive. The cities that have proved most robust and most historically (and continuously) successful are those that have demonstrated an ability to adapt to change.

Urban ingenuity is not always necessarily easy to see – even though you might know it when you encounter it. It might not be reflected in the skyline, but rather in the activity at street level. It might not be immediately apparent in a city suffering from crushing poverty, yet that innovation might be exerting a significant, invisible, impact on the lives of the poor.

The presence of urban innovation can also be obscured by quite how surprisingly bad we are at predicting which technologies and innovations will have the most impact on our everyday existence. One of the finest examples of this has been text messaging. Never expected to be taken up by users in such numbers, it has proved a cheap method of communication for those who might previously never have gained access to a landline. Another might be the washing machine, which freed women from the drudgery of one of the most onerous domestic chores. Ha-Joon Chang, the economist, described it as a technology that had a more far-reaching effect than the much-lauded internet.

But what are the contemporary equivalents of these innovations? If cities are crucibles of ingenuity and invention, what are the best ideas that have been generated in recent years? The aim of the FT/Citi Ingenuity Awards is to try to discover the best and most ingenious ideas to improve the lives of city dwellers across the world, both rich and poor.

The awards process has concentrated on four areas:

energy, infrastructure, health and education. Together, they provide a cross-section of contemporary innovation in urban life. The entries range from the macro to the micro, from city-wide transport infrastructure to the provision of toilets for shanty towns.

A great number of the entries focus on energy, as we might expect, and these evoke the spectre of global warming and the increasing load that cities are putting on the earth's ecosystems. Cities account for 70 per cent of the world's carbon emissions – but they can also provide the infrastructure for an extremely sustainable way of life. Their density, shared facilities and the innovation driven by their insatiable needs may well be what drives the solutions to our environmental concerns.

The architect Teddy Cruz, who works between San Diego and Tijuana on either side of the US/Mexico border, has proposed that the success of a city should be measured not in terms of economic transactions per square metre over a given period but in terms of social transactions.

This would dramatically redefine our notions of what a successful city looks like – drawing it in terms of its population rather than its turnover. This kind of city also favours the density, the pedestrian-friendly size and close familiar and friendly connections of the favela over the social isolation, the inaccessibility outside the car and the sterility of the single-use suburb. It turns on its head our idea of economic success in terms of personal space and residential footprint and, in a stroke, democratises our view of the city.



Connected: many innovations have been generated by people who had to learn to live in close proximity to one another

The city is a machine for creating and sustaining relationships between people

Many of these innovations propose solutions for the informal city as well as the developed city. We have become used to the idea of the trickle down of developments from the global north, but perhaps in terms of city innovation, it will be the global south that begins to inform our new view of an urban world. It would be wonderful to think that ingenuity could be a two-way process and that our occasionally moribund but wealthy cities could learn from the nimble responsiveness of the informal city in which people have had to learn to live in the proximity and interconnectedness of the light footprint that may well come to be necessary if our cities are able to accommodate their burgeoning populations.

The trick, it seems, really is connectivity. Not just in the fashionable digital sense but in the notion that the city is a machine for creating and sustaining relationships between people. A city's systems need to work in every sense, its transport, its pavements and parks, its alleys and civic and cultural spaces, its education and healthcare infrastructures, the water and power that flow like lifeblood through its subterranean and aerial veins. "The chief function of the city is to convert power into form, energy into culture, dead matter into the living symbols of art, biological reproduction into social creativity," wrote Lewis Mumford, the historian and sociologist, in 1961.

His humane vision of the city, conjured in an age of fear of nuclear destruction, remains as potent and as clear today as it was half a century ago. The city, though it may not often feel that way, is a machine for improving human life. It is ingenuity that makes that improvement visible, useful, equitable and enjoyable. ■

ADVERTISEMENT



The dream of linking the Atlantic and Pacific

with a waterway through the narrow land bridge between North and South America dated back to the earliest exploration of the New World. In the 19th century, as trade between nations became ever more important, that dream grew into a necessity.

France initiated construction of the 51-mile Panama Canal in 1880. Progress was slow, hindered by poor equipment, disease and lack of funds. The U.S. government took over in 1904, launching the most ambitious engineering and financing project up to that time. For funding, President Theodore Roosevelt turned to the International Banking Corporation (IBC), a legacy that is part of Citi's business.

The bank's capital allowed the government to purchase the best equipment available. The new machinery—including massive steam shovels, enormous steam-powered cranes, hydraulic rock crushers and pneumatic drills used to make holes for explosives—drew on the ingenuity of American engineering.

Two other equally important tasks were fighting disease and raising the standard of living for a workforce that eventually exceeded 40,000. The bank invested millions on proper sanitation, healthcare and social amenities, including YMCA clubhouses, a library and assembly rooms. Health and safety improved and staff retention rose.

The importance of the canal—not just to American defense and trade interests, but also to the wider global trading community—was underlined by President Roosevelt's personal interest in the project. In November 1906, he traveled to Panama to inspect progress, the first trip outside of the U.S. by a sitting president. On August 15, 1914 the cargo ship *SS Ancon* became the first vessel to transit the Panama Canal.

It is impossible to overstate the benefits this waterway has brought to world trade and commerce. New York and California, for example, suddenly became 8,000 miles (12,874 km) closer. In its first year, 1,000 vessels crossed the Canal. That number has risen steadily to the present rate of 50 ships a day, which will rise again in 2014 when the current project to widen the Canal is completed. From the Canal's earliest days, Citi operated branches on both sides of the waterway. The bank also issued guarantees to cover the tolls paid by ships.



On August 15, 1914 the SS Ancon became the first vessel to transit the Panama Canal.

To this day, Citi remains a strategic partner for the Panama Canal Authority, an autonomous government entity and Panama's largest corporation, responsible for the operation of the canal and all its installations and equipment.

Transport, whether by sea, road or air, has always played a part in Citi's growth over the past 200 years. Many of the lessons learned on the Panama Canal have been put to good use since. For example, when the founder of a large trucking company wanted to install racks on cargo vessels, which would lead to safer handling and stowing in rough seas, he turned to Citi for backing. New types of trailers were designed to fit on to his fleet of ships, a design that led to the invention of the cargo container.

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1865 U.S. CIVIL WAR ENDS

1904

CITI MEETS ROOSEVELT. ATLANTIC MEETS PACIFIC.



1945 U.N. FORMS

At the time, many people thought digging a 51-mile canal through the jungles of Panama would be impossible. But, not Teddy Roosevelt. And when he needed help to finance this monumental and perilous undertaking, Citi was there to support him. Today, east is 8,000 miles closer to west. 50 vessels pass safely every day. And international trade is booming.

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WALL FALLS

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COMMENT

MELANIE WALKER



Cities think big

The ability of urban areas to pool resources breeds innovation, which enhances everyone's quality of life

Whether it stems from babies born within the confines of a city or families migrating into municipal boundaries in search of a better life, the world's urban population is growing by 65m people per year. This may at first seem daunting, but population agglomeration can be a good thing. Concentration of services and resource allocation leads to a smaller carbon footprint, and creates conditions for growth. In fact, it might even be fair to say that urbanisation is a key driver for development, as per capita economic activity increases at least 10 per cent with every 5 percentage point increase in urban population. Further, for every percentage point increase in the urbanisation rate, in many places there is more than a 2 per cent increase in gross domestic product per capita.

Three important qualifications apply: not all growth is equal; not all commercial gains remain in the place they were created; and not all economic activity is accounted for in formal statistical reporting. These implied nuances should not be interpreted as negatives, but instead reflect the incredible resourcefulness and creativity emanating from cities to attract investment, create jobs, and

even improve the quality and standard of living for residents.

Cities are laboratories for invention. The time feels right to redefine traditional teaching about market failures to include informal markets, the globalisation of economies, and the notion of risk. What sounds like a great technological solution to someone sitting in a conference room in Silicon Valley might not

appeal to the target beneficiary residing in a slum in Harare. Yet, these are the systems and processes we continue to embrace.

Most people equate innovation in goods and services to advances

in scientific technology. While this is very important, there is also much to be done around the reinvention of financial tools. Mobilisation of domestic resources through metafinance, the pooling of individuals' loans or savings, brings the power of community savings to the equation and reduces infrastructure cost. Digitised payment (or identification) systems allow for simplified, transparent billing and collection systems. The power of social media can also be harnessed.

Service delivery tools and

It might even be fair to say urbanisation is a key driver for development

structures are outdated too. Advances in infrastructure across all sectors are desperately needed, but tend to fail when aimed either at the poor or the rich exclusively. Creative distribution systems for energy, transport and water offer great potential. Management and information systems for city governments of all sizes that are affordable, adaptable and accessible are lacking.

Introducing concepts and organisations with transformative potential is just the beginning. Investors, development professionals, communities, scientists and governments need to start a realistic discussion about new partnerships and shared vision.

Urbanisation is a platform for development, and cities can be a nexus for large-scale and replicable change. There are incredible opportunities to transform urban development into an equitable, profitable, and sustainable prospect. By inviting new partners to the table, we dream together. ■

The author is deputy director for special initiatives at the Bill & Melinda Gates Foundation

Destiny: the world's urban population is growing by 65m people per year



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1945 WORLD WAR II ENDS

1948

MARSHALL HAD A PLAN. LUCKILY, SO DID WE.



1957 THE EEC
IS FORMED

George Marshall, U.S. Secretary of State, knew that helping Europe recover from the devastation of WWII would mean restimulating its economies, not just rebuilding its structures. So, Citi decided to help support the funding for the "Marshall Plan." In under three years, 16 nations had received nearly \$13 billion in aid, and postwar Europe was fast becoming prosperous Europe.

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1999 THE EURO
IS INTRODUCED

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ENERGY INTRODUCTION



A tricky balance

Economic development shows a striking comparison between urban and rural energy use, finds **Ed Crooks**

Cities hold about half of the world's population but account for 60 per cent of its energy use, according to the International Energy Agency, which is backed by developed country governments.

Many of the problems of urbanisation – local pollution,

greenhouse gas emissions, provision of services and economic development – are linked to energy use.

