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Building cities for the future











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EXCLUSIVE interviews with urban development leaders

Foreword by Dr Joan Clos, UN-HABITAT Executive Director

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WELCOME

3.5 billion people currently live in cities around the world and a further 2 billion are expected to move to urban areas in the next twenty years. Cities also cover just 2 per cent of the Earth's land surface, but account for over 70 per cent of carbon emissions and energy consumption.

With urbanisation and the transition to a green economy two of the greatest challenges of our time, cities present a unique opportunity to reduce our ecological footprint and adapt to a changing climate. Improvements in transport, energy, construction, technology, and utilities hold the key to sustainable development.

Against this backdrop Climate Action, the United Nations Environment Programme (UNEP) supported communications platform, publishes Sustainable Cities. After being launched at the Rio+20 Earth Summit in June 2012, we now present the second edition of Sustainable Cities; a platform for governments, industry and international opinion leaders to debate the case for sustainable development in cities around the world.

This edition features a special European focus in the lead up to COP19 in Poland; perspectives from senior officials around the world including the Mayors of Freiburg, Germany and Sendai, Japan; plus strategic and technological solutions to today's urban challenges from companies such as Metso and Somfy. We are delighted to include exclusive interviews with José Figueres, President of the Carbon War Room; David Miller, former Mayor of Toronto; Patrik Schumacher, Senior Designer at Zaha Hadid Architects and Jane Burston, Head of the Centre for Carbon Measurement at the National Physical Laboratory.

Sustainable Cities is circulated twice a year to ministers, global mayors, senior policy, planning and procurement staff, as well as international developers, facility heads and architects.
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UNEP SUSTAINABLE BUILDINGS AND CLIMATE INITIATIVE (UNEP-SBCI)

The United Nations Environment Programme – Sustainable Building and Climate Initiative is a partnership of major public and private sector stakeholders in the building sector, working to promote sustainable building policies and practices worldwide. It works to present a common voice for the building sector stakeholders on sustainable buildings and climate change. It draws on the UNEP's unique capacity to provide a global platform for collective action.

WORLD GREEN BUILDING COUNCIL (WORLDGBC)

The WorldGBC is a coalition of more than 90 national green building councils, making it the largest international organisation influencing the green building marketplace. The WorldGBC's mission is to facilitate the global transformation of the building industry towards sustainability through market driven mechanisms. The WorldGBC supports new and emerging Green Building Councils and ensures they have the resources needed to prosper, advocates the important role of green buildings in mitigating global climate change and promotes effective building performance rating tools and the development of mandatory minimum standards for energy efficiency in buildings.

ICLEI - LOCAL GOVERNMENTS FOR SUSTAINABILITY

ICLEI is an association of over 1,220 local government members who are committed to sustainable development. The members come from 70 different countries and represent more than 569,885,000 people. It provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level. The basic premise is that locally designed initiatives can provide an effective and cost efficient way to achieve local, national, and global sustainability objectives.

C40 CITIES CLIMATE LEADERSHIP GROUP

The C40 Cities Climate Leadership Group is a network of large and engaged cities from around the world committed to implementing meaningful and sustainable climate-related actions locally that will help address climate change globally. The organisation's global field staff works with city governments, supported by their technical experts across a range of programme areas. The current chair of the C40 is New York City Mayor Michael R. Bloomberg, who with the support the C40 executive leadership team, guides the work of the C40, along with the members of the C40 Steering Committee: Berlin, Hong Kong, Jakarta, Johannesburg, Los Angeles, London, New York City, Sao Paulo, Seoul and Tokyo.

INTERNATIONAL ASSOCIATION OF PUBLIC TRANSPORT (UITP)

The International Association of Public Transport is the international network of public transport authorities and operators, policy decision-makers, scientific institutes and the public transport supply and service industry. It has the aim of doubling the market share of public transport worldwide by 2025. Over 150 signatories to the UITP's Charter on Sustainable Development have made a voluntary but measurable commitment to monitor, measure and report on their own performance. UITP is a platform for worldwide co-operation, business development and the sharing of know-how between its 3,400 members from 92 countries.

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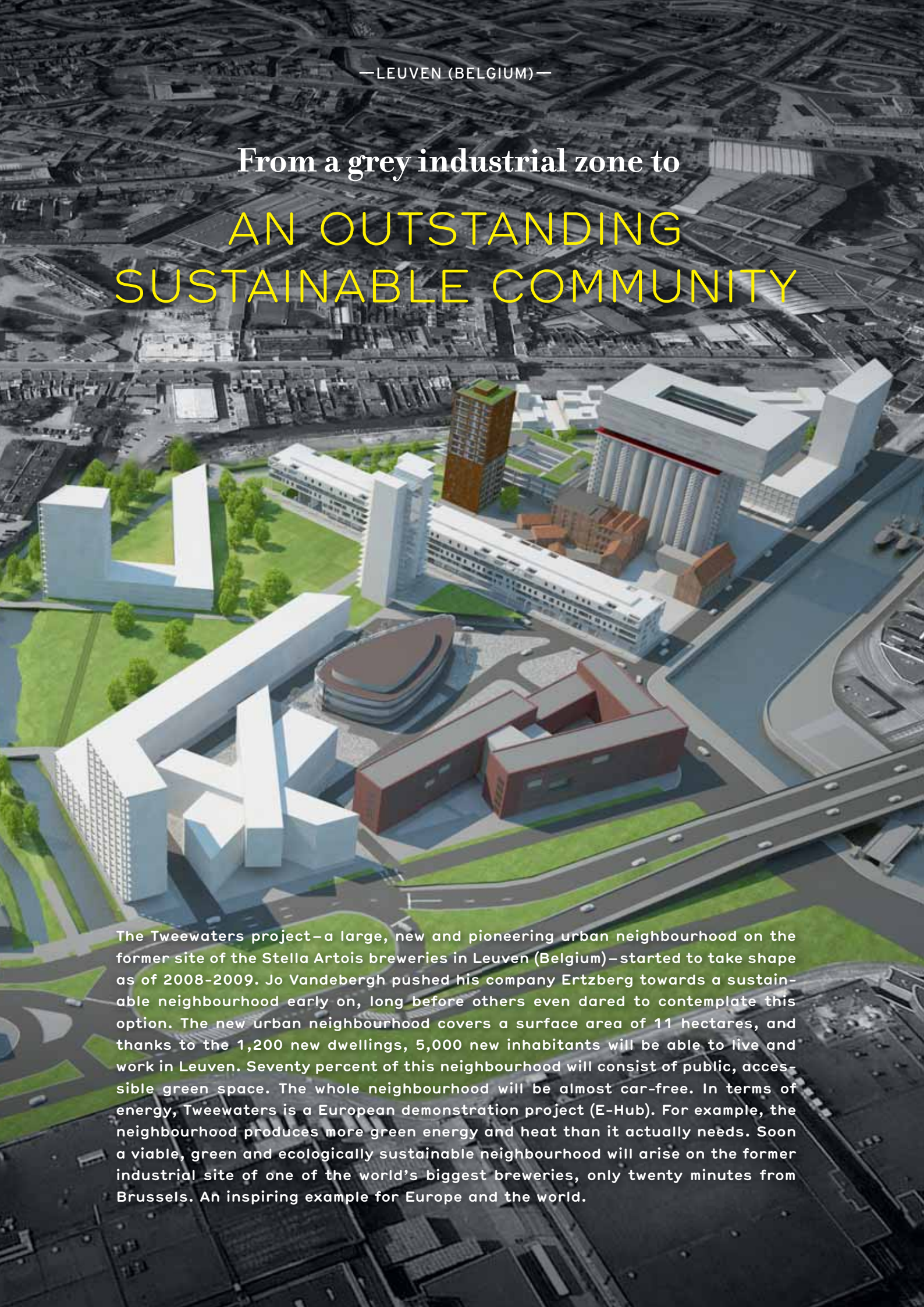
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—LEUVEN (BELGIUM)—

From a grey industrial zone to AN OUTSTANDING SUSTAINABLE COMMUNITY



The Tweewaters project – a large, new and pioneering urban neighbourhood on the former site of the Stella Artois breweries in Leuven (Belgium) – started to take shape as of 2008-2009. Jo Vandebergh pushed his company Ertzberg towards a sustainable neighbourhood early on, long before others even dared to contemplate this option. The new urban neighbourhood covers a surface area of 11 hectares, and thanks to the 1,200 new dwellings, 5,000 new inhabitants will be able to live and work in Leuven. Seventy percent of this neighbourhood will consist of public, accessible green space. The whole neighbourhood will be almost car-free. In terms of energy, Tweewaters is a European demonstration project (E-Hub). For example, the neighbourhood produces more green energy and heat than it actually needs. Soon a viable, green and ecologically sustainable neighbourhood will arise on the former industrial site of one of the world's biggest breweries, only twenty minutes from Brussels. An inspiring example for Europe and the world.

The formerly lifeless and depressing neighbourhood has already largely paved the way for Tweewaters. The "Balk van Beel" (Beel's beam) – Stéphane Beel is Flanders' leading architect with an international reputation – has already been built. An innovative car park for 250 cars was recently built. The plans for a visually striking apartment building – the Twist – are being designed onsite. And Q – a residential complex with assisted living facilities – has been designed and is ready to be built on the banks of the River Dyle.

The rather desolate urban section of the brewery is being transformed into futuristic buildings, founded on a vision. Tweewaters is all about "living in the future" in today's biggest contemporary city centre project in Belgium. And Europe perhaps? Jo Vandebergh formulated the sustainable vision – offering "urban convenience" or "time and a carefree existence to everyone and being able to guarantee this to the following generations" – which underpins this integrated project. With Tweewaters, the Ertzberg development firm wants to show that sustainability and comfort go hand in hand.

New way of life

The urban development firm offers a "new way of life" to the inhabitants and people who experienced and believed in the new neighbourhood, with certain living patterns that are strikingly "different" from what we accustomed to: smart meters, one-key access, a very high level of acoustic comfort, fibre optic cables and home delivery lockers. The latter especially are inventive and innovative. *People living in Tweewaters can have goods delivered to their home or picked up from their home, even when nobody is home. This promotes sustainability and comfort because, whereas all the inhabitants drive to the shops individually in traditional neighbourhoods, transportation is much more efficient in Tweewaters thanks to these lockers and the smart logistics associated with it. One delivery for the entire neighbourhood and, thanks to the smart link between the supplier and customer, the delivery is always made, even when nobody is home.*





The ambitious project is an eye-catcher in many ways, but the sustainability aspect is probably the most striking. Tweewaters is ground-breaking among others in terms of energy, mobility, waste management, the built-up surface area and consumption and services. All the aspects that are so closely connected in our society are tackled in this urban neighbourhood. The approach is holistic. All the aspects have an environmental impact, which is why they all influence the reduction of the neighbourhood's ecological footprint: compact buildings, a reduction of the energy demand, maximum waste sorting, a decentralised energy generation, etc. Tweewaters will be a CO_2-negative neighbourhood. Where possible, the complete lifecycle analysis is taken into account for the selection of the materials.