In emerging economies, cities typically consume more commercially provided energy than rural areas. City dwellers are more likely to have access to electricity, to own energy-hungry

consumer goods, and to work in places that need to be powered.

Rural areas typically use much more biomass such as wood and animal dung for cooking and heating, so their total energy consumption is often higher. But the demand for coal, gas and power is greatest in cities. In China, cities use twice as much commercial energy per capita as the countryside.

In developed economies, including the US and the EU, that pattern is reversed, and cities are typically the most energy-efficient places. In the US, people in rural areas use 12 per cent more energy per capita than city dwellers. Those in the suburbs use 20 per cent more.

PHOTO: GETTY; GRAPHICS: RUSSELL BIRKETT



GRAPHICS: UN-HABITAT GLOBAL URBAN OBSERVATORY 2008, "STATE OF THE WORLD'S CITIES 2008-09"

Cities that address the challenges of energy provision can improve the lives of their residents and their prospects for economic development, as well as show the world ways to respond to energy shortages.

The entries for this category indicate that there is a demand for innovation that is economic and social, as well as technological. Often, the technology to make significant changes already exists, and the important part is finding ways for it to be deployed on a large enough scale to make a difference.

Proterra's electric bus is an example of a technological innovation. With a completely new body and systems, and an

innovative lithium titanate battery, the EcoRide has been out in front of the rest of the US bus industry.

Two other entries address the fact that poverty forces people to cook and heat their homes with coal, charcoal, wood and animal dung. Smoke and soot from those fuels are estimated to cause 2m deaths worldwide each year, mostly of women and children.

The Community Cooker from Kenya is a stove that burns waste at very high temperatures, above 800 degrees Celsius, to minimise noxious waste gases and ash. Reaching those temperatures was difficult, but the stove has been designed so that it can be built, maintained and repaired in the slums where it is being used.

The LPG project from India uses a very well-established technology, familiar from any backyard grill in the US, but with a new economic framework to increase access. One of the greatest obstacles

to the use of liquefied petroleum gas by poor households in India is the upfront costs for a stove, a regulator, a gas cylinder and fuel. The LPG scheme takes regular contributions from members of a community and pools them to pay those costs for a few house-

In China, cities use twice as much commercial energy per person as the countryside

holds every month. In the pilot project, all 60 households were connected over a period of five to six months.

Two influential cities, Tokyo and Houston, have taken very different approaches in their attempts to achieve greater energy efficiency and reduce greenhouse gas emissions.

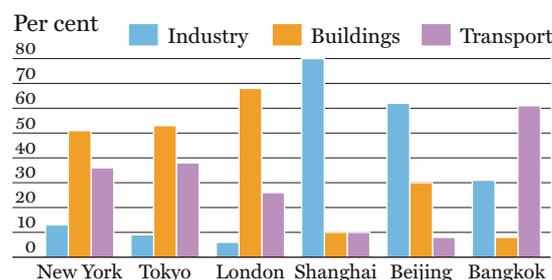
Japan's capital has introduced the world's first city-level cap-and-trade programme for carbon dioxide emissions, requiring commercial and industrial buildings to make energy efficiency modifications or buy emissions permits.

The scheme, launched in 2010, is a culmination of Tokyo's effort to improve energy efficiency, which it began in 2002.

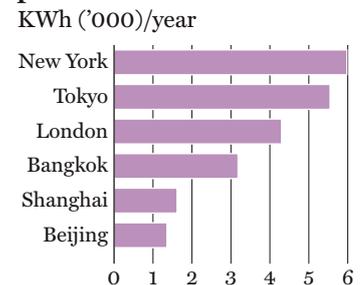
In Houston, by contrast, the energy efficiency programme is voluntary. The mayor's Green Office Challenge harnesses the competitive spirit of the city's businesses to drive down their energy use, with recognition and the possibility of some small cash grants its only rewards.

One of the many concerns about worldwide urbanisation – that economic development will mean standardised cities. While that may prove true eventually, the lesson of these awards is how diverse the challenges, as well as the solutions, still are. ■

Energy consumption by sector



Electricity consumption per household



ENERGY COMMUNITY COOKER FOUNDATION

As Jim Archer became more and more upset at the alarming growth of rubbish in Kenya, he hit upon a plan.

“I thought I’ve got to somehow find a way so that people pick it up and don’t just throw it away,” says the 75-year-old architect about the country of his birth, where he has designed several iconic tower blocks and hotels in Nairobi and along the coast.

“When I was small, Kenya was just the most beautifully pristine clean place on earth. Now everywhere you go there’s rubbish. By the mid 1980s, it really began to trouble me.”

Kibera, the largest slum in east Africa, is a case in point. Litter is part of life in the sprawling Nairobi area, made up of 13 villages and home to hundreds of thousands of residents who rent metal shacks bound with string. Rubbish piles up in broken storm drains and lines the railway track that cuts through stalls selling clothes. But now, thanks to Archer and a team of volunteers, slum rubbish is used to power an oven.

Archer came up with the “community cooker”, an industrial-scale oven made from bricks and metal, put together by the slum’s residents and fuelled with rubbish. This project recycles trash into energy for everything from frying and baking to boiling water for hot showers.

“What’s unique about it is its utter simplicity and the fact that something so simple can generate immense heat,” says Archer.

Not even the ash goes to waste, as it can be used for making bricks and adorning makeshift houses. The cooker guzzles rubbish and at the same time provides a safe and treeless ►

Out of the ashes

Kenyan slum dwellers have found an innovative solution to their garbage problem. By **Katrina Manson**
Photographs by **Georgina Goodwin**

A photograph showing a person in a black jacket moving a large pile of rubbish. The person is in the foreground, bent over, and the rubbish is in the background. The scene is outdoors, and the lighting suggests it's daytime. The background shows some structures and trees.

More than garbage: Timothy Murathi (left), Vinisias Asiango and other Youth for Change members move collected rubbish to the next drying rack every three days. It will be used in the community cooker





alternative to charcoal and firewood, as well as paraffin.

The project managers say the heat produced from one of their ovens saves the equivalent of 2,400 trees a year.

Some young men have volunteered to collect waste in wheelbarrows and deliver it to the cooker's storage area.

"Rather than staying idle, we say let's do something. Somebody who is idle is the devil's work, that's what they say," says David Kireki, a leather-jacketed, part-time rapper.

Standing amid the rubbish, Kireki performs a rap in Swahili about his ghetto life. He blames the government for harassing residents and abandoning them, despite many promises to help. But he does not mind the smell: "We enjoy it because we don't want to be idling."

It might be basic, but the slum is always busy turning the least likely offerings into profit. Bright trainers are strung up among other goods for sale – everything from trousers to school books. Stalls sell ripe avocados, entrails and samosas.

"It's a full assault on all the senses," says Janice Muthui, manager of the Community Cooker Foundation set up by Archer. She refers to Kibera's "kadogo" economy, which sells everything in small amounts at high profit margins. Washing powder and shampoo are sold in single-use sachets, for example.

"Kibera itself is like its own country – there are a lot of slumlord millionaires. Everything



ENERGY COMMUNITY COOKER FOUNDATION



makes money in Kibera one way or another,” she says.

The rubbish collection and cooking group hopes they will be earning their living within three months. The men pick out anything that will not burn, such as glass, or that should not, such as batteries, or that might sell, such as bottles. Some of what remains goes for organic compost. The youth group, whose motto is “Waste No Waste”, hopes to collect a small fee eventually.

The rest of the rubbish – clothes, plastic pots, plastic bags, paper and cardboard – goes to fuel the oven. It is dried out for three days before being sent down a chute to fuel an oven large enough to roast a goat and heat a large hotplate used to cook rice, stews and chapatis.

A team of young women runs the cooking section. “We have to do our best to make our life better,” says Jackline Sindenji, who cooks chapatis and boils sweet tea on the hot plate in front of her. “We prefer cooking with this because it’s cheaper and bigger. It’s too hot, but you just live with it.”

The original team overcame an initial design flaw. “I realised the noxious gases that would be generated would be very harmful

Doing it for themselves: locals built and maintain the community cooker

indeed, just like the seemingly harmless fires burning by the roadside – those are actually very dangerous,” says Archer. The World Health Organisation guidelines stipulate a minimum of 800C to burn off these fumes.

“It was burning at 300 and we had run out of ideas,” says Archer, who was equally determined to keep the solutions simple as he was to make the cooker sustainable in its slum environment. “If you can’t fix it with a piece of string, wire or a welding torch, I don’t want to know,” he says.

One resident, later nicknamed “Firebox Francis”, suggested that stoking the rubbish into a firebox fed with used engine oil and water via a drip-feed system on to a superheated metal plate would raise the temperature sufficiently.

“We had to dismantle and rebuild the firebox eight times in order to get the natural air flow into the combustion box correct.” Today it burns at 880C and an independent assessment from consultants SGS, commissioned by the Foundation, found it has 99 per cent efficiency, much higher than other heat generators.

The Kibera example is one of two prototypes, and having achieved the technical task, it still needs a coherent business model. The youth group that runs it foresees eventual sales of KSh2.3m (\$27,000) every month, but the foundation funded the entire construction and it does not expect to get its money back from the pilot project, although future models could be different.

The youth group also needs to boost advertising and add a seating area to attract the

punters, as the cooker is hidden from sight.

“I suppose, with hindsight, we as architects focused entirely on getting the community cooker functioning technically correctly and responsibly, which we’ve done,” says Archer. “It never occurred to us that somebody would need to spend time to spread the word, make it commercially viable. I didn’t want to rush off and start promoting community cookers until I was 100 per cent certain that we got it right. Naively, I assumed once we had such low-cost heat available,

there would be a mad rush to use it.”

The pace of the slum project was also set back by post-election violence following the 2007 polls. Many slum dwellers, including those who first

“If you can’t fix it with a piece of string, wire or a welding torch, I don’t want to know”

operated the pilot cooker, fled horrific ethnic violence in 2008, back to the rural lands of their families. Firebox Francis was among them.

But the technical breakthrough alone, and the fact that two pilot projects have put the cooker to the test, is already attracting widespread interest. The United Nations is considering funding community cookers in 29 Kenyan schools. A horticultural company in the nearby town of Naivasha wants one to feed its workers, many of whom stay in a slum. Groups in Botswana, Malawi and Nigeria are keen to replicate it, while humanitarian experts in Haiti and Japan have asked for help to do the same in disaster zones.

“We are only scraping the surface, I know we can do refrigeration as well as electricity,” says Archer. “And I’m sure that’s just the start of it.” ■

ENERGY

TOKYO METROPOLITAN GOVERNMENT

Eastern premises

An attempt to cut CO₂ emissions in the world's largest metropolitan area has been remarkably successful, says **Ben McLannahan**

There are two crucial questions for a cap-and-trade project: does it work and can it be copied?

Tokyo scores on both counts. There is compelling evidence of the success of its first mandatory emissions trading programme – introduced in April 2010 after three years of consultation – although an occasional visitor to the neon-lit bars of Ikebukuro may struggle to see signs of reduced power consumption.

Every owner of an energy-hungry office building in the area covered by the Tokyo Metropolitan Government (TMG) was asked to do three things: study its utilities bills, pick a three-year period between 2002 and 2007, then, by 2014, shave at least 8 per cent off the average electricity and gas consumption during that period (factories must cut 6 per cent or more). After the second phase, from 2015-19, consumption must be cut by 17 per cent from that base.

How owners reduce consumption is their decision. Some have replaced overhead strip lights with less energy-intensive, desk-based lighting. Others have retuned old air-conditioning units, removed fans from underground car parks, and asked tenants to make small sacrifices. Many bathrooms, for example, now lack the luxuries of hot water in summer and heated toilet seats in winter.

Preliminary figures suggest that in the programme's first full year of implementation, to April 2011, total emissions were down by 13 per cent from the base year, significantly higher than the equivalent fall of roughly 7 per cent across Japan. More than a quarter of facilities that had submitted reports by March 2012, moreover, had already exceeded their targets for 2019.

"Many people criticised the targets as being too aggressive," says Toru Morotomi, a professor in economics at Kyoto University. "In reality, it turned out that the targets were not so ambitious."

For many, conserving energy is becoming second nature. After the earthquake in March last year knocked out two nuclear reactors operated by Tokyo Electric Power (Tepco), triggering fears of electricity shortages in the nerve-centre of the world's third-largest economy, the central government ordered that big users of power in Tepco's service area cut consumption by 15 per cent during weekdays, beginning July 1 last year.

"Consumption of power in the entire area was down 18 per cent, and it was not rare to find some users cutting by as much as 30 per cent," says Teruyuki Ohno, director-general of the TMG's Bureau of Environment.

For many people, conserving energy is becoming second nature

In the end, the government lifted its restrictions nearly two weeks earlier than planned.

Tokyo is home to more people and more Fortune 500 companies than any city, but it is very light on heavy industry. Just two small steel mills lie within the TMG's jurisdiction. "They are struggling to meet their reduction targets," admits Ohno. "They have not been rendered inoperable, though. We are providing them with advice and consultation."

The TMG faced stern opposition from Keidanren, the nationwide business federation, and from Tepco itself. To appease the city's Chamber of Commerce, the TMG will provide poorer landlords with ¥2.5bn (£20m) of subsidies to ease compliance. If property developers build new buildings to the highest energy-efficiency standards, they have less tough reduction targets.

So far, excess credits have simply been banked until the first reckoning in 2014.

"The primary aim is to cap emissions; trading is just an additional benefit," says Yasushi Ninomiya, director at the Institute for Global Environmental Strategies, a central-government-funded research group.

The Tokyo model is beginning to spread. Saitama, a neighbouring prefecture, has something similar in the works and 35 other prefectures have adopted compulsory emissions reporting. Five cities and two provinces in China have shown an interest in adapting Tokyo's template.

Since the Democratic Party abandoned a proposed national emissions trading scheme in December 2010, politicians have not touched it. They would do well to try again, says Ninomiya.

"Tokyo has done as much as it can," he says. "Now it's over to the Ministry of Environment." ■



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ENERGY HOUSTON GREEN OFFICE CHALLENGE





On a mission

Efforts to increase energy efficiency in the capital of the US oil industry are changing the city, says **Ed Crooks**

When you first arrive in Houston, it appears to be one of the most

energy-hungry cities on earth. A sprawl of 10-lane highways crowded with cars and gas-guzzling trucks, it is the heart of a conurbation covering 8,778 square miles – larger than the state of New Jersey.

Air-conditioning blasts through its offices and homes to make them habitable in the brutal Texas heat. Everywhere are the gleaming tower blocks and spacious business parks that serve as headquarters of the companies that make this high consumption possible: Royal Dutch Shell, British Petroleum, ConocoPhillips, General Electric Oil and Gas, Weatherford International, and many more.

Houston is a big city – the fourth-largest in the US – and a very diverse place. It is also the subject of a concerted attempt to change the face that it shows to the world.

Texas is not, in fact, the most energy-intensive of US states; that dubious honour goes to Wyoming. In terms of consumption per capita, Texas ranks sixth, behind places such as Alaska, Louisiana and North Dakota, according to the US Energy Information Administration. But its inhabitants use almost 50 per cent as much energy as the US average, and twice as much as the residents of Florida. ►

PHOTO: GETTY



Brian Yeoman, Houston director for the Clinton Climate Initiative, a non-profit group that works to cut greenhouse gas emissions, argues that those figures give a misleading impression, because the city and the state are producing fuel for the rest of the country, itself an energy-hungry activity. But the fact remains that Texans burn a lot of fuel. As in the Middle East, a lavish endowment of oil and gas seems to militate against being careful in their use.

Houston's mayor is trying to change that. Elected in 2009, Annise Parker's priorities for the city are her "sustainability strategy" and the reduction of greenhouse gas emissions. She

The mayor has even bought a small fleet of electric cars and hybrids for the city

talks about making Houston the "green leader" in the US, and says "our vision and leadership can be models for the nation".

Laura Spanjian, the mayor's director of sustainability, argues that there is a direct economic motive for that strategy. "People want a city that is more bikeable,

more walkable, more livable, more sustainable," she says. "Employers want to be able to retain and attract the best people. To make sure they can do that, our city is undergoing a transformation."

The changing face of Houston includes a farmers' market outside City Hall, urban gardens on rooftops and in vacant lots, a city bike-share scheme, and a \$900m investment to expand the city's down-

town light rail network, opened in 2004.

In a bold act for a city often known as the world's oil capital, the mayor has even bought a small fleet of 25 all-electric Nissan Leaf cars and 15 Toyota Prius hybrids, and encouraged the installation of vehicle charging points.

Another innovation is the Houston Green Office Challenge (GOC), which attempts to turn the dry issues of energy efficiency into something to engage and motivate businesses.

Yeoman remembers a meeting in 2007, under the previous mayor, that showed what might be possible. Leading Houston employers and property owners were gathered to talk about certification for Leadership in Energy and Environmental Design (Leed), which is run by the US Green Building Council,

ENERGY HOUSTON GREEN OFFICE CHALLENGE



Taking charge: sustainability is a priority for Annise Parker, Houston's mayor

a non-profit organisation backed by the construction industry.

An executive from Schlumberger, the oil services group, said that to improve staff recruitment and retention, it had decided its offices should meet the Leed standard for energy efficiency, because the younger, technically skilled workers it wanted saw that issue as important. A representative from Shell said it was considering a similar move, and before long every company in the room was thinking about following suit.

"If these oil companies in the sin city of Houston can see the light, then everybody else can respond as well. Banks and insurance companies made sure they were not going to get left behind," Yeoman says.

The GOC works on Houston's competitive spirit, seeking to encourage improvements in

energy efficiency and other environmental practices from businesses across the city, and giving them a reason to do better even if they do not reach the Leed standards.

Property owners and tenants sign up at www.houstongoc.org. They are then sent a scorecard covering a list of subjects such as energy use, waste disposal and transport to work. This automatically generates a percentage score that the entrants attempt to improve over the following year, with the help of training and other support from the city.

At the Houston Permitting Center, where businesses and individuals go to get the permits they need to comply with regulations such as construction codes, there is a permanent display of environmentally friendly technologies such as solar-powered ventilation fans and water-saving toilets.

The information is all self-reported, with no system of supervision. The principal reward is "great publicity" for the companies that have performed well during the year. They are recognised by the mayor at an annual awards ceremony.

There is also a \$3m fund for grants to help businesses pay for efficiency improvements if they are going to save at least 15 per cent of their energy use.

Participating companies, however, say the greatest benefits have often been the ideas it has given them for saving energy and reducing waste, and the motivating effect on their staff.

Smith & Associates, an electronic components distributor, had already been pressured to improve its environmental performance. Its customers,

leading big-name computer manufacturers, have for several years been using less energy and creating less waste. Recently, they have started driving that down the supply chain to companies such as Smith.

"We had had an environmental audit in 2008, and it was not very pretty," says Matt Hartzell, chief operating officer. "That was an awakening."

The company reached a critical moment when it needed to replace its air-conditioning system. It decided to try a new high-efficiency, water-cooled unit from Carrier, part of United

Technologies, the conglomerate.

"That would have been a large capital outlay whatever we had done. We spent more than \$1m, although we got a tax rebate. We are looking at a seven-11-year payback. But we expect the equipment

to last 25 years, so it is worth it."

In the spring of 2011, Smith found out about the GOC, which had been launched at the start of the year, and eagerly embraced it as a guide. "It has been invaluable having the city of Houston to benchmark our progress, set goals and targets and standardise our baseline," Hartzell says.

The company added energy-efficient light-emitting diode lamps, solar panels for the sunshades protecting the parked vehicles outside, and two electric cars to lend to employees each month. Display screens in the reception area show how much power the panels generate.