World-class

Tweewaters ties in closely with the existing urban fabric, but at the same time, it marks a break with the traditional streets and squares of the city centre. Tweewaters offers a lot of public space, but in a different urban development pattern. In terms of energy alone, Tweewaters is a world-class project. There is no other, similar project that is founded on the same holistic approach.

Architecturally speaking, Tweewaters also has several gems that will put Leuven on the world map. The silos of the former Stella Artois site are certain to be a striking icon. The brick superstructure and front part of the 54 cylinders will be removed to make them look even more remarkable. The round façade openings will allow for the necessary daylight. A new superstructure will protrude by 18 metres and will redesign the neighbourhood's skyline. Just under the superstructure – 50 metres from street level – there will be an exceptional public square, the *city balcony*, with a spectacular view of the city.

Prices

The first building to be built in Tweewaters was the "Balk van Beel". The ambitions for this building were quite high. The combination of high-level, contemporary architecture, increased comfort of living, and exceptionally solid sustainability principles, initially did not even appeal to the financiers. That is why Ertzberg built the "Balk van Beel" with its own resources, without compromising in terms of sustainability. And so the "Balk van Beel" was built, in compliance with the highest standards in terms of welfare and health, ecological impact, quality of life, energy, ecology, materials used, waste management, innovation, etc. It earned the "outstanding" Breeam certification, and is considered to be the most sustainable building in its category on the continent. Which is why Ertzberg was invited to London to accept the 2013 Breeam International Award. Moreover, Ertzberg also received the Sustainable Partnerships Award this year for its innovative and socially committed collaboration with the organisations in the neighbourhood.

After the "Balk van Beel", the next buildings to be built are the Twist and Q. The silos and the rest of the neighbourhood will then follow. All the buildings and the entire neighbourhood will comply with the highest sustainability requirements. Or how Tweewaters is going in search of recognition as the first "outstanding sustainable community".

www.tweewaters.be

FOREWORD



By **Dr Joan Clos**, Under-Secretary-General, United Nations and Executive Director, United Nations Human Settlements Programme (UN-HABITAT)

> At current rates of urbanisation it is predicted that more than two-thirds of us will be living in cities in the next forty years while the world's population continues to grow rapidly. To ignore these trends is to be constantly playing catch up with our city service provision and to miss vital opportunities to create a different vision of our Urban Future.

By now we are all well aware of the negative impacts of rapid urbanisation taking place as more and more of our population lives in cities. Many of us experience them on a daily basis; traffic congestion, services struggling to keep up with demand, pressure on affordable housing. Many cities in the twentieth century grew following a model based on private vehicle ownership and low fuel costs expanding to fit all available space and creating silos of land dedicated to different uses. But the reality is that many countries can no longer afford for people to live in this way and planned, compact urbanisation offers unrivalled development opportunities that can be used to the advantage of the entire country – both urban and rural areas.

Economic historical studies have shown that there is a proven positive relation between urbanization and development. It is also clear that the urban economy is more productive due to the proximity of the factors of production and increased specialization and market sizes. In The State of the World's Cities Report 2012/13: The Prosperity of Cities, UN-Habitat showed that cities are places of economic growth and where people find satisfaction and the provision of goods and services.

Cities and towns in developing countries are facing serious challenges due to the lack of proper urban policies, which include: unemployment, especially amount the youth; high percentages of people living in slums; dominance of the informal sector; inadequate basic services, especially water, sanitation, drainage and energy; unplanned peri-urban expansion; social and political conflict over land; high levels of vulnerability to natural disasters, partly resulting from climate change; and poor mobility systems, among others.



Instead of fearing, denying or even trying to halt urbanisation, countries – especially those in Africa and Asia which are urbanising the fastest – need to embrace it. UN-Habitat and our Habitat Agenda Partners work to highlight these challenges and to propose new ways of thinking about how to meet them. The World Urban Campaign provides a living and growing platform for sharing and learning on initiatives, actions and policies driving positive change in cities. It includes partners from governmental and non-governmental organisations as well as the private sector who promote knowledge sharing and best practice.

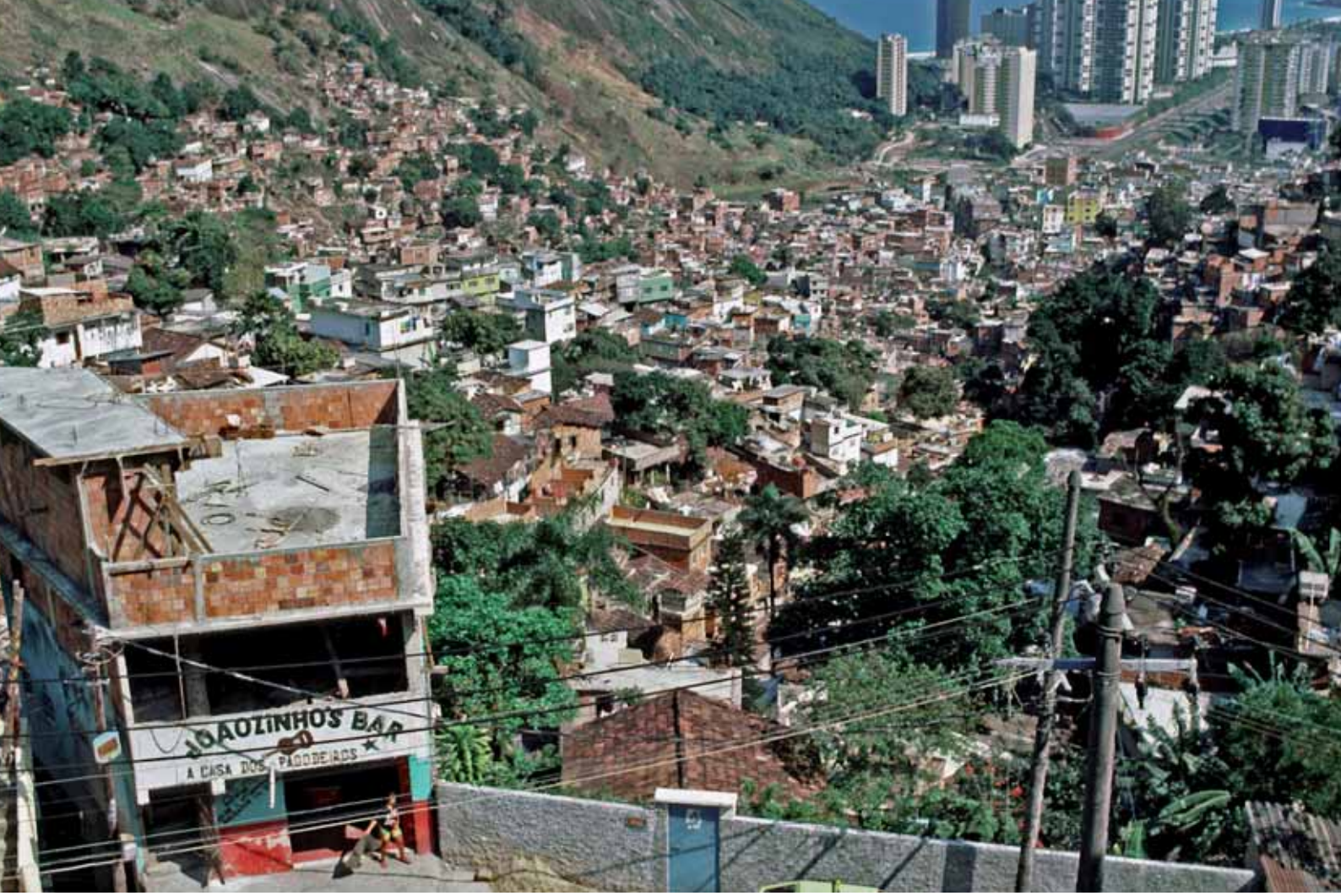
For example, a sound National Urban Policy provides a framework for future urban development. It ensures maximization of the national and local benefits of urbanization while at the same time mitigating potential negative impacts and adverse externalities. UN-Habitat has engaged with 20 different countries, ten of them in Africa, in order to cooperate in developing their National Urban Policies. These policies are meant to provide a framework for future urban development in countries, and are designed to coordinate the work of different sectors and ministries in urban development. They also ensure

"Through this publication, Climate Action is addressing a defining topic of our era."

that urban planning occurs in phases and addresses the scale of existing problems appropriately.

At the same time, properly planned city extensions are necessary to address the widespread phenomenon of spontaneous informal settlements, to create urban jobs, and to achieve social integration. They are designed to plan and manage rapid population growth in cities. The usual way of spontaneous urban growth is the formation of the slum but cities facing mass population growth need a plan for where this growth is going to take place and how it can be designed in order to create urban jobs, and achieve social integration.

In 2015, UN-Habitat will host the Third United Nations Conference on Housing and Sustainable Urban Development (Habitat III). Here the



challenges of the present and future will be outlined and addressed by the world's leaders in urban issues. The inclusive, strategic and forward-looking format will allow government officials to hear from mayors and on-the-ground practitioners about what it really means to be living the urbanization process. Leaders and citizens alike discuss how to approach the new urban agenda from an integrated perspective covering all three pillars of sustainable development; economic, social and environmental.