Other cities have GOCs but Houston's is now the largest, with 375 participants. And Spanjian is optimistic about the future. "We are making progress," she says. "What we are doing is changing Houston." ■

"If these oil companies can see the light, then everybody else can"

ENERGY

THE ENERGY AND RESOURCES INSTITUTE

Spark of inspiration

A cook stove project designed to reduce smoke levels in India's slums has not only helped to alleviate poverty, but can also provide climate change benefits, finds **James Crabtree**
Photographs by **Harsha Vadlamani**



Traditional cooking: Timmakka Sandagiri prepares a meal on a wood-fuelled stove at her home in Nandanavanam, Hyderabad



Jayamma Dumpa knows only too well the difficulties of cooking the old-fashioned way. Outside her tiny one-room house on the outskirts of Hyderabad, she demonstrates how she fabricates a makeshift stove to prepare a meal for her family of seven.

She squats down and packs sawdust into a rickety old metal bucket, with an empty beer bottle placed in the centre. The bottle is removed, leaving a hole to hold her fuel, which she lights using kerosene. Once it gets going, plumes of black, acrid smoke rise quickly into the air.

She burns wood mostly, bought from a market around 2km away and carried back on her head. But when supplies are scarce or times are tough, she makes do. On the ground nearby lies a pile of alternative fuels, including plastic bags and an old punctured football.

Dumpa is just one of an estimated 2.7bn people worldwide who depend on food cooked on rudimentary or traditional stoves, roughly a third of them living in India. The practice is an important, if lesser-known, contributor to climate change. Its health effects can be severe, too. "Every year we see about 2m deaths as a result of smoke from these traditional stoves," says Radha Muthiah, executive director of the Global Alliance for Clean Cookstoves, a campaigning body. "That is a life lost every 16 seconds or so."

Such problems were well known to Christine Werthmann, an economist from Berlin's Humbolt University. In 2010, she conducted a survey examining energy use patterns in Hyderabad, as part of a wider academic programme examining ways to promote green policies in rising global "megacities". With ►

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a population projected to hit around 10m by 2030, according to McKinsey, the consultancy, Hyderabad's growth will lead to increased demand for fuel of all descriptions. But her team was convinced that the city's slum-dwellers would prefer to cook with liquefied petroleum gas (LPG) stoves. These are cleaner and more convenient than their wood-burning cousins. What, then, was holding them back?

Working with The Energy and Resources Institute (TERI), a New Delhi-based sustainability research group, Werthmann's team began to dig into the problem. Although the researchers had assumed cost to be the most likely barrier, the results of their survey suggested otherwise. "What we realised was that these women spent the same amount on wood that others spent on gas," she explains. "This was confusing. If it was just as cheap, why were they still using the wood?"

The reason turned out to be twofold. First, the women were unable to convince the local agents from state-controlled gas companies to supply them

with the gas cylinders, which are rented and require a security deposit. Most lacked proper identification documents, even if they did have enough money.

Many were also waiting for a long-running government programme that promised to cover much of the cost of buying a stove – which the supply companies try to persuade customers to buy from them – but repeatedly failed to deliver.

Yet even those who had documents and a willing supplier faced a second problem: saving enough to afford the upfront cost of roughly Rs3,600 (\$65) for the stove and a deposit for two canisters. With an average monthly income for most slum-dwellers of only about Rs5,000 (\$90), the price was too steep for most.

The researchers turned to the work of Muhammad Yunus, the Bangladeshi economist who pioneered microlending to the poor, for inspiration. "We all knew about Muhammad Yunus,

Heated debate: women argue with police during their protest against a rise in cooking gas prices in June 2011

Under the surface these slums turn out to be surprisingly co-operative

and we knew about the critics, too," says Werthmann, referring to widespread criticism that some micro-finance organisations over-lent to their clients and then used aggressive collection methods to recoup investments.

But she decided to explore a version of his approach by encouraging local women to save small amounts in groups. "Our question then was would there be enough trust in an urban community to make this work?"

At first glance, the slums of Hyderabad seem unlikely to be wellsprings of mutual aid. Take Nandanavanam, which I visited to learn about the cook stove problem. Compared with the tightly packed shanties of cities such as Mumbai, it is reasonably spacious, with rows of single-room brick houses on either side of dirt lanes. Even so its name, which means "celestial garden" in the local language, could hardly be less apt.

These are places that throw together the city's very poorest, and most residents eke out a subsistence living. Yet under the surface these slums turn out to

“Before we got the stoves, we had to spend much longer cooking. Now we can spend more time earning”

be surprisingly co-operative, not least in the form of local self-help groups that work with residents to support each other in times of need, or to lobby for the provision of basic public services.

“This approach dates back to traditional groups in India’s villages,” explains CS Reddy, chief executive of APMAS, a charity that helps to facilitate self-help groups. To see whether they could form the basis of a cook stove saving team, the researchers conducted an unusual field experiment. Working with APMAS, they invited around 270 residents in eight slums to play a game designed to measure levels of trust. It is a technique used widely in experimental economics, although more typically with students in laboratory conditions.

Participants play in pairs. Each person receives four Rs50 notes. The first is asked to hand over some money to the second. Whatever that person gives is trebled by the organisers. The second player is then able to return the favour, by giving as much money as she or he pleases.

The more money each side gives, the higher the returns to both. And the more they play, the more they learn that co-operation benefits both sides. “We discovered that while most people in the slums didn’t send much, mostly 50 or 100 rupees only, we also found that no one sent nothing... so we could be sure there would be no free riders,” says Werthmann.

Encouraged, the project team sought volunteers to take part in pilot projects. Two slums were chosen, including Nandanavanam, with 30 households taking part in each. Every participant in the Nandanavanam pilot put in Rs600 (\$11) each month. This was a manageable amount, but one that created a total large enough to purchase

gas stoves for five members, with the recipients chosen by a lottery. The next month the process was repeated. Over a period of six months, each member of the group received a cook stove.

The process was surprisingly trouble free, says Reddy. At one point the gas company suddenly increased prices, but everyone still made their payments. “They already knew they needed gas stoves, so there wasn’t much need for education,” he says.

Those who took part are clear about the benefits. There is less smoke in their houses, and cooking is easier. Time is also freed up, explains Rangamma Namala, one of the oldest participants. “We used to wake up between 4 or 4.30, but now we can sleep until 5 or 5.30, or cook food first and then rest,” she says.

Many of the women used the extra time to work, earning additional income for their families. “Before we got the stoves, we had to spend much longer cooking.

Now we can spend more time earning,” she adds.

Laxmi Gomara, another pilot participant, mentioned an unexpected benefit: “With the new stove, my husband started to cook. It’s easy, and he is now a good cook.”

Not everything is perfect. They sometimes run out of gas, and must revert to wood before replacement cylinders arrive. The pilot reached only 30 people, while around half of the slum’s residents, including Dumpa, are still cooking with wood.

The organisers are keen to scale up the project, although they admit this would require greater co-operation from the local authorities and gas companies. And in a slum like Nandanavanam, new stoves do not represent an end to the residents’ problems. Even so, Werthmann is happy with their first steps. “It’s a small project, yes, and it’s simple, but it works. And that is the beautiful thing about it.” ■

Modern methods: cooking with gas is cleaner



ENERGY PROTERRA

The green route

Fast-charging technology is making electric public transport feasible while helping the environment, says **Matthew Garrahan**
Photographs by **Ed Carreon**



In southern California, the car reigns supreme. But in a region not exactly known for its wide range of public transport options, one city is experimenting with technology that could point the way to a greener future.

Named after the Roman goddess of fruit, Pomona is a city of 160,000 people, about an hour's drive from Los Angeles along the usually congested freeway. It is in the foothills of the San Gabriel Valley, one of the most densely populated parts of the US and an area that has historically struggled with poor air quality caused by emissions from cars.

Improving air quality and

moving to cleaner fuels is a priority across southern California. Foothill Transit, which operates public transport in Pomona and 21 other local cities, has implemented an all-electric bus scheme, running a test involving three vehicles since 2010. The buses are provided by Proterra, a South Carolina company backed by Kleiner Perkins, the venture firm that was an early investor in tech companies such as Google and Amazon.

Proterra developed the charging stations and buses, which, unlike most other electric systems, only require 10 minutes to charge. "The fast charging made it really interesting for us,"

says Felicia Friesema, director of marketing for Foothill Transit. "Charging in under 10 minutes is essential for making electric technology feasible for use in a day-to-day system."

On a typically hot, cloudless southern California day at the bus station, passengers wait patiently outside a terracotta-coloured building that houses the central transit operation. It has changed little in decades: the main office has even preserved the original telephone exchange behind glass.

Outside, though, it is a different story, with an electric bus-charging facility built above a power line supplied by Southern California Edison, the local

utility. The docking station hangs over the road, allowing the bus to drive underneath it and connect with the charging arm, which plugs into its roof.

Charging is simple and straightforward: the driver only has to pull up close to the charger and the rest of the process is automated. And while it may be technologically sophisticated, the bus stop, outwardly at least, appears little different from the other stops at the hub. "Pomona's city planning commission required that Proterra install a docking station that mimicked the original architecture," explains Friesema.

A charged bus glides away from the station noiselessly. Electric motors make less sound than diesel or petrol engines, and the noisiest component of the bus – apart from a scripture-quoting man regaling his fellow passengers – is the air-conditioning unit.

The bus takes a short circular route and after about 20 minutes it returns to the transit centre, where it is charged once more.

"Previous electric systems would need an overnight charge," says Friesema. This was not practical, she adds. "It meant we would be short a bus for an entire day... so electric bus technology wasn't really realistic for the type of service that we provide. We needed something that could get back into service quickly and work seamlessly for the customer. They don't want to know that the reason their bus didn't turn up is because it ran out of juice."

The project was paid for with stimulus funds provided to states and local governments by the US government following the 2008 financial crisis. With the Federal

Transit Administration keen to move public buses to cleaner, lower-emission fuels, money was made available to Foothill Transit and other transport authorities. Foothill Transit received a \$20m grant: if the project is deemed a success, an additional nine buses will be ordered.

Proterra originally looked at fuel cell technology before concluding that battery-powered buses would be more economical and practical. The group was founded by Dale Hill eight years ago, after launching a pioneering fleet of alternative-fuel buses in Denver, Colorado. Kleiner Perkins Caufield & Byers has been Proterra's largest shareholder since 2011, when it invested \$30m. The funds came at a critical time for Proterra, which was desperate for capital following a Securities and Exchange Com-

mission investigation into one of its largest shareholders.

GM Ventures, the investment arm of General Motors, invested alongside Kleiner Perkins in Proterra. But with the money came a push for more

experienced management: Hill was replaced as chairman by David Lehmann, a former executive with General Electric and Caterpillar, the earthmoving equipment maker.

Marc Gottschalk, Proterra's chief business development officer, says zero-emission buses can also save money in the long run. "Because of the higher efficiency of the buses we can save [the transit authorities] money they would have spent on fuel costs in a pretty dramatic fashion."

An all-electric bus would save more than \$500,000 in fuel costs over a 12-year period,



On the buses: the only difference commuters notice on Proterra's electric vehicles is the lack of noise; the charging process is automated (left)

he says. In the UK and Europe, where petrol prices tend to be higher than in the US, "the saving would probably be 50 per cent more than that".

There is the matter of paying for electricity. There is also an environmental cost: as more people switch to electric vehicles, power stations will have to produce more power. Friesema says Foothill Transit is offsetting its electricity consumption by buying renewable energy credits that promote cleaner energy. California is also aggressively moving towards renewable energy.

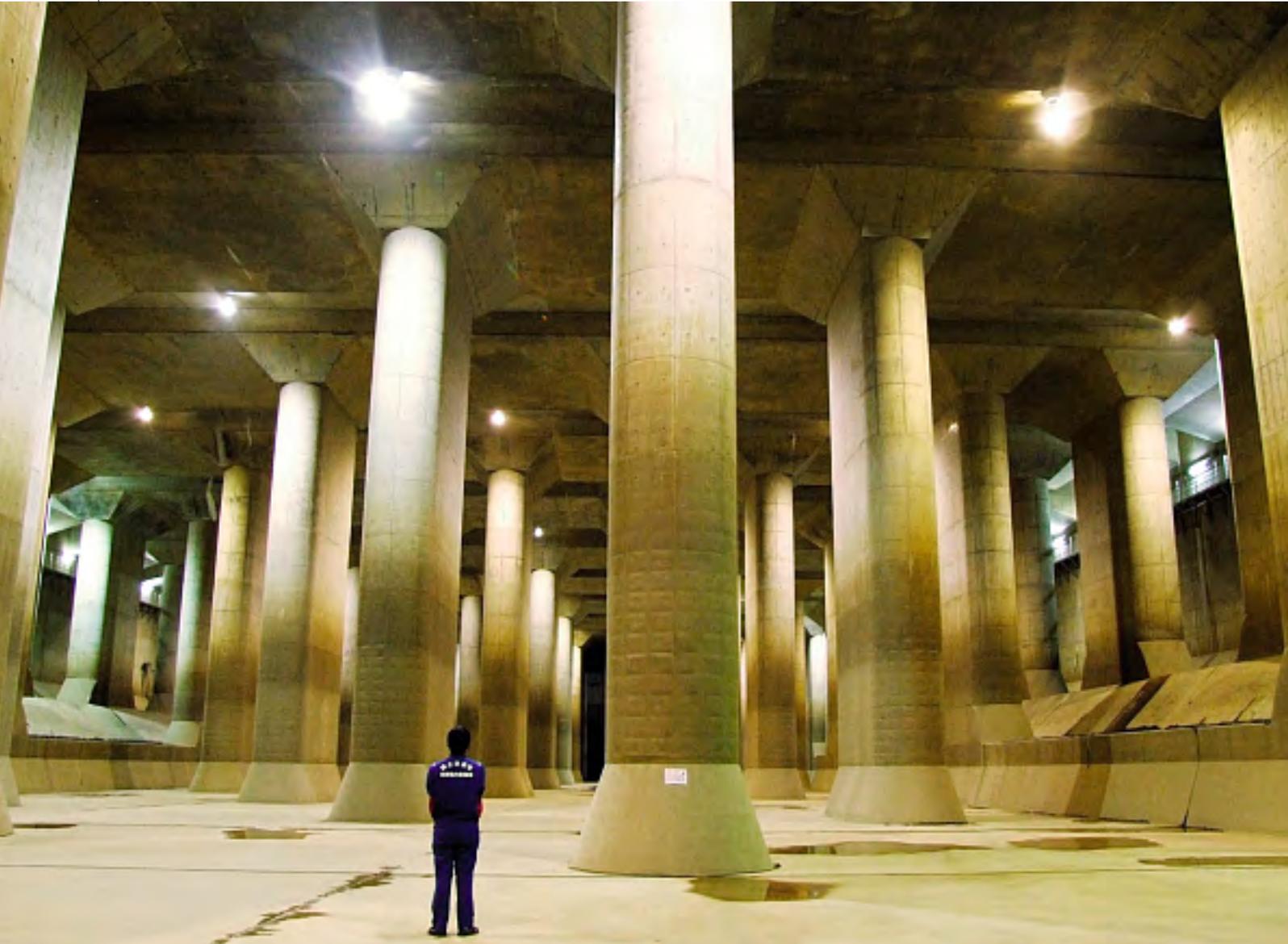
With electric buses offering big savings on fuel – and federal grants available – it is little wonder that cash-strapped transit authorities are interested. But the nascent technology continues to be expensive for now.

"On the capital cost side, what we're seeing is more economies of scale being driven by the auto industry," says Gottschalk. Car-makers are already selling electric cars, which is driving down the price of components and related parts. "When we first put a price on a [bus charging station] the price was \$1m. But it has fallen now to about half that, and is coming down all the time."

In Pomona, the project has worked well. "We feel that the number one way we can clean up the air is by getting people to [use] public transport instead of their car," says Friesema. ■

"Charging in under 10 minutes is essential for use in a day-to-day system"

INFRASTRUCTURE INTRODUCTION



Only connect

Few people realise the true importance of basic services for the industrialised city, writes **Edwin Heathcote**

The etymology of the word “infrastructure” is intriguing. It comes from the French, who used it to describe technologies below the surface, underneath the street. Its definition embraces sewers, water mains, gas pipes and electric cables. It is comparable to the viscera in the body, the guts and the airways that allow us to function while they remain concealed.

PHOTO: REUTERS;
GRAPHICS: RUSSELL BIRKETT

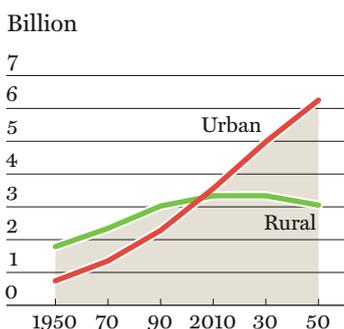
In fact, infrastructure is something we become aware of only when it is not there, when something begins to leak or when the water, the power or the signal fails.

Lewis Mumford, sociologist and historian as well as perhaps the greatest urban theorist, referred to infrastructure as the “invisible city”. He predicted the growing importance of the unseen infrastructure of communication, which has become known as the “smart city”.

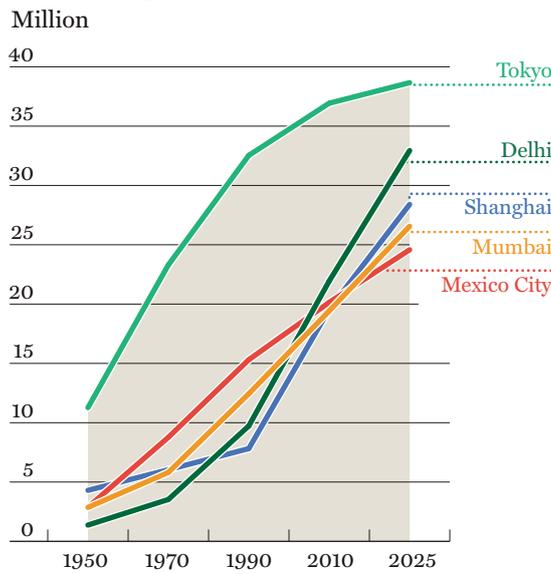
Of course, we take infrastructure for granted. Water and power, cable and phone lines are almost a human right in industrialised cities. In much of the world, however, dreams of pipes remain pipe dreams. Streets double as open sewers and water is dragged from polluted wells miles away. Power might be stolen from grids or might be available, but intermittent.

Infrastructure has also come to mean the very fabric of the city – its transport networks, streets, schools and hospitals, bridges and tunnels, airports and aviation, logistical systems, mining and agriculture, communications and so on. *Infrastructure*, Brian Hayes’ compelling 2005 book, covers all of this and reveals the world of unseen yet magnificent technology that allows us to live our lives. This

World population



Population growth in five of the world's largest cities



is building on an epic scale, a manifestation of man’s impact on the landscape that is often far more significant than the cities themselves – which, in comparison to the vast scale of infrastructure, often seem modest.

The downside to the idea of infrastructure is its ubiquity. Not only is there this stuff that we are dimly aware of; there is also “soft infrastructure”, a slippery term that can embrace everything from the education system and healthcare to the emergency services and law enforcement. Infrastructure is everything. This makes it a difficult category to define, but also the most interesting.

The entries have embraced everything from parks and district heating to the online Shack/Slum Dwellers International forum. There are transport schemes and urban plans, incremental improvements to informal settlements and hugely ambitious plans such as Abu Dhabi’s Economic Vision 2030, the emirate’s concentrated effort to reduce its reliance on the

oil sector and focus instead on knowledge-based industries.

There are cycling schemes and projects to improve road safety, and there are greening proposals embracing everything from the Superkilen Park in Copenhagen – a colourful public space intended to express the more than 50 immigrant cultures of the city’s Nørrebro district – to a portable farm in Manhattan.

The increasing privatisation of the city may strengthen security and may well lead to greater investment via business improvement districts and corporations, but it can also alienate the public from the civic space that is the lifeblood of urban activity: the space of communication and civic culture. Cities can exist only because of their communal spaces. Without these they become suburbs, and they need to be nurtured and adapted to continue to function.