Through this publication, Climate Action is addressing a defining topic of our era. The articles contained in Sustainable Cities offer a powerful source of knowledge and expertise on the solutions available to us as we face the challenge of sustainable development. ■

Appointed Executive Director of the United Nations Human Settlements Programme (UN-HABITAT) at the level of Undersecretary-General by the United Nations General Assembly, ***Dr. Joan Clos*** *took office at the Programme's headquarters in Nairobi, Kenya on 18 October 2010. Born in Barcelona on 29 June 1949, he is a medical doctor with a distinguished career in public service and diplomacy. He was twice elected Mayor of Barcelona serving two terms during the years 1997-2006. He was appointed Minister of Industry, Tourism and Trade of Spain (2006-2008) under President Jose Luis Rodriguez Zapatero. In this role, he helped rationalize the Iberian Energy Market in line with European Union Policies. Prior to joining the United Nations, he served as Spanish ambassador to Turkey and Azerbaijan.*

The ***United Nations Human Settlements Programme*** *(UN-HABITAT) is the United Nations agency for human settlements. It is mandated by the UN General Assembly to promote socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all. UN-HABITAT's programmes are designed to help policy-makers and local communities get to grips with the human settlements and urban issues and find workable, lasting solutions. UN-HABITAT's work is directly related to the United Nations Millennium Declaration, particularly the goals of member States to improve the lives of at least 100 million slum dwellers by the year 2020, Target 11, Millennium Development Goal No. 7, and Target 10 which calls for the reduction by half of the number without sustainable access to safe drinking water.*

CITIES AND **GREEN GROWTH**



By **Lars Løkke Rasmussen**, Chair of the Council, Global Green Growth Institute (GGGI) and Chairman of the Liberal Party, Denmark

Game-changing efforts are required in cities to avoid long-term lock-ins and help relieve the continued stress on resources like energy, land and water. With urban areas already accounting for some 66 per cent of global greenhouse gas (GHG) emissions, we are forced to push for political leadership, including at city-level, in order to fight climate change.

Urbanisation and the shift to a green economy are two of the greatest challenges of our time. Cities are expected to expand by another two billion residents over the coming twenty years. More than 90 per cent of urban population growth is expected to occur in the developing world, where many cities are already struggling to provide basic needs.

Urbanisation trends also provide opportunities. Cities are often able to enact more ambitious GHG reduction policies than national governments. And amidst a global economic crisis, cities, at perhaps more than any other level of government, have tremendous power to influence the choice, design, and implementation of technologies, innovation, building codes, and the pattern of spatial growth – all of which may promote sustainable resource-use and unlock green growth opportunities.

The conventional view about combating climate change suggests that a mix of market forces, government regulation, empowered citizen's groups, technological innovation, and sharing of best practices will need to come together and "save the day". But this may not be sufficient. Even if a range of supportive and breakthrough technologies and price regimes were present, and even if the political will is there, they may be overwhelmed by pervasive market failures, split incentives amongst actors in the decision and value chain, and the gaps in implementation capability of local governments, business and citizen's groups. As such, these are today's key challenges and barriers facing cities striving for sustainable and green growth.

CITY COLLABORATION

I am encouraged over recent years to have witnessed impressive city leadership



and a growing number of new city-to-city collaborations. The sustainable and green growth agenda has spread from city governments to urban planners, infrastructure investors, technology suppliers, architects and citizen's groups.

As an example for inspiration, I am glad to see the leadership undertaken by the City of Copenhagen. With a long-term target of becoming CO_2-neutral by 2025 the city has already reached its mid-term target of reducing its GHG emissions by 20 per cent - 4 years ahead of schedule. This target was reached with a population growth of 10 per cent and with economic growth around 5 per cent in

"The sustainable and green growth agenda has spread from city governments to urban planners, infrastructure investors, technology suppliers, architects and citizen's groups."

the same period. As Chairman of the Council of the Global Green Growth Institute (GGGI) I am glad to see this kind of leadership help strengthen and shape the Global Green Growth Forum (3GF), which is focusing on smart cities this year.

The City of Copenhagen is however not faced with the same constraints facing a number of city governments around the world that seek to promote sustainable and green growth solutions - not least in the developing countries.

"The private sector and civil society actors also need to be engaged and integrated."

A recent report from the World Bank re-affirms the fact that most new urban growth will not take place in megacities, but rather in "second tier" cities in developing countries. More needs to be done to address the challenges of these cities. This is why GGGI in its green growth planning and implementation programs in developing countries have taken on urban planning along other key sectors of the economy in our strategic planning efforts. It is also the reason why GGGI this year will start developing its "Green Growth and Cities Program," which aims to address key constraints – and green growth opportunities - facing city governments in developing countries.

A key point is to realise that city and national governments cannot provide the necessary leadership on their own. They need to be integrated in their regulatory, planning and enforcement efforts. More importantly, the private sector and civil society actors also need to be engaged and integrated up-front and throughout the planning, financing and implementation phases of urban planning and development. This one of the success features of the City of Copenhagen as well. Targeted and long-term public-private partnerships with private sector technology suppliers, developers, and investors can be key for city governments in pursuit of sustainable objectives.

Other key barriers to address in our efforts going forward may include:

- Enhanced north-to-south, and not least south-to-south, city collaboration among "model city" green growth solutions
- Stronger focus on "near-tem", off the shelves and proven efficiency solutions in the area of water management and the built environment
- A stronger focus on integrated organisational structures in city governments
- Analytical capacity and instruments have to be established and developed for city governments, allowing for the assessment of life-cycle costs and green growth implications of large-scale infrastructure investments
- Financing needs to be more locally based on self-financing and self-generating financing schemes; this will be essential to inclusive, sustainable urban development

This list is by no means exhaustive, but it may help contribute to our common and crucial efforts of tackling the lock-in challenges and unlock opportunities of the urbanisation agenda of the 21st. century. ■

Lars Løkke Rasmussen *is Chair of the Council of the Global Green Growth Institute. He is also currently the Chairman of the Liberal Party in the Parliament of the Kingdom of Denmark and serves the North Zealand greater constituency. He was the Prime Minister of Denmark from 2009 to 2011. Prior to his position as Prime Minister, Mr. Rasmussen served as Minister of Finance from 2007 to 2009 and Minister for the Interior and Health from 2001 to 2007 under Anders Fogh Rasmussen's government. In all, Mr. Rasmussen has been a Member of Parliament since 1994.*

The ***Global Green Growth Institute (GGGI)*** *is dedicated to pioneering and diffusing a new model of economic growth, known as "green growth," that simultaneously targets key aspects of economic performance, such as poverty reduction, job creation and social inclusion, and those of environmental sustainability, such as mitigation of climate change and biodiversity loss and security of access to clean energy and water.*



THE LOW CARBON FUTURE INTERVIEW WITH JOSÉ MARÍA FIGUERES

The facts surrounding climate change and the extreme crisis point humanity has reached are almost beyond dispute. The former President of Costa Rica and President of the Carbon War Room, José María Figueres is acutely aware of the grave situation and the need for a transition to low carbon energy solutions.

José María Figueres has a stellar CV that looks as if it should have taken more than one lifetime to achieve. After graduating from the renowned US military institution West Point, Figueres began his civilian career as an engineer working in agribusiness. After ten years as a successful engineer he entered public service in his home country of Costa Rica as Minister of Foreign Trade and then Minister of Agriculture. In 1994, Figueres became Costa Rica's youngest elected president and his four-year term was distinguished for progressive environmental policies, such as the unpopular but pioneering carbon tax. In 2000, Figueres joined the World Economic Forum as Managing Director, and soon became the organisation's first CEO. Figueres went on to become a UN advisor on climate change and energy, and he is currently Chairman of the Global Fairness Initiative, a board member on numerous environmental groups such as the Geneva Earth Council, managing partner of investment and wealth management company I J Partners, and also President



of the Carbon War Room. A formidable champion of a low carbon economy, Figueres combines sharp business acumen with a steely conviction that we already have the necessary arsenal in place to combat poverty and climate change.

Figueres has made it a dedicated mission in life to wage war on two of humanity's greatest enemies, poverty and climate change. His determination is sustained by a deep value-based conviction that humanity can win both wars. "I grew up in a family that believed every person should be given a starting point – an opportunity in life – upon which, depending on their personal efforts, they could then achieve different results. At the same time, my parents always taught us the virtues of living austere lives and not living beyond ones means. To win the war against poverty means creating opportunities for all, especially for those that have least. Winning the war on climate change means living within the limits of our planet. Today, with the economic resources and technological advances we have

created, we can win both wars with the same strategy: migrating to a low carbon economy. That shift represents the largest economic opportunity humanity has ever had.

"During my last year at West Point, I took a course on management of resources. The army is, after all, a big user of them. The emphasis placed on responsibility and efficiency of their use encouraged me to begin a professional journey in which I have always looked at the environment and resources as an opportunity for not being wasteful. Beyond that, the understanding I have built over the years of climate change has made me seek opportunities to lower carbon emissions based on efficient market-based mechanisms, in order to attract the entrepreneurial talent and capital required.

"I believe Europe has been a global leader when it comes to taking action on climate change. In the US there is a good amount of activity at city and state level, in spite of federal caution. What is important to recognise here, is that while about 50 per cent of emissions require some type of regulation or state intervention, the other half does not. It is this other half that offers terrific business opportunities, the one we should concentrate and act on with market-based solutions."

In 1994, when Figueres was President of Costa Rica, his government made the pioneering move of applying a carbon tax on all fuels. He has a simple explanation of why so few other governments have followed Costa Rica's example. "Governments are normally short-term oriented and greatly influenced by public opinion polls. A tax on carbon emissions does not fit into these moulds. When we passed our carbon tax there was a one-term constitutional limit on governments. Hence we had the luxury of not having to worry about being re-elected, and could take bold initiatives such as this one."

As President of the Carbon War Room (CWR), Figueres can press effectively for global carbon reduction. "The Carbon War Room is a global initiative set up by Sir Richard Branson and others to accelerate entrepreneurial solutions and help deploy profitable and scalable clean technology. Currently, the world has the technology and policy in place to tackle 50 per cent of the climate challenge.

"The CWR takes a global, sector-based approach, and looks for ways to reduce carbon at gigaton scale. We are dedicated to breaking down industry market barriers and getting money flowing towards low carbon opportunities. By leveraging our power to attract key industry and financial players to the table, we try to create market demand for clean technologies. In practice, the Carbon War Room plays a variety of catalytic roles, such as providing market information to an industry sector to help create new market demand, or devising self-financing mechanisms to get capital moving to clean technologies.

"Currently, we do have the technology and policy in place to tackle 50 per cent of the climate challenge. The job at hand now is how to shift existing capital to all entrepreneurial solutions that are profitable today and reduce massive amounts of carbon. To do this, we must remove the market barriers that are currently stopping the successful scaling of carbon reduction technologies globally. The Carbon War Room focuses on a powerful force – that is business, capitalism and the entrepreneurial spirit.

"We see the flow of capital to clean technologies as the bottleneck, not policy or technology. If we can create scaled market demand for clean technologies using the power of the market – and the force of capitalism with companies chasing profits – then we can make great strides towards a lower carbon economy."

"While about 50 per cent of emissions require some type of regulation or state intervention, the other half does not."