It is encouraging to see the rich cocktail of public and private entries in this category, an implicit recognition that neither public nor private

It is something we become aware of only when it is not there, or when the power fails

sector has all the answers and that neither sector alone can cater for the complexity of the city. The particular combination of community co-operation, private, corporate and charitable finance

and municipal leadership, guidance and governance is what will drive innovation in cities.

It is only by acknowledging the proximity and coexistence of all the social strata of the global city that we can ensure they are made safer, more equitable, more alive and more successful. Cities continue to be places where more and more of us want to live. ■

INFRASTRUCTURE BITCARRIER

Go with the flow

A Barcelona company's traffic regulation system is easing congestion in cities around the world, but **Miles Johnson** discovers the technology can do much more

Following Spain's recent victory in the European football championships, the country erupted into celebration, with tens of thousands taking to the streets of city centres to cheer and dance in the fountains.

Festivities in the days following made travelling through the centre of Madrid near impossible, with traffic on some streets cut off to make way for the returning heroes' open-top bus.

Currently, Madrid's centralised traffic planning is a matter of keeping a watch on cameras to react to specific events or adverse weather conditions in order to decide whether to make contingency plans. Martin Méndez, the founder and chief executive of Bitcarrier, a Barcelona-based technology company, hopes that this style of traffic management is at an end.

Bitcarrier, founded by Méndez in 2006, is in the vanguard of using Bluetooth and wifi signals generated by mobile telephones and global positioning system devices to provide highly intricate, real-time traffic information to cities.

While the business is still small, Bitcarrier's traffic management system is active in 28 cities on five continents, with the company hoping to be present in Quito, Dubai, Mumbai and Chongqing by the end of 2013.

The company's proprietary technology involves deploying

sensors across a city. The sensors beam data back to a control centre every seven seconds to update town planners and infrastructure operators about vehicle speeds and traffic density.

Although Bitcarrier's traffic tracking technology knows where individual Bluetooth and wifi signals are, it does not have access to the identity of the owner of the equipment generating those signals, so privacy is not compromised, the company says. Zaragoza, one of Bitcarrier's customers, says Spain's data protection agency cleared the system for privacy.

Méndez, stresses the instantaneous benefits any urban centre, especially those in fast developing markets, can derive from effective traffic planning.

"A few years ago many people were talking about 'smart cities', and the idea suffered a bit from the hype," he says. "We tell our clients about how much productivity can be lost from people being stuck in traffic. It can be a hindrance not just to economic development, but the environmental impact of traffic jams is also important. We can provide a cost-effective solution that works very quickly."

Bitcarrier stresses that its product is not intended just to provide real-time updates. The aim is to allow users to optimise traffic flows, which means that congestion can be reduced, rather than simply observed. ►





INFRASTRUCTURE BITCARRIER

After the data is sent to controllers using a private cloud-computing network, the controllers can then manage flows by dynamically adjusting traffic light timings, closing and opening specific routes, and by changing street directions using reversible lanes.

Another advantage for cities looking to change their traffic control systems, aside from the benefits of Bitcarrier's detail, is that it costs far less than traditional systems that use cameras to grab images of car licence plates.

In Zaragoza, currently the one location where the company has rolled out its sensors across an entire city, the whole system cost about €800,000, with the local government paying Bitcarrier a maintenance fee.

The Zaragoza project, the company claims, has reduced vehicle journey times in the city by an average of 15 per cent. Such systems can also be used to improve the efficiency of public transport, as cities are able to know the level of demand for a particular route, and the congestion that can delay buses at particular times.

Besides allowing motorway operators and town planners to manage traffic, Bitcarrier says there are numerous further applications of its technology that it plans to harness. Bill-board advertisers could learn precisely the average number of cars that pass a particular location over a certain period, while individuals could use an app-like programme to make their own travel plans more accurate than current products offered by Google and Apple, the US technology companies.

Méndez was invited by the city of New York to use the technology to gauge the number of visitors looking at



water installations paid for by Mayor Michael Bloomberg. Later, the Louvre piloted its use for mapping visitor density at the Paris art museum. Bitcarrier has since won several contracts with cities and companies.

"Working in the Louvre was a priceless experience," recalls Méndez. "The gallery was closed so we could see the Mona Lisa in our own time."

Méndez has been joined in his business by his wife Cristina Galán, a corporate lawyer with an MBA from the Iese business school in Barcelona. She serves as Bitcarrier's chief financial officer and legal counsel, with the two of them building a team of 12 employees, and revenues of €3.5m last year.

Pau Rodriguez, a computer engineer who has worked on



several other start-ups, is responsible for development as chief technical officer, while Ricardo Fernandez, a former management consultant at the consultancy firms Accenture, Boston Consulting Group and KPMG, serves as chief operating officer.

Bitcarrier's big breakthrough came in 2009, when it won a contract to provide traffic data to Abertis, one of the world's

largest infrastructure companies, for its toll motorways in Spain.

"You always need to show that your product works first, and that means the first sale is always the hardest," says Méndez.

Bitcarrier's successful track record of 28 cities now includes partial deployments in Rio de Janeiro, São Paulo, Buenos Aires and Moscow.

Currently the company markets its product by working with larger companies as strategic partners that can help introduce its technology in markets far away from Bitcarrier's offices in Barcelona.

Within Latin America, where the company has managed to attract several big cities to trial its product, Bitcarrier is partnered with Telvent, the information technology company that is owned by Schneider Electric, and it has a partnership with IBM, the computer services group.

In spite of the advantages of having such names on board, Bitcarrier's business model is focused on providing services to cities, meaning the decision-making chain is inevitably slower than in the less politicised arena of corporate sales.

"We can implement things more quickly with infrastructure operators than with cities, as we need to convince cities that they need the system," says Méndez.

When working in emerging markets, the company has at times had to convince sceptical politicians that their cities have a sufficient number of users of smartphones, which generate the signals the system derives its information from. But the company is convinced that such technology is spreading so rapidly across the globe that this will soon cease to be a concern.

A trial in Panama City, which had relatively low smartphone



Streets ahead: in Zaragoza the system has reduced vehicle journey times by an average of 15 per cent; Cristina Galán is Bitcarrier's chief financial officer and legal counsel (left)

"We are a piece in the larger process of cities embracing technology"

penetration compared with European cities, has so far been a success.

Word has spread, and enquiries about trials have come in from an increasing number of places, including Iran and Japan.

Now that the business has established a pool of clients and a recurring revenue base, it is speaking to possible investors. So far the company has been built up using the founders' own capital, but the next step will be to partner with a venture capital investor to boost its sales platform and development team and help it expand further.

However, in spite of Barcelona's strong standing as a hub for European start-ups, there are few venture capital groups working directly within Spain, meaning companies must often look outside the country.

At the same time, foreign investors are reluctant to put money into Spanish companies due to the uncertainty surrounding the eurozone, even when many technology-focused groups in the country have little exposure to their domestic market.

Méndez remains confident that Bitcarrier will be able to sell itself on its own merits, and that investors will be able to see the potential of a company that he expects will derive only a small amount of its revenues from within Spain in the future.

"There are many possibilities with this business, such as revenue-sharing with cities themselves, which will be one of our next steps," he says. "We are a piece in the larger process of cities embracing smart technology." ■

INFRASTRUCTURE ORE DESIGN + TECHNOLOGY



Crate to plate

In a stalled construction site, urban farmers grow ingredients for their restaurant, finds **Alan Rappeport**
Photographs by **Pascal Perich**

Basil, tomatoes, bronze fennel, okra, eggplants: such crops are usually grown on pastoral farms in the countryside or the gardens of leafy suburbs. But one Manhattan restaurant has taken the

farm-to-table craze literally, building a vegetable farm in its concrete backyard.

New Yorkers hate wasting space, so when construction stalled on one of the two towers of the Alexandria Center, the Riverpark restaurant decided to make the most of the site. The restaurant, founded by Tom Colicchio, head judge on the popular *Top Chef* television series, serves classic US fare. Its menu is packed with bold flavours and, of course, local produce.

Riverpark is tucked away on a barren stretch of the city's Kips Bay neighbourhood, overlooking the East River from the ground floor of an office building

“Milk crates are 130 years old, developed through their own kind of ergonomic design, but they were perfect technology transfer,” Kosbau says. “It was natural.”

This was the innovation that allowed the urban “pop-up” farm to succeed. Their ergonomics allow them to be moved easily to catch the sunlight and their holes, combined with a dense fabric, allow the plants to breathe without the soil washing away.

The Riverpark farm is a moveable feast and will eventually relocate once the second tower of the Alexandria Center gets off the ground. The port-



Green credentials: Riverpark Farm's chef, Sisha Ortúzar (second from right) with, from left to right, Thomas Olin Kosbau and Sergio Saucedo from ORE Design + Technology, and Scarlet Shore from Alexandria Real Estate



that houses several life sciences companies. Its farm grows 168 varieties of vegetables, herbs and fruits across 15,000 square feet.

“This is the first of its kind; when we asked for permits to do it, the city was like, what is it?” says Sisha Ortúzar, head chef at Riverpark.

The farm sits on top of a parking garage, with concrete rather than earth beneath the urban farmers' feet. But Thomas Kosbau, founder of ORE Design + Technology, the architects, decided to use more than 7,000 recycled milk crates filled with soil to provide fertile, and portable, beds for the plants.

ability of the milk crate planters was tested last year, when Hurricane Irene threatened to submerge New York City. In less than five hours, the Riverpark team moved the farm indoors.

Two Brooklyn-based farmers irrigate the crops with a hose and supervise the harvest. During spring and summer, the farm produces roughly 80 per cent of the restaurant's vegetables, making it a sustainable project that pays for itself. To feed the crops, the farmers use refuse from the restaurant, such as coffee grounds and the shells of eggs and oysters, to put minerals back in to the soil.

Ortúzar says the farm makes him think differently about his menu. The farm attempts to grow produce that is harder to find commercially, but sometimes things go awry. For example, last year an abundance of eggplant production led to a menu with five different eggplant dishes. “As fresh as everything here is, since it is not genetically modified, it has to be used fast,” he explains.

Urban farms have been sprouting in New York. Groups such as Gotham Greens and BrightFarms have developed rooftop farms in Brooklyn and Queens. The city is also considering a new green zone that would allow for more greenhouses to be built on top of commercial buildings.

Riverpark's creators think that the portable farm model can be applied to other places where food is scarce, space is limited or construction projects have been halted.

During the daytime, the Riverpark farm is sometimes used for school classes and workshops, where visitors can learn about mulching, compost-

The farm sits on top of a parking garage, with concrete beneath the farmers' feet

ing, pruning and even preparing crops for winter. In the evening, the farm is lit with accent lights and becomes an attraction, drawing discriminating diners to the edge of the city to eat

amid a slice of nature.

The future of the farm remains unclear, as the rest of the Alexandria Center is getting ready to rise. But the farm's portability is part of its purpose.

As Ortúzar says, “Even if we only have it for two years, at least we had it.” ■

INFRASTRUCTURE IKHAYALAMI



Home, sweet
home: Priscilla
Siziwe outside
her home, built
by iKhayalami



Home comforts

A South African organisation has found a cost-effective way to improve living conditions in informal settlements, writes **Andrew England**
Photographs by **Ilan Godfrey**

Standing in front of a clutch of shiny tin shacks, Priscilla Siziwe reels off a litany of challenges that go hand in hand with life in one of South Africa's impoverished informal settlements.

There is having to line up to use one of the few toilets serving hundreds of residents; the fire hazards of having shacks cobbled together from bits of wood and other materials; and the chore of walking to collect water from a communal tap. And then there are the elements. "We are living inside the shack, but it was like living outside," she says. "Because of the materials, the wind would come inside and the rain would come inside."

Siziwe is among the hundreds of people living in Sheffield Road, an informal settlement of ramshackle, makeshift homes built on land reserved for a road extension. The settlement is illegal and bereft of services, with a community crammed into a small section of Cape Town's sprawling Philippi township.

In Sheffield Road, however, conditions have begun to change after the intervention of an alliance of non-governmental organisations led by iKhayalami. Under the NGO's initiative, clusters of shacks have been demolished and rebuilt with walls of zinc aluminium. And, critically, while the "new" homes continue

to cover the same land area, they have been reorganised to make the best use of the space.

This has meant that where there was once a haphazard warren of shacks, there are now relatively neatly aligned rows of huts, allowing courtyards and clearly defined alleyways to emerge. The structured formation increases security and the zinc aluminium walls – thicker and more flame resistance than the materials traditionally used – reduce the ever-present risk of fire. It has also created more space for the municipal authorities to install additional toilets.

The concept, dubbed "blocking out", was conceived by Andy Bolnick, iKhayalami's founder. She was seeking a solution to help ease South Africa's massive housing challenges, which are a result of decades of segregation under apartheid and people flooding from rural areas to urban centres in the years since.

The government has built about 2.7m subsidised housing units for poor black families since the first full-franchise election in 1994, but it has failed to keep pace with demand as more people have moved to cities in search of work.

It is estimated there were 300 informal settlements in the country 18 years ago, but by the end of 2010, the number had mushroomed to 2,700, home to some 1.2m families, while another 1m ►

INFRASTRUCTURE

IKHAYALAMI



are stuck in “backyard shacks”, says Steve Topham, director of the National Upgrading Support Programme at the Department of Human Settlements.

Many informal settlement dwellers have applied to receive free government housing and see their situation as a temporary predicament. But most end up waiting for years to be allocated homes as the government struggles to meet the demand.

Given the backlog, the hope is that the blocking-out model can be extended across the country and make informal settlements more liveable, with improved access to basic services.

“There needed to be a way of addressing this huge problem, which affected so many millions of people, in a way that was far quicker and more affordable,” Bolnick says.

The iKhayalami NGO, supported by funding from Selavip, a Chilean NGO, and South Africa’s Percy Fox Foundation, first had an

Room with a view: “blocking out” has created more personal and public space





opportunity to test its model after a fire in 2009 in another Cape Town township destroyed more than 500 homes. Working with the Informal Settlements Network (ISN) and the Community Organisation Resource Centre (Corc), it replaced 125 of the shacks.

Sheffield Road was then chosen as pilot to implement blocking out under more normal conditions and to gauge whether residents would support the concept. Not only did the community have to accept their homes being knocked down and rebuilt in a day, but they were also expected to contribute 10 per cent of the R3,000 (\$370) cost for a 15 sq m shelter.

“It’s a means of convincing the state or other donors that... they are committed to this process, that they themselves are prepared to put something in,” Bolnick says.

The initiative is intended to be community-led, with residents involved in the replanning, but initially there was resistance as people waiting for government housing questioned why they should have to

make a financial contribution. “They didn’t see the logic of an improved layout,” Bolnick says. “Their minds and their focus was: ‘we want the promised house.’”

Gradually, however, increasing numbers of households have been convinced of the programme’s benefits and, working in clusters of about a dozen houses at a time, the project has rebuilt 152 homes since it began in 2010.

“What we have seen is members of the community are much more positive now they have seen how it is panning out,” says Nozusakhe Mandlevu, who moved to Sheffield Road when the settlement first sprung up in 1994. “In the past we did not even have enough space for the children to play in.”

She shares her shack with her husband and four children, a curtain splitting the home in two – a bedroom and a living area. A small courtyard – a result of the blocking process – looks out on to the road and provides space for the family car and, importantly, a washing line that Mandlevu shares with just three neighbours.

Before, she had to dry clothes on a communal line, which meant she or one of her children had to guard the laundry to ensure nothing was stolen.

After the success in Sheffield Road, Cape Town municipality has

earmarked another 22 informal settlements where it will work with NGOs to implement the blocking-out model, says Ernest Sonnenberg, a councillor who sits on the mayoral committee for human settlements.

“We are very optimistic about this process. We believe it should



Pulling together: the whole community had to agree for the new layout system to work

be rolled out in all municipalities where people have to wait long [for housing],” he says.

Hundreds of thousands of people in Cape Town fall into this category. There are almost 194,000 informal units in the city, which has a housing waiting list of 310,000 families. In the financial year that ended in June, the municipality targeted providing 8,800 new homes, and yet Cape Town has an inward migration of 18,000 new households per year, Sonnenberg says, highlighting the housing challenge the city faces.

Topham at the central government’s human settlement department says there are already plans to use the blocking out model around the country.

“While they [the projects] are small, they are really significant in the sense that what they are doing is putting the community in the driving seat,” he says. “It’s demonstrating a better way of doing things for the state and the community... and will lead to stronger and better organised communities.”

There is an acknowledgment that it is not a long-term solution to South Africa’s housing problems. Shacks still rely on electricity illegally tapped from nearby houses for power; there are only five water taps for the entire Sheffield Road settlement, and in spite of efforts to raise up the newly built huts, they are still susceptible to floods.

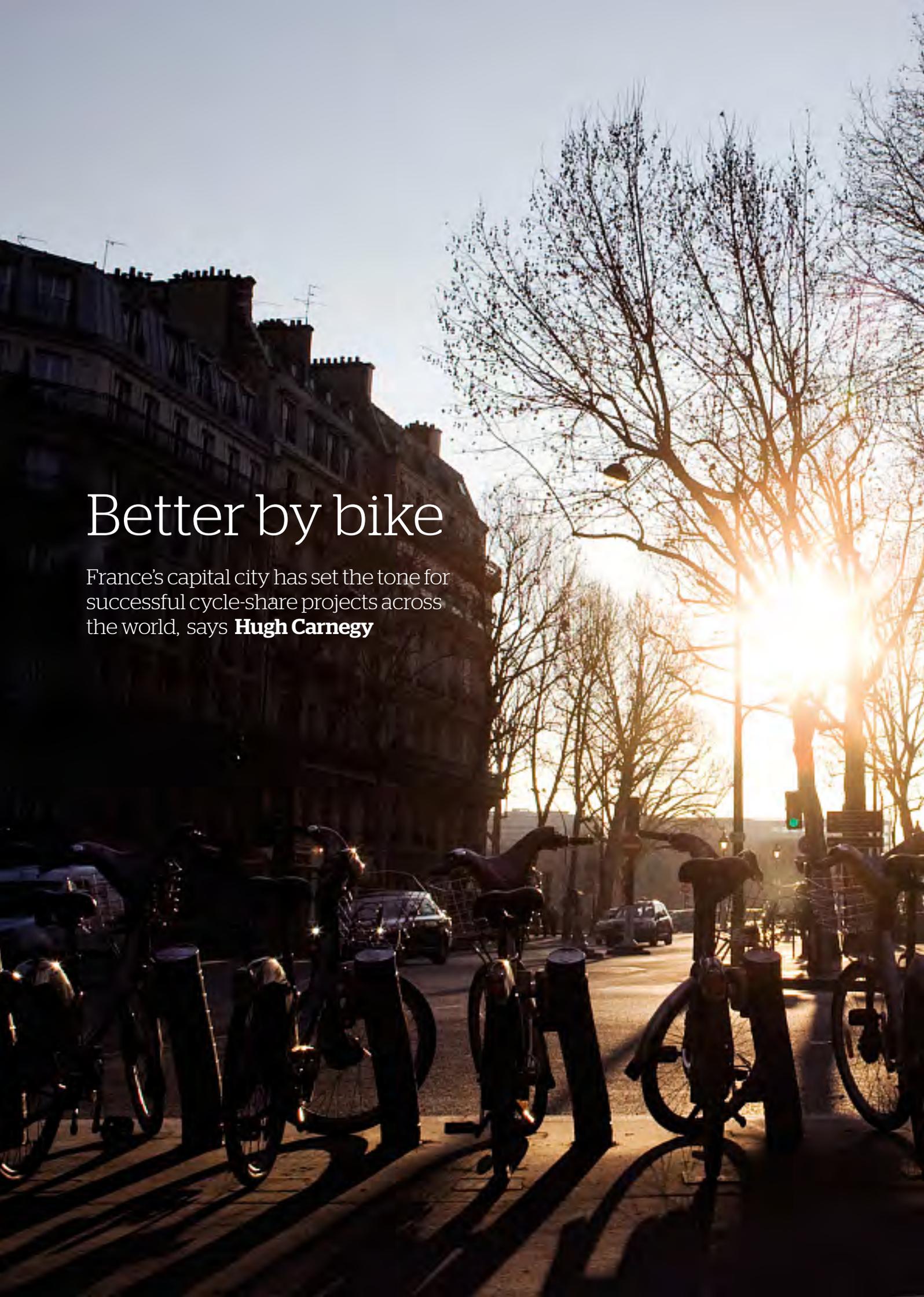
But in Sheffield Road there is a genuine sense that blocking out has provided the community with an uplift and helped inject a little more pride into the shack dwellers.