Asked if we are coming to the end of the industrial revolution, Figueres responds by adopting a particular definition. "I believe we are coming to the end of a period of carbon intensive economic activity and development. The road ahead must and will be on a different track towards lower emissions. The challenge and real opportunity is moving from a world that emits over 800

grams of carbon per unit of global GDP today, to one that will emit only 8 by 2050. This represents a hundredfold decrease in carbon emissions. Imagine the new business models, technologies, and possibilities for well-being that will emerge from this transformation!

"To build a low carbon economy, we will need to reinvent everything: the way we transport ourselves, the way we live, the way we work, the way we interact in society.

At an international or country level, Figueres looks forward to many win-win opportunities. "Moving to a carbon economy gives us a great chance for business and government to work together. It's a wonderful new option for the North – owner of many needed technologies – to cooperate with the South. Finally, it represents a new option for South-South cooperation. More and more of this is beginning to happen around the world."

In spite of the notorious tendency of economies and businesses to be sluggish in adopting new models, Figueres insists that the opportunities are with us today – if we look hard enough. "Once we can correct the current market barriers that prevent the successful scaling of clean technologies globally, opportunities will become more and more abundant. Take aviation: the renewable jet fuels market can achieve significant scale by 2020. In 2011 alone, airlines spent US$140 billion on kerosene-based jet fuel and $200 billion is projected for 2012. Yet, alternatives are available. Two types of renewable jet fuels have been approved for use in the last eighteen months and several more are in the testing and certification pipeline. In addition, the first few commercial renewable jet (and diesel) fuel production facilities came online in 2012.

"However, significant market barriers remain. Renewable fuel entrepreneurs are struggling to meet capital requirements, due in part to investor uncertainty in such a complex technology and market landscape. There are concerns surrounding the entire value chain, the scale-up risk, technology status, environmental and carbon impact, and feedstock availability, as well as perhaps the most critical: the cost. With all these barriers inhibiting the scale up of biofuels, there is currently no publicly available source of information documenting or comparing these factors across companies. Our strategy at the CWR is to address these market barriers and try to kick-start the market. We are working to dismantle the market failures by allowing strategic buyers – in this case, the airlines – to place the right bets on an affordable, scalable, sustainable future fuel choice.

"To solve the information barrier, we teamed up with Elsevier, a Dutch Fortune 500 company and the world's largest scientific publisher, to build an online database of companies. In December last year the Carbon War Room created www.RenewableJetFuels.org, which evaluates and ranks companies using criteria based upon companies' economic viability, scalability, and sustainability. There are now over a hundred companies that our team is tracking in the database, which is crosschecked and curated by industry experts. We are also helping to get renewable jet fuel deals done; deals that become the model for the industry to follow, starting with Virgin Atlantic Airways and our other partners. The Carbon War Room is looking at a variety of deal models, and none of them rely on government intervention."

> "We must remove the market barriers that are currently stopping the successful scaling of carbon reduction technologies globally."

Environmentally responsible business has often been seen as attracting extra costs rather than profit opportunities. Figueres sees this as changing in recent years, thanks to many factors – greater regulation, better public awareness and more competitively priced products and services. "For me the key is market demand. This will continue to strengthen sustainability as a strategic imperative for business today. A great anecdotal example is from the recent Hurricane Sandy disaster in New York. Earlier, in 2008, the mayor of New York had bravely tried, though unsuccessfully, to mandate for all future New York cabs to be hybrids. Cabbies baulked at the idea. Last month, I happened to be in Manhattan just after the hurricane hit – and the only cabs left on the streets that day were hybrids. Gasoline queues



were 10 hours long in places. Speak to any cabby today about hybrids – post Sandy – and they will tell you a very different story indeed. Many more now intend to buy hybrids, with or without regulation – an extreme example, maybe, but a clear one. The power of market forces to bring about change for the good is staggering. We now need to accelerate it for all industry sectors."

On the role of the private sector in providing solutions, Figueres is optimistic. "For cities, the Carbon War Room, like other groups, has found that many solutions are already available. The challenge we see is that there is a lack of market information about a great deal of the technologies, and lack of access to capital for city authorities. We set up our Green Capital operation to tackle this. Currently, we work with over 30 city authorities and mayors globally, helping them to share best practices, vetting and showcasing the latest and greatest technologies for them – and devising financing mechanisms to assist the scaled retrofitting of commercial properties. In the US last year we announced a US$650 million deal with the Property Assessed Clean Energy Commercial Consortium, to help move private capital into Sacramento, California, and Miami-Dade county, Florida – and bring about scaled retrofitting of buildings there. We expect work on the ground to begin there in 2013."

"Our strategy at the CWR is to address these market barriers and try to kick-start the market."

Similarly with technologies, Figueres sees problems in the market rather than in the process of innovation. "Again, we believe that 50 per cent of the technologies exist today. They are proven and potentially profitable. Currently lacking, but far from impossible, is full market demand for these technologies and the capital to bring them to significant scale. Take maritime shipping. There are over 350 clean technologies that would help save US$70 billion of fuel for ship owners every year, but they are currently lying idle – some are as simple as eco-paints for vessel hulls, to reduce friction and stop the build-up of organic matter.

"We don't currently focus on technologies to capture carbon emissions from the likes of power stations, as carbon capture is undergoing major R&D investment and testing to prove its economics and show that it is environmentally safe. The Carbon War Room focuses either on existing technologies that are potentially profitable today or in the near term, that need to be scaled globally in existing markets if they are going to cut gigaton chunks out of society's annual carbon emissions. These range from energy efficiency technologies for buildings, or industry sectors where currently the technology is largely absent, as in maritime shipping or on sustainable island nations."

The control of overconsumption and resource depletion is not just a question of more discipline, says Figueras – solving this problem needs the positive development of an alternative economy. "To do and have less is not the only way to defeat the problem of climate change and conserve the environment. And quite frankly, if the only choice we have is to do and have less, then we are going to lose the battle. The other choice is to build a prosperous low carbon economy. To do this we need to engage motivated groups of people, making innovations to solve climate problems while chasing profit at the same time.

"Ever the optimist, I see the challenges of our generation not as inhibitors of creating a better world, but as exciting opportunities. Far from being the biggest threat, I believe that climate change is the greatest economic opportunity we have ever seen. The challenge today is to rectify current market failures and make resource plunder commercially unattractive."

Figueres sees a stable and sustainable global economy, with social cohesion, inclusion, and equal opportunity for all, as a destination worth aiming for. "What is important is to start a process that picks up speed and moves us in that direction. While we support and urge the intergovernmental negotiations on climate change, businesses have already been on the move around the world, transforming environmental stewardship into positive bottom line results. They understand consumers are growing increasingly supportive of businesses that take this direction. Back in 1985 the biggest environmental challenge was the depletion of the ozone layer by the use of CFCs. When we finally committed to fixing the problem, business moved to substitute CFCs, and governments enacted the Montreal Protocol. In only 10 years, by 1995, we fixed the problem. We can repeat that success story, even though it will take us longer given the dimension of the climate change challenge.

"Businesses have already been on the move around the world, transforming environmental stewardship into positive bottom line results."

"If within the next 10 years we can produce profitable, scalable, replicable models for renewable energy and sustainable living – as the Carbon War Room is currently aiming to do with in its project with the discrete island economy of Aruba, which seeks to go 100 per cent renewable by 2020 – then we stand a great chance of transforming these sectors permanently. But you have to start the process by proving change can be made."

Asked which of his many achievements makes him the most proud, Figueres gives a characteristic reply: "No matter what the circumstances, I always find a way to see the glass at least half full. Not so much an achievement, this is an attitude to life, towards challenges and opportunities. A positive disposition goes a long way to getting anything done. The rest can be done with a good dose of teamwork, not taking yourself too seriously, and being willing to give credit to others." ■

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CLEAN AIR SOLUTIONS FOR ASIA'S CITIES





By **Professor Simon Tay**, Chairman, and **Henrick Tsjeng**, researcher, Singapore Institute of International Affairs (SIIA)

Rapid economic growth and development is bringing millions of Asians to live in urban centres. This has provided opportunities and rising incomes for many, yet it has also come at a cost to the environment. Supposedly vibrant cities are quickly becoming epicentres of environmental degradation with unsustainable patterns of growth, and nowhere is this more obvious than in the rapidly deteriorating levels of air quality in Asia's cities. This article describes Singapore's threefold approach to the pressing problem of air quality and its associated environmental challenges.

Clean city air is a public good which should be enjoyed by all. However, many cities in Asia are increasingly unable to provide their inhabitants with this basic public good. This issue is critical, as air pollution is highly detrimental to people's health, making the development of sustainable blueprints for clean city air an increasingly urgent task. In formulating and implementing such plans, three tactics need to be adopted: a holistic approach that tackles all issues comprehensively; the involvement of all stakeholders and not just the government; and transformational technology to ensure that the solutions are permanent and not merely a short-term fix. In this regard, Singapore, with its reputation as a clean and green city, can be a model for good environmental governance in promoting clean air, even if certain issues need to be addressed.

TROUBLE IN THE AIR

The global media have highlighted the numerous air problems that many Asian cities face. In January 2013 Beijing's air quality readings rose to off-the-chart levels. More recent reports highlight villagers who suffer from the impacts of air and water pollution from nearby factories. In India, the rise in air pollution in cities such as Bangalore outpaced even those in China between 2002 and 2010, according to a report by *Time* magazine citing a Tel Aviv University study. New Delhi's air pollution also saw levels rivalling that of Beijing at the end of January 2013.

The situation in South East Asia also requires attention. The Wall Street Journal reported that in the Indonesian capital of Jakarta, particulates, carbon monoxide and nitrogen dioxide increased



by between 40 and 85 per cent in 2011. In Thailand's capital of Bangkok, air pollution has been linked to the city's huge number of cars on the road, and traffic jams.

Despite its green reputation, even Singapore experiences air quality issues. The city still suffers from the haze caused by forest fires and clearing by plantation owners in Indonesia which, in 2012, recurred in one of the most prolonged spells for over a decade. According to Singapore's Ministry of the Environment and Water Resources, annual levels of particulate matter 2.5 micrometres in diameter (PM2.5) or below were at 17 micrograms per cubic metre in Singapore in 2011, unchanged from 2010. While this level is lower than that in other cities in Asia, it is still above the 10 microgram target set by the World Health Organization's Air Quality Guidelines.

THREE KEY TACTICS

As mentioned above, there are three key tactics in achieving clean city air, and these can also be applied more generally for better and more liveable cities across Asia.

"The city still suffers from the haze caused by forest fires and clearing by plantation owners in Indonesia."

First, a holistic approach that tackles related issues as a whole is required. A 'silo' mentality of tackling problems in isolation from one another is not an appropriate approach, especially for complex environmental challenges. Simply focusing on one issue in isolation from another can in fact be detrimental to overall long-term goals towards environmental sustainability as policies to tackle each individual problem may end up at cross purposes. A holistic approach is needed, for instance, in addressing the need for clean city air along with the issue of climate change and transport policy, as opposed to tackling one issue separately from the others.

Second, environmental solutions often require technology, but this has to be 'transformational'.

This does not refer simply to something that can be built or adopted immediately, nor is it a one-off effort. Transformational technology requires a fundamental change in the underlying structures of an economy, demanding sustained investment as well as training and education over time. Only by transforming the underlying culture and habits can the positive effects of technology achieve long-term environmental goals.

Third, the participation of all stakeholders – including citizens and the private sector – is also needed in taking on the responsibility for better cities. The government has a responsibility to curb pollution and ensure sustainability, but policy action alone is insufficient. The government can also encourage greater participation with policies that are inclusive and consultative.

Looking at the need for clean city air in this light, how can ordinary people be empowered to act? Policy change begins with analysis, but that is not enough for implementation and sustaining the change. Perceptions among the stakeholders need to shift to heighten their awareness. From this, people can move to action, to become empowered and to empower others, taking greater ownership of air quality issues.

Citizen awareness is now playing a large role in pressuring governments to act against air pollution in Asia. For example, the municipal government in Beijing began releasing hourly readings of PM2.5 levels after ordinary Beijingers vocally called on the authorities to do so, a crucial first step towards addressing the Chinese capital's infamous air pollution.

The active participation of the private sector is also crucial. If corporations are able to respond to greater consumer awareness and provide greener options, it will empower consumers to make informed choices that benefit the air and environment.

SINGAPORE'S SOLUTIONS

By adopting this three-part approach, we can apply good governance in devising more suitable solutions in tackling air pollution comprehensively and with a long-term view. Singapore, which was highly ranked in the Asian Green City Index 2011 by the Economist Intelligence Unit, provides examples of the three lines of attack.



A holistic approach to dealing with environmental challenges is evident in the National Climate Change Strategy 2012 document. The NCCS-2012 outlines Singapore's plans to address climate change through a whole-of-nation approach, while tackling clean air issues at the same time. These plans include reducing emissions across sectors, harnessing green growth opportunities, and forging partnerships towards environmental sustainability. The NCCS-2012 builds upon Singapore's past plans on climate change and environmental sustainability, such as the Sustainable Singapore Blueprint where sustainability goals including clean air targets were set for 2020 and 2030.

Singapore is also positioning itself as a living laboratory to pilot and validate new technologies such as electric vehicles and smart energy grids in real-world settings before commercialisation and large-scale deployment. Stakeholder involvement can be seen with a Singapore-based company currently providing rental services for electric vehicles. Such enterprises could become catalysts to enhance current initiatives by the government to test electric vehicles, in addition to letting the public try out these green vehicles.

Singapore's government has liberalised its energy market, allowing larger electricity users who consume over 10,000 kilowatt-hours annually to choose their electricity providers. The Energy Market Authority is currently reviewing plans to allow all consumers to choose their energy providers, which if implemented will eventually empower consumers to choose providers that generate power from more efficient, cleaner and 'greener' methods.

To further deepen stakeholder involvement, the government engaged the public in a series of consultations from September 2011 to January 2012 as part of the development of the NCCS-2012.

TRANSFORMATIVE EFFICIENCY

Energy efficiency has been one of Singapore's strategies in introducing transformative technology to cut pollutant and greenhouse gas emissions. This approach required a sustained investment over years to reach where it is today – an effort involving the switch from less efficient oil-fired facilities to cleaner and more efficient gas-fired plants; a Green Mark Certification scheme to promote the adoption of green and energy-efficient building design and technologies; and the implementation of the Energy Labelling Scheme which informs buyers on the energy efficiency levels of electronic appliances.

These policies and innovations being developed in Singapore will not only help to address its own environmental challenges, but also provide solutions for clean city air and sustainable development to assist other cities and urban communities.

Still, there have been trade-offs and there is room for improvement. For example, there has been a recent push to reduce the environmental impact of vehicles. One significant policy change is the newly introduced Carbon Emissions-based Vehicle Scheme which will encourage the use of low carbon emission vehicles by offering rebates, and will be implemented from 2014. Vehicles with emissions of less than or equal to 160g of carbon dioxide per kilometre qualify, as well as the diesel cars that implement the more stringent Euro 5 emission standards.

This is a step forward in dealing with climate change. However, there are concerns that (even under Euro 5) an increase in diesel cars will add to the overall pollution load, with more particulate matter and nitrogen oxides – as has been the case in many Asian cities. While diesel vehicles generally provide better mileage and therefore less carbon, their suitability for cities is less certain. With traffic congestion, diesel engines run less efficiently and generate greater particulate emissions per kilometre travelled. For city use, the balance of concerns may therefore be different.

A HOLISTIC APPROACH BEYOND CLEAN AIR

The environment is important to Singapore but the city-state has also developed into a hub for commerce and industry. The three-part approach to sustainability is key to balancing environment protection with innovation and development.

While we have focused on clean air measures which are still developing, this can perhaps be most clearly seen in the water sector.

Over the past decades, Singapore has made considerable efforts to make its supply of water sustainable and secure. At the centre are transformational technologies in recycled 'NEWater' and efficient, large scale desalination. But Singapore's holistic approach towards managing the water cycle, including the construction and maintenance of sanitation systems and drainage networks to prevent flooding, also bears attention. Efforts in public education for water conservation have been sustained since the country's founding and were recently re-emphasised by Prime Minister Lee Hsien Loong. The public is also led to appreciate, help conserve, sustainably use and enjoy rivers and reservoirs through an 'Active, Beautiful, Clean Waters' programme.

As a result, by deploying technology, raising awareness and action among stakeholders and taking a holistic approach, Singapore has sought to tackle water as a key concern for the city. That approach can help to deal with the other emerging concern of clean city air. ■

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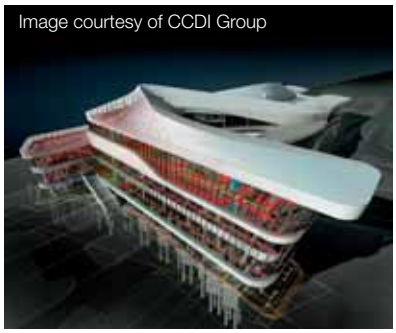
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SUSTAINABLE CITIES IN ASIA-PACIFIC MEAN A BETTER WORLD





The growth of Asian cities has been responsible for improving the living standards of many, but if cities are not properly managed, the results can be catastrophic. Already, they are grappling with pollution, an inadequate supply of potable water, people living in urban slums and traffic congestion of crippling proportions.

In order to address these challenges, cities need to think positively and strategically. Their aim should be to balance sustainable urban practices with the need to provide ever-more people with access to a better quality of life and economic opportunities.

Over the next few years, sustainable design strategies will become a standard expectation of the market, alongside traditional considerations like cost and durability.

ASIA'S ENVIRONMENTAL CHALLENGES

Government and city mandates are already starting to address sustainability requirements. China's 12th Five Year Plan dictates reductions in energy intensity, with a strong emphasis on improving buildings, infrastructure design and operation[1]. Tokyo's Cap-and-Trade Program requires an 8% drop in energy-related CO2 emissions from office buildings and 6% for industrial facilities by 2014[2]. Local and national governments across the globe are implementing zero waste initiatives, coupled with significant cost and energy saving designs.

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THE ASIAN OPPORTUNITY

Environmental imperatives for sustainability have never been greater, and urban expansion in Asia presents enormous opportunities for positive impact. By 2025, there will be 37 megacities with populations of over 10 million; 22 of those cities will be in Asia[3]. Worldwide, we will have to build the same urban capacity in the next 40 years that we have built over the past 4,000 years[4].

Sustainable cities in Asia can become models for the rest of the world to emulate – without the scramble for limited fossil-fuel resources, and without neglecting the environment challenges that so far have gone hand-in-hand with economic progress.

Our future lies in cities. This demands solutions that ensure those cities are places for people-places of economic development, and places with a quality environment. ■

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[1] Chinese Government's Official Web Portal, 2011
[3] Smart Cities Report, PikeResearch, 2013
[4] Global Risks, World Economic Forum, 7th edition, 2012

THE ROAD TO **LOW EMISSIONS** GOES THROUGH **THE CITY**



By **Gino van Begin**, Secretary General, ICLEI – Local Governments for Sustainability

It is time for the global climate community to work with local leaders and governments to urbanise the climate agenda through ambitious goals and direct implementation.

"It's good that the negotiations are saved. Now it's time to save the climate!" This comment sums up the mixed feelings of many participants on their way home after concluding the last 48 hours of the historic Durban Conference in December 2011. This positivism had been strengthened by additional inspiring news like the successful reduction of China's carbon intensity since 2005, the moderate decline of US national emissions in the last couple of years, or with reports that the global annual renewable energy investments exceeded those in fossil fuels for the first time in 2010.

But this incremental and eclectic progress becomes meaningless as global concentrations of greenhouse gases in the atmosphere reach peak values every year, the Arctic ice reaches its record summertime low extent, or unprecedented extreme heat and drought together with precipitation and floods occur in the same location within weeks of each other. In order to guarantee a safe climatic space in which six or seven billion urban dwellers can thrive in 2050, a fundamental transformation in our development model is required.

If low emission development is the challenge of our time for both developed and developing countries, the international community must work together with local governments to ensure that sustainable urban development is the main driver of this transformation.

WORDS TO ACTION: RAISING THE LEVEL OF AMBITION

ICLEI has urged the global climate community with the words, "So everyone needs to raise their ambitions." In Durban, this clarion call was taken up in the official document. But more importantly, during the first Durban platform workshop in May 2012 in Bonn, Germany, many national delegations, as voiced by Jonathan Pershing of the US State Department, expressed serious interest in the suggestions laid by ICLEI to engage local governments as governmental stakeholders to scale up climate actions.



Seoul City Mayor and World Mayors Council Chair Park Won Soon demonstrates ambition through his 'One less nuclear power plant' plan



Mexico City Mayor and former World Mayors Council Chair Marcelo Ebrard announces the impressive Mexico City's 2008-2012 Climate Action Programme.

The week before Rio+20, at the ICLEI World Congress 2012 in Belo Horizonte, Brazil, numerous local governments demonstrated what raising levels of ambition meant in practice. The inspiring examples set by prominent local leaders tell a positive story:

- **Showing political leadership.** Park Won Soon, the newly elected Mayor of Seoul and Chair of World Mayors Council on Climate Change, swiftly demonstrated his ambition through Seoul's new 'One less nuclear power plant' plan. The plan aims, through energy efficiency and renewable energy generation – and with a strong emphasis on stakeholder engagement – to reduce greenhouse gas emissions by 7.33 million tonnes of CO_2 equivalent, save US$2 billion and generate 40,000 jobs by 2014.
- **Re-invigorating and redoubling efforts.** Not content with existing commitments, Environment Mayor Ayfer Baykal shared a renewed plan for Copenhagen to become the world's first carbon neutral capital by 2025, by acting on energy consumption, production, mobility and the city administration. Copenhagen's efforts have been rewarded: it has just become the European Green Capital of the Year for 2014.
- **Implementing emissions reductions.** Minister of Environment Martha Delgado shared the impressive vision and strategy of Mexico City's 2008-2012 Climate Action Programme. Two months later, she joined Mayor Marcelo Ebrard to proudly announce that Mexico City managed to reached a total emissions reduction of 7.7 million tonnes CO_2 equivalent, exceeding its initial goal by 10.2 per cent. It has also succeeded in implementing a new programme to adapt to climate change.
- **Being innovative.** Kenji Suzuki, Director of International Cooperation, presented the first year's results of Tokyo Metropolitan Government in successfully implementing the world's first urban cap and trade programme. Targeting 1,300 buildings that contribute 40 per cent of the city's commercial and industrial emissions, the Tokyo Cap and Trade Programme has not only become a key driver of emissions reductions, but also increased the city's resilience to energy shortages during the Fukushima disaster.

These are just snapshots of the massive amount of information reported by hundreds of local governments worldwide at the carbon*n* Cities Climate Registry (www.citiesclimateregistry.org) where "national governments can be encouraged to take ever bigger and more ambitious steps to fight climate change", in the words of Christiana Figueres, Executive Secretary of the UN Climate Change Secretariat.

A VEHICLE FOR PROGRESS

The development path of emerging economies' growing urban areas in the next 30-50 years is vital in attaining global emissions targets designed to limit the global temperature increase to 2°C; and so is the ability of cities to provide a

sustainable and quality environment for the well-being of their citizens. Success will depend on a fundamental transformation in our development model. We need to demonstrate that shifting urban development to a low emission path can offer both a better urban livelihood to billions of people and yield immediate, direct, cost-effective and scalable greenhouse gas emissions reductions. Local governments cannot do this alone.

Low emission development strategies, or LEDS, offer one vehicle towards making this transformation. In the Copenhagen accord, they were described as being indispensable to sustainable development. 'Low carbon growth plans' or 'LEDS' – the terminology is irrelevant. The important thing is that they effectively integrated economic development plans with low emission and/or climate resilient economic growth. Unless climate and development policy are created and implemented in a coherent way, we shall only be re-arranging deck chairs as the Titanic is sinking under us.

That is why ICLEI has recently begun work, in partnership with UN-HABITAT, on a €6.7 million project, funded by the European Commission, to assist eight cities in four emerging economies to reduce their emissions as they grow. Implemented in Brazil, Indonesia, South Africa and India, the project will help model cities to formulate and adopt Urban LEDS, and then share these experiences within their countries and beyond. Model cities will be guided through a comprehensive process using ICLEI's GreenClimateCities methodology, to create a coherent, development-based strategy which identifies the cities emissions' footprint, identifies and prioritises actions, and moves to implementation through fully costing solutions in different sectors while seeking investments to bring them to fruition. The project will also strive to develop a globally acceptable and nationally appropriate verification process for reporting of local greenhouse gas inventories and mitigation actions.

SCALING UP, MOVING TOGETHER

A key aspect of the Urban LEDS project is to scale up action, and to link cities to the actors in the international climate regime. With up to 20 other satellite cities able to share the experiences of the model cities and use this experience and learning to move forward on low emission development, scaling up will be started.

The movement of local governments acting to promote low emission development is big, but it needs to be massive. Innovative ICLEI member cities need to be joined by thousands more. The hope is to move closer to a much needed global framework that involves and appropriately supports local governments, including enabling implementation through direct and additional financing, and matching their level of ambition. The global climate community has to provide all the necessary support to visionary local leaders and governments who are willing to move faster in reducing emissions and in offering sustainable livelihoods for their citizens. For the Earth doesn't care where reductions take place – but demands urgently that less emissions are accumulated in the atmosphere.

The author acknowledges valuable contributions of Steven Bland, Project Manager at ICLEI Africa Secretariat and Yunus Arikan, Manager of Cities Climate Center at ICLEI World Secretariat in the preparation of this article. ■

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ICLEI – Local Governments for Sustainability *is the world's leading association of cities and local governments dedicated to sustainable development. ICLEI is a powerful movement of 12 megacities, 100 supercities and urban regions, 450 large cities, and towns in 85 countries. ICLEI promotes local action for global sustainability and supports cities to become sustainable, resilient, resource-efficient, biodiverse and low-carbon; to build a smart infrastructure; and to develop an inclusive, green urban economy with the ultimate aim of achieving healthy and happy communities.*

PORTLAND'S TRAILBLAZING **CLIMATE ACTION PLAN**



By **Susan Anderson**, Director of Portland's Bureau of Planning and Sustainability

Portland, Oregon is often called the most sustainable city in America. Twenty years ago it launched its ambitious Climate Action Plan and progress in combining an economically prosperous community and a healthy environment has been significant.

Portland has been a national leader in the USA on urban policies and investments that have resulted in a prosperous, healthy and more resilient city. Often called the most sustainable city in America, Portland's brand is both emulated by other cities and parodied on television in 'Portlandia'. New urbanism, transit oriented development, green building and sustainability practices were common tools in the city long before they had garnered much attention elsewhere.

Much of the work began in the 1970s and 80s. As many American cities pursued an approach of expanding freeway networks and creating sprawl, Portland took a different path and focused inward. An Urban Growth Boundary was established for the metropolitan area to protect surrounding agricultural land and forests. Federal funding for a new freeway was redirected to one of the first modern light rail lines. This was built out over the years into a 52-mile light rail system connecting through downtown and the metro area, and a 15-mile streetcar (tram) system.

Much of the early focus was on building the community. The interstate highway was moved from along the Willamette River and replaced with Waterfront Park, bringing the community together instead of bisecting it with an impassable freeway. A downtown parking structure was torn down and replaced with a more European public plaza, Pioneer Square, often called Portland's living room.

At the same time, a comprehensive plan was completed to balance and integrate goals such as economic development, housing, water and air quality, transport, parks and urban forests, and resource efficiency. The oil crisis of the mid and late 1970s spurred the development of the first local energy plan in the USA, which included specific actions to promote energy efficiency and renewable energy resources such as solar and wind power.

In the 1990s and 2000s, many new efforts were begun that focused on sustainable building,

Images, left to right: Downtown from washington park with MT. Hood in distance; Pioneer square.
© Bruce Forster Photography





energy and water efficiency, recycling and waste reduction, bicycle infrastructure, solar and wind power, storm water management, and creating walkable 20-minute neighbourhoods.

A SUCCESSFUL CLIMATE ACTION PLAN

In 1993, Portland became the first US city to adopt a Climate Action Plan for its entire community. At that time, few Americans cared much about what was then called 'global warming'. The focus of the plan was to reduce carbon emissions, but to do it in a way that would help families save money, reduce local air pollution, cut operating costs for businesses, and build more liveable, walkable neighborhoods.

The City took action on climate change for two reasons: first, 20 years ago the Federal government was moving very slowly and it seemed unlikely that much change would happen at the national level. And second, Portland felt it could do its part because cities can have a major impact. They often have responsibilities for:

- Creating and implementing zoning and building energy codes
- Constructing streets, sidewalks and bicycle lanes
- Developing transit systems or working closely with transit authorities
- Collecting solid waste, recycling and composting, and
- Owning public electric utilities or having partnerships with utilities and NGOs to help businesses and residents reduce energy use.

The 1993 plan has been updated regularly and has been a success. Since 1990, per capita carbon emissions are down by more than 25 per cent, with total emissions down 6 per cent. At the same time, carbon emissions in the US have increased by about 10 per cent. So it is clear that Portland is moving in the right direction, and the gap between the two diverging numbers leads to a compelling story – that American cities can be both prosperous and reduce carbon emissions.

"Federal funding for a new freeway was redirected to one of the first modern light rail lines."

RAISING THE BAR

Unfortunately, even with the success of the original plan, Portland residents and leaders have taken note that while the city is heading in the right direction, a 6 per cent reduction is only a small step towards the 50-85 per cent reduction needed according to climate scientists.

In response to the growing urgency of the need to shift to a low-carbon economy and community, in 2009 Portland adopted a new Climate Action Plan with a goal of reducing 1990 level emissions by 80 per cent. To reach that goal, the City has focused on both innovative and practical solutions in such areas as transport and land use, energy



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efficiency, renewable energy, and solid waste reduction. The following examples illustrate a few approaches and results.

THE TRANSPORT 'GREEN DIVIDEND'

Over the past 20 years, gasoline sales per person have dropped nearly 25 per cent, and vehicle miles travelled have dropped 8 per cent. At the same time, bicycle riding has steadily risen from less than 1 per cent to more than 6 per cent of people commuting to work. With more than 300 miles of bikeways, Portland is consistently ranked one of the most bicycle-friendly cities in the USA.

More and more people want to live in neighbourhoods where they can bike or walk to parks, school, shops, restaurants, grocery stores, libraries and other amenities. Portland calls this 'living in a 20-minute neighbourhood', and has a goal for 80 per cent of residents to live in such a neighbourhood by 2035. While this may just seem normal in most of Europe, it definitely is not the norm in America, where so much of urban design and planning has been focused on the private car.

In many communities in the US, people agree that sustainable development and protecting the environment are important, but conclude that taking action is too expensive. Yet nothing could be further from the truth. In comparison with other US cities of a similar size, Portland residents drive 20 per cent fewer miles each day. That's just four miles per day per person, but it does add up, and it equals more than US$1 billion annually in reduced transport costs. This money is then available to purchase other goods and services. And, since Portland has no oil drilling or refineries, a dollar spent on just about anything besides oil recirculates in the economy many more times than buying another gallon of gasoline, and it provides for economic growth.

THE CITY GOVERNMENT ENERGY CHALLENGE

In the early 1990s, Portland began a systematic and aggressive review of all of its buildings and facilities to improve energy efficiency. The result is a saving of more then US$5.5 million annually. Projects range from lighting, heating and cooling improvements to solar panels on City buildings, to LED street lights; and generating nearly US$1 million worth of electricity each year from sewer gas at the waste water treatment plant.

GREEN BUILDING AND LEED

In 2001, Portland took a first step and adopted a green, high-performance building ordinance that required new City-owned buildings and any project that received any City tax credit or financial incentive (such as for low-income housing projects) to meet the LEED building standard. The City also established a technical team to provide green building training to architects, designers, engineers, homebuilders and commercial developers through workshops and hands-on review of building plans.

"The City established a technical team to provide green building training to architects, designers, engineers, homebuilders and commercial developers."

Several developers saw an opportunity to establish Portland as a national centre of on-the-ground, practical green building expertise. The results were phenomenal considering that Portland did not change the actual building energy code, but instead provided training and marketed successful buildings. The State of Oregon assisted with this transition by providing a tax credit to developers who exceeded the LEED standards for energy performance.

In Portland, 168 commercial projects are now LEED certified. LEED Gold and Platinum have become the norm for quality building in the city. In fact, Portland has 31 LEED Platinum projects, three more than New York City – a successful result for a community with only 7 per cent of New York's population.

The green building story in Portland goes beyond reductions in carbon emissions. An entire industry has evolved with hundreds of architects, engineers and developers providing sustainable building expertise to cities throughout the USA and the world. In addition, Portland's new economic development strategy focuses on clean technologies and services, with one of the most significant concentrations of firms in the USA involved with renewable energy, energy



Right: ZGF building
© Bruce Forster Photography
Below: ZGF building; Solar home project



efficiency, environmental services and green building. A recent employment report showed about 60,000 employees have clean-tech jobs throughout Oregon.

CLEAN ENERGY WORKS

In 2009, Portland began a pilot project to provide an easier, more efficient way to enable homeowners to make energy efficiency upgrades to their homes. The pilot provided a comprehensive package including low-cost, long-term loans, assistance from an independent energy adviser, and the convenience of repaying monthly loan obligations on their electric or natural gas utility bill. Not only did pilot project participants undertake deeper upgrades than their counterparts in other local energy efficiency programmes, but they also made the decision to take action more quickly.

The pilot project attracted national attention and was the recipient of a US$20 million federal grant. The programme now is well under way and thousands of homes have been 'weatherised'. The City started the programme, but quickly realised it would be more successful as a non-profit organisation, so Clean Energy Works Oregon was born. The organisation now offers services statewide.

Clean Energy Works Oregon goes beyond traditional energy saving programmes by focusing on the social side of sustainability via a Community Workforce Agreement. This agreement was the first of its kind in the USA. It set specific high standards for hiring local workers, especially women, veterans and minority contractors. It established a higher minimum wage, and required that workers receive health insurance or additional wages in lieu of coverage.

"Neighbours organised a bulk purchase of solar electric systems and negotiated a volume discount."

SOLARIZE PORTLAND!

In 2010, the first 'Solarize' campaign started as a grassroots effort to help residents overcome the financial and logistical barriers to installing solar energy systems on their homes. What began in one neighbourhood quickly caught on with residents across the city. With technical assistance from the Portland Bureau of Planning and Sustainability and the Energy Trust of Oregon, neighbours organised a bulk purchase of solar electric systems and negotiated a volume discount. About 1,500 solar systems have been installed as a result of this project, and more than a dozen other American cities have started their own Solarize programmes.

RECYCLING AND COMPOSTING: BEATING THE PLATEAU

In 2011, Portland took the bold step of shifting to a household garbage collection every other week, continuing the weekly recycling collection, and adding weekly food compost to the garden debris regularly picked up. This change resulted in a dramatic 38 per cent reduction in residential garbage.

Portland began weekly household recycling collection more than 20 years ago. Participation has always been strong, yet in recent years household recycling had hit a plateau of about 60 per cent. While this is more than double what most cities recycle, Portland wanted to take it to the next level. The City Council established a goal to recycle 75 per cent of all commercial and residential waste by 2015. Commercial waste recycling is currently at about 70 per cent.

To make sure the programme ran smoothly, advertising and direct communication with households took place for several months before the change began. Each household received a free countertop food waste bucket. In addition, each household already had three kerbside containers – one for garbage, one for recycling, and one for garden debris. With the new programme, all food (meat, dairy, vegetables, fruit, etc.) and food-soiled paper can now be placed in with the garden debris. The debris and food waste is taken to a few large sites, composted and then sold to farmers, landscapers and residents as quality compost, a valuable product from what would have been waste just a few years ago. Waste reduction, recycling and composting are powerful tools for reducing carbon and methane emissions.

WHAT'S NEXT FOR PORTLAND?

Achieving an 80 per cent reduction in carbon emissions by 2050 remains a very ambitious goal. Proposed new efforts on the horizon include:

- More bikeways and an additional seven miles of light rail
- Enhanced energy efficiency programmes
- New rules for energy performance disclosure for commercial buildings
- More solar and wind power generation
- Investments in district-scale energy systems and community-owned solar energy installations
- Improved zoning and a new comprehensive plan that focuses on creating more connected, 20-minute neighbourhoods
- More technical assistance for companies pursuing sustainable operations
- The City's first climate preparedness plan.

Portland's success relies on its strong partnerships among residents, businesses, charitable and academic institutions, and other governments. Together these individuals and organisations work as a catalyst for action, as they continue to seek new partnerships with cities throughout the world. ■

"The debris and food waste is taken to a few large sites, composted and then sold as quality compost."

***Susan Anderson**, Director of Portland's Bureau of Planning and Sustainability, leads urban design, planning and code development for Portland, and builds partnerships to advance energy efficiency, solar, green building, clean energy technologies, waste reduction, composting and recycling, toxics reduction, sustainable food, and historic preservation citywide. In the early 90s, she led the development of the first local government Climate Action Plan in the United States. Susan has presented at over 100 venues nationally and internationally on sustainable urban development. She has held director-level positions in the public and private sector, and has a B.A. in Economics, B.A. in Environmental Science and Masters of Urban and Regional Planning.*

***Portland Bureau of Planning and Sustainability**, through partnerships and collaboration, provides: Citywide strategic and comprehensive land use planning; neighborhood, district, economic, historic and environmental research, planning and urban design; policy and services to advance energy efficiency, green building, waste reduction, composting and recycling, solar and renewable energy use, and local sustainable food production; as well as actions to mitigate and adapt to climate change.*

ISKANDAR MALAYSIA: **LEADING THE NATION** IN SUSTAINABLE DEVELOPMENT



Iskandar Malaysia was launched in November 2006. With a total size of 2,217sq km, Iskandar Malaysia is envisioned to be a Strong and Sustainable Metropolis of International Standing by the year 2025. One of Iskandar Malaysia's greatest assets is its strategic location in the heart of South East Asia.

Iskandar Malaysia's development is guided by the Comprehensive Development Plan (CDP) 2006-2015, which consists of three development phases: Planning and Building the Foundation, Strengthening and Generating Growth, Sustain and Innovate.

Since its inception, Iskandar Malaysia has recorded cumulative committed investments of RM111.37 billion up to March 2013, with realised investments of RM44.82 billion. Local investors contribute RM72.6 billion (64%) of the cumulative committed investments while the balance RM38.8 billion (36%) is contributed by foreign investors.

LOW CARBON SOCIETY

In November 2012, Iskandar Regional Development Authority (IRDA), the agency mandated with the planning, promoting and facilitating in investments in Iskandar Malaysia, launched the Low Carbon Society Iskandar Malaysia Blueprint at the United Nations' Conference on Climate Change in Doha, Qatar. This is a move towards an environment-friendly and sustainable development.

The Blueprint aims to reduce the economic corridor's carbon intensity emissions by 50% once it reaches maturity in 2025.

The blueprint was a result of a joint effort between Japan and Malaysia, which started in July 2011. The project "Development of Low Carbon Society Scenarios for Asian Regions" was initiated by the Science and Technology Research Partnership for Sustainable Development (SATREPS).

RESEARCH AND VISION

Sponsored by the Japanese International Cooperation Agency (JICA), the project brought together a team of multidisciplinary researchers from Kyoto University, the National Institute for Environmental Studies (NIES), Okayama University and Universiti Teknologi Malaysia (UTM) with a view to defining Low Carbon Society (LCS) visions and crafting a road map towards LCS at the national and city-regional level.

This is in line with Malaysia's voluntary commitment to reduce the country's carbon intensity by up to 40% by year 2020 (based on 2005 levels) and the research project began with a pilot study of Iskandar Malaysia. ■

Website: www.irda.com.my

URBAN CHAMPION
INTERVIEW WITH **DAVID MILLER**

From a rural upbringing in Cambridgeshire, England, to the Mayor's office in the City of Toronto, Canada, David R Miller has forged a professional life built upon the solid values of resourcefulness and environmental responsibility.

David R Miller's beliefs and commitment to sustainable values were instilled without him even noticing. Growing up in the pastoral countryside of Southern England, respect for the land and its resources was the norm, not something you had to plan and promote. Miller moved to Canada as a young boy and later attended Harvard University where he graduated in Economics in 1981. He then studied law at the University of Toronto, the city for which, as his journey from law to politics played out, he would eventually become mayor. Upon assuming office, Miller's long-held conviction of the need for sustainable principles was soon expressed in direct action. He introduced a C$3 million 'clean and beautiful' city initiative, involving ordinary Torontonians, followed by the allocation of a further C$21 million over three years to pay for more clean-ups. Miller was also progressive in the new technologies he introduced, including energy-efficient traffic signals and the Deep Lake water cooling project, in which water from Lake Ontario was used to cool office buildings in downtown Toronto.

After two terms in office Miller returned to the law profession. He also works at the Polytechnic Institute of New York University as Future of Cities Global Fellow, teaching courses on finding technological solutions to urban problems.

Miller has made it his mission to promote sustainability, following his core belief in environmental values. "I grew up in a small farming village in England. Everything was very sustainable and it wasn't that people chose to do it; it was just what we did. You didn't throw things away, you fixed them; people never had enough money, so. Everybody had a compost heap and produced very little waste. All the farming was organic because that's just the way it was. So it's just part of who I am. As a politician and now post-politics, I'm very passionate about this because the world's obviously





at a crisis point with respect to climate change. I believe there are solutions that already exist or that are close to existing, and my passion is to spread those solutions and the knowledge of those solutions so that we can do much much more. It's sort of an optimistic quest because I know that we can combine solving environmental challenges with creating jobs and a sustainable economy. What drives me really is the hope that we can get people to change their behaviour individually and collectively, because the knowledge and the solutions are there. If you learn to live in environmentally sustainable ways it does stay with you for the rest of your life."

THE CARBON NEUTRAL CHALLENGE

Given that the political sphere has not made sufficient progress on climate change, the business world needs to instigate radical gains in moving the world closer to a carbon neutral economy. Miller believes that environmental and financial concerns are not necessarily in conflict, but often mutually reinforcing, depending on the right kind of public policy. "If you look at the basics of a business, you need efficiency – but how do you achieve this? You get rid of waste. So reducing your environmental impact is getting rid of waste, making everything more efficient and innovative. I think there are lots of opportunities now, even without good government regulation. For example, ground source heat pumped geothermal energy works in Canada – it's economic today as a clean source of energy. A Canadian entrepreneur in a company I work with called Fenix Energy has figured out, using oil industry horizontal drilling techniques, how to install geothermal energy under existing buildings. Previously this was only possible under new buildings or if you had parkland areas nearby. This technique allows you to add geothermal facilities under crowded downtown areas. And this is all driven by the market, and by the innovative use of technology – seeing a market opportunity and realising that people want to turn to clean energy sources. You know tenants in buildings will pay a bit more if it's clean energy.

"So that's one tiny example; but there are a lot of places where today businesses can do very well, not necessarily because governments have forced them to, but because they're thinking differently and starting from the premise of 'how do we save the waste of resources here?' – and that saving of waste is good for the environment, as well as good for business."

In the past, being environmentally responsible in business was always perceived as a cost, rather than an opportunity to actually increase profits. In contrast, the media tycoon Sir Richard Branson recently stated that reducing our carbon output and capturing carbon emissions is one of the greatest wealth generating opportunities of our generation. Miller sees this change as reflecting people's consciousness of environmental issues. "In Toronto's case, for example, the market for condominium offices and commercial apartments has changed over the past 10 years – partly because of some by-laws that we bought in, but mostly driven by the preferences of buyers and the rental market. Businesses want premises to be green as they find it difficult to get new employees unless they meet younger people's moral and ethical standards. And with respect to apartment owners, it's often less expensive to run a low energy building, but more expensive to build it. And you have benefits in both cases of things like cleaner air in buildings, which will have a productivity benefit for businesses. So I think it's driven by people changing their minds and saying, 'I want to live by my values – not just in the charities I contribute to or the people I vote for, but in my business life too.' That's producing a lot of thinking among businesses about how do we do this."

"We need to move to clean electric sources of power so we can stop using fossil fuels."

ENVIRONMENTAL RESPONSIBILITY

A real sense of environmental responsibility has been fostered among Toronto's citizens, most importantly with the leadership of the City authorities. "We have an aggressive climate change strategy that passed city council unanimously," points out Miller. "One of the measures we took was a green building by-law, for example, but we also fostered the community. So we hired people called community animators that go out and work with people on green projects, and there are often incentives from government to allow citizens to work together as a neighbourhood – for instance in a small community farm

or allotment gardens. I think that the business world has become more conscious too, and that has helped us. Small businesses in Toronto are often organised into to something called a Business Improvement Area or BIA – they call them Business Improvement Districts in the USA, much like a high street in British terms. The association of all those BIAs got together and said 'we want to green businesses because our customers are asking questions', and they created an organisation called Canada Green TO, short for Toronto. So it came from those three things: enlightened self-interest of businesses, some leadership shown by the city, and from systematically engaging citizens from where they live in their neighbourhoods."

CUTTING COSTS

As an international businesses advisor, Miller imparts these core messages in the course of his consultancy work. "I find businesses want to do the right thing and they want to do it for a variety of reasons. As well as cutting waste and recruiting employees, they also want to be able to navigate the complicated policy world and have some idea where people are going. So I try to assist them in understanding how cities think and where the urban opportunities are. They will be seeking input from a different angle – 'Where do we fit in? Where is the public policy going? What's the market opportunity for us?' There's a lot of resonance, people understand that it's about saving costs; and they're very interested in looking at the perspective of where cities and mayors are trying to go."

Miller recently championed Light Rail Transit (LRT) as the solution to modern mass transit issues. He explains that the choice of the best system depends on the nature of the city. "What's really strong about light rail is, first of all, it's electric. Very quickly we need to move to clean electric sources of power so we can stop using fossil fuels. Diesel buses are highly polluting, bad for local air quality. For example, there are very high rates of asthma in Canada among children, and diesel has a lot do with that, as well as producing greenhouse gas. So you want to move to electric-based transport. And when you're considering what format, from electric light rail and subways, which do you choose?

TRANSPORT

"First of all you need to look at transport demand. Most North American cities have been built for the car, not for people. The densities are not enough to justify the cost of running trains in subways. In Toronto's case we're building a network of LRTs because we could reach medium density neighbourhoods, and we can provide an entire network for the cost of building one subway. First, it's important to have the technology that works for the areas you're going to; and secondly you need a strong network. In North American culture people tend to drive everywhere because they need to get home – they don't know for sure that they'll end up near a subway. London for example has a brilliant network – the underground trains and the bus network. Toronto has a couple of lines.

"So we chose LRTs for these three reasons: they're electric so they're clean and in time much more powered by renewable sources; secondly, they're affordable; and thirdly, they meet the transport needs of the city."

Miller puts emphasis on the importance of language, rejecting blanket terms such as 'taxpayer' and reclaiming the more direct words such as 'neighbours', 'friends', 'residents' and 'citizens'. "I've been to a number of public meetings as an elected official, where people have stood up to comment and prefaced it by saying 'I'm not a taxpayer', by which they mean they have a low income. But of course they are taxpayers: if they buy anything it's taxed, and if you rent you pay tax. So these terms are very exclusionary, and I think people have to take back the language. I think we're neighbours, we're friends, we're residents, we're citizens. We won't take the language back unless people start speaking up collectively, through things like – well, over here the newspaper always uses the word taxpayer when it means citizen. And I think people should start writing letters to editors, and making the point to each other. Politicians should be very vigilant about their language. This exclusionary language seeped in over the past 25 to 30 years and we need to speak up.

"And we also need actions. The idea of citizenship means people have rights to participate, taking some actions and also duties, like jury duty. But a government needs to be inclusive and to make sure people's voices are heard. It's about speaking up and being consistent with those values and the way you act. Grassroots movements are the way to change this kind of discussion, but it needs leadership as



Left and below: Business Improvement Areas in Toronto, Canada, have created Canada Green TO to improve sustainability in business



well. It really helps if leading politicians or figures in the non-profit and business world are making the same point.

Town planning, the building and construction industry and government policies have to align together to create sustainable cities in the future. Miller is optimistic that this is a realistic hope. "Cities are where the bulk of greenhouse gas emission are, they're where the bulk of the people are. We passed a moment in 2008 where, for all time until that moment, more people lived outside cities than in them. Now, and for the rest of time, more people will live inside cities. This was an earth changing moment. So that tells me, if you create solutions that are economic and environmental, then by necessity they'll be in cities, because that's where the economy is, where the problems and opportunities are, and where the people are. And I think the good news is that lots of these innovations are under way. We need to do more, we need to help people to scale up to a worldwide range, but that's why it's so important to focus on cities.

"Cities themselves need to be built in a sustainable way. You need to think about it from a land use perspective, from a planning perspective. When I was mayor we flipped the equation around and welcomed growth into the city. By building a transit in the city we are able to welcome development into places where we think there are good opportunities for developers. You have to build in a sustainable way, and that includes new buildings of a high environmental standard, and old buildings having retrofits. Then it will start to get into a virtuous cycle, and you will create economic opportunity from these issues as well. You become sustainable from a different perspective, so you get a triple bottom line approach that includes social justice and equity, if you put those principles at the heart of your strategy."

The steps that a procurement department should take to make progressive, beneficial decisions that won't backfire in economic terms deserve a new style of thinking, according to Miller. "Procurement departments are set up for the lowest cost solution, and in thinking environmentally you have to think differently. It's not the lowest purchase cost, it's often the lowest operating cost that you should be looking for. Often you can buy something inexpensive that's very wasteful. As a minimum you need to look at lifecycle costs; with a low operating cost you've usually got something very efficient, which usually means more environmentally friendly. Another part is to learn from each other and that's something the C40 Cities Leadership Group can do. Cities can say, 'Here's how we solve that problem', or 'Here are technologies that have worked previously'. And the third thing cities can do before the purchasing stage is to run pilot projects and tests to make sure the promised benefits from a new technology are real. Toronto's been a pretty good example of that – we piloted LED street lights, for example. In between, Los Angeles liked the idea so much that they just went ahead and did it. So from a bureaucratic perspective you need the purchasing department to sit down with the environment department and make sure they can understand each other."

LOW COST SOLUTIONS

With regularly changing parliaments and the sustainability of a city being an ongoing investment, Miller acknowledges that it is tricky to ensure that long-term developments are not sacrificed for short-term gains. "I think that part of that is the accounting point I made about lifecycle costs. In the bigger picture ultimately you

need the political will. If you're a leader trying to bring in a progressive agenda, as I was, you have to push the civil service together in new ways to make sure that agenda happens – and will continue to happen when you choose not run again, otherwise things will just revert to normal."

CITY PLANNING

Keeping up with innovations and new techniques is vitally important for a city's sustainability planning. Miller mentions two that offer the potential to really make a difference. "There's a Vancouver company called International Waste Water Heat Treatment Systems. They have found a technology that works in China, that uses the heat from waste water to heat a building, or in reverse to cool it via a heat exchanger. They've licensed that technology in North America, they're manufacturing it in Canada, and that's transformative. If you have a condominium building, in the morning between 6.30 and 8 am people are taking hot water for showers or baths and that all goes down the drain; this machine takes the heat out and they can use it to heat a building all day. And if there's a commercial building next door and you have a thermal loop between them, you can literally heat the commercial building next door with the morning waste water heat from the condominium.

"Another one I saw which is a bit more experimental is from a guy who has a technology that they've used in the US military to get rid of nerve gas through a hydrogen process. They can create inert materials and fuel in this process where you put in things like garbage and sewage