“The place was dirty, it was smelly,” Siziwe says, sitting in her shack, the walls painted bright orange and the roof blue. “After blocking out, people started to feel they are living differently.” ■

“The projects are small, but they are putting the community in the driving seat”

Better by bike

France's capital city has set the tone for successful cycle-share projects across the world, says **Hugh Carnegie**





INFRASTRUCTURE

VELIB'

On a bright early summer morning in Paris, close to the Champs-Élysées, a US family is setting off for a sightseeing tour using bicycles hired from the city's Vélib' bike-share system.

"Wait, wait, I've only got one pedal," calls the mother, as she suddenly realises her mount has a serious fault.

Regular users of Vélib' bikes will recognise the scene. Since the scheme was launched in 2007, it has been dogged by problems of theft, vandalism and the difficulty of keeping up with the results of heavy use.

But as Paris celebrates the fifth anniversary of the Vélib' (the lib' is short for liberty), it can rightly claim that the system has had a significant impact, providing a popular service to tourists and commuters alike and becoming a beacon to other cities seeking to boost bicycle use, reduce pressure on public transport networks and ease urban pollution.

Bertrand Delanoë, the socialist mayor of Paris who introduced the scheme, recently opened a weekend of celebrations to mark the fifth anniversary, which culminated in a mass Vélib' gathering on the Champs-Élysées.

"I never expected that the Vélib' would by this point have become a social phenomenon and so valued by those who use it," he said.

The statistics are impressive. In five years the number of Vélib' bikes has more than doubled to 23,000, spread around the 1,800 stations that are now a familiar part of the Paris streetscape. The scheme, run by JCDecaux, the

outdoor advertising company, has been extended from the core of the city to include the suburbs.

There are 250,000 annual subscribers and between 100,000 and 150,000 daily journeys, including those taken by tourists and others who sign up on a daily or weekly basis for a moderate fee. Each bike makes an average of eight trips a day.

On a more sombre note, six Vélib' users have died in collisions since the launch, but the city points out that the accident rate has been falling and there were no fatalities in 2011.

Paris was not the first city to adopt a bike-sharing scheme.

In the 1960s, a libertarian movement in Amsterdam launched a bike-share scheme after the municipal authorities refused to take up the idea. They repaired abandoned bikes, painted them white and left them on the street for people to use. In 1976,

Vélib' bike stations are now a familiar part of the Parisian streetscape

La Rochelle in France introduced 300 "municipal bikes" for shared use.

Other cities experimented with similar operations. Vienna is credited with pioneering mass city-backed schemes such as those now so familiar across Europe. It organised something much like the Amsterdam "white bikes" in 2001. Within three months, most of the 1,000 bicycles had been stolen. But Vienna persisted, launching a paid-for system in 2003, also operated by JCDecaux.

Now there are some 400 bike-share projects in cities all around Europe. London joined the list in 2010. There are similar schemes in China and the trend is spreading to North ►

INFRASTRUCTURE

VELIB'

“Paris was like a lighthouse. Until then, nobody really knew much about bike-shares”

America, with New York rolling out a system this month.

The European Cyclists' Federation (ECF) credits the scheme in Barcelona, run by Clear Channel, JCDecaux's principal rival, as being the top performer in Europe. With only 6,000 bikes, it is much smaller than the system in Paris (the two started at about the same time), but it has a higher rate of usage, scoring about twice as many journeys in relative terms.

“Barcelona is the best,” says Martti Tulenheimo, policy officer for urban mobility at the ECF. “But the importance of Paris is that it was like a lighthouse. It was not the first, but up until the point that Paris joined the club nobody really knew much about bike-share schemes. Because of the cultural importance of Paris, other cities began to ask whether they should do it too.”

There are different funding and operating models in use among the many cities now providing bike-share schemes. Delanoé chose a partnership with the private sector, based on trading prime advertising space on street furniture in return for funding and operating the system.

With a start-up cost of more than €100m, JCDecaux was then hit by an unexpectedly high level of theft and vandalism that led to an 80 per cent replacement rate in

the first two years – much worse than in other cities, such as Lyon, where it operates similar systems.

The company and the city say the attrition rates have fallen significantly since then. But, as the US family found, maintenance remains a problem, with many bikes on Vélib' stands suffering from faults, from flat tyres to broken chains and buckled wheels. JCDecaux carries out 1,500 repairs a day.

Users can also suffer the exasperation of either empty stations with no Vélib' available for hire, or full stands with nowhere to

park. This suggests the operators still struggle to manage the complex flows of demand throughout the day, with the expensive byproduct of having to haul bikes around the city to even out the supply.

JCDecaux does not provide financial figures for the scheme. Jean-Charles Decaux, co-chief executive, said before the anniversary celebrations that it was now operating on a break-even basis.

But he admitted that Paris had been “a very costly business in terms of running costs” for his company.

There is also a debate about the way bike-share operations such as the Vélib' have evolved from, typically, voluntary schemes, to local authority initiatives, to the heavy involvement of the private sector.

“We see the bike-share schemes as a ‘gateway drug’ to more cycling”



In Paris, JCDecaux now has control over large amounts of public space, including big slices of pavement, displacing private vehicle parking.

Last year, the city launched a car-share scheme. Called Autolib', it is run by Vincent Bolloré, the industrialist, and it plans to have 3,000 electric cars spread across 6,600 recharging stations in the city by 2014.

Maxime Huré, of the Lyon Institute of Political Studies, wrote in a recent article: “Behind the innovations of these two services lies a less well-publicised transformation: the emergence of new private sector players in the shaping of the city.”

This “privatisation” of urban management raises questions about the influence companies have on public policy, he says. Paris, he adds, has been “transformed into a dense jungle of street furniture”, dominated by private sector companies.

“With this model, the occupation of public space leads to public authorities becoming highly dependent on businesses. Furthermore, any change of provider for this type of service represents a major political risk, as the removal of one company's fixtures and fittings necessarily means tearing up the city.”

But those campaigning for greater use of cycling see the Vélib' system as a leading example of what can be achieved. Bicycle use in Paris, which the city says accounts for 3 per cent of vehicle traffic, has increased by some 40 per cent since 2007.

The ECF says: “We see the bike-share schemes as a ‘gateway drug’ to more cycling. Places like Paris had very little in terms of bicycling infrastructure before. But [now] they have seen an explosion in bicycling infrastructure and riders.” ■

Successful product: Jean-Charles Decaux (left), co-chief executive of JCDecaux, operator of the scheme, rides a Vélib' bicycle on the Champs-Élysées



COMMENT

DAVID MILLER



Action is eloquence

Cities are where the people and the problems are – and where the solutions can, will and must be found

Yet another global summit has come and gone – the United Nations Rio+20 conference – and the world seems little closer to tackling the huge challenges of climate change and economic prosperity. Sadly, there has not been much progress.

Some countries, such as Canada, have governments that openly deny the science, and have pulled out of the Kyoto Protocol to the UN Framework Convention on Climate Change. Others fret that doing the right thing for the environment will cost too much. People see this inaction of national governments and lose hope. But cities hold solutions and activist city governments, led by strong mayors and supported by private sector innovation, are not waiting.

Today, more people live in urban areas than do not. This trend will continue as flows of climate migrants in the developing world cause those cities to grow. China seems to build new cities weekly. Even in the

developed world, studies show that younger people prefer dense urban environments to suburbs.

Pollution and jobs are found in the cities too. One study commissioned for the C40 Cities Climate Leadership Group found that while 75 per cent of economic activity takes place in cities, up to 80 per cent of greenhouse gas emissions can be allocated to city-based consumption.

The good news? Measures that reduce greenhouse gases create jobs. The even better news is that three sectors – energy generation, heating and cooling of buildings, and transportation – are responsible for most of the emissions. Get those sectors, and waste management, right and the world's dual goals are achievable.

Technology can save money, create jobs and add capital value to buildings

The best news is that cities are acting. Consider buildings, typically the greatest source of emissions. Many cities are adopting building standards that require “green” construction of buildings. The

private sector has responded, and has discovered that green buildings can be more profitable (because they are more in demand by tenants) and have lower operating costs.

Michael Bloomberg, mayor of New York City, has directed commercial buildings over a certain square footage to post energy consumption statistics. Meanwhile, Melbourne and Toronto have focused heavily on energy retrofits. In fact,

Toronto's Tower Renewal programme will reduce greenhouse gases by 6 per cent – the first Kyoto target – and will create 30,000 full-time jobs.

Shrewd investments in technology can save money, create jobs and add capital value to buildings. New technologies, such as Canada's International Wastewater Heat Exchange Systems, are capable of rapid adoption and can dramatically reduce the need for fossil fuels to heat and cool buildings.

Many cities have recognised that traffic planning for the automobile does not meet their transportation, development or environmental goals. They have built walkable cities, with rapid transit networks that encourage cycling. Copenhagen is the best example of this.

On energy, smart-grid-enabled cities of the future will look to conservation and demand management first, and energy generated on a distributed model from renewable sources second. The energy grid is moving away from energy generation based on extraction toward one based on technology. German cities do this today.

The state of Victoria in Australia has passed regulations that help to overcome financing hurdles in energy retrofits, which will lead to significant private investment. This model should be copied globally, as issues of security and time for payback hinder private financing.

Most of all, we need people to know that the answers are there. Only then can the desire of millions to do the right thing be translated by their governments into a clean environment and good, sustainable jobs. ■

David Miller is a World Bank special adviser on urban issues and former mayor of Toronto



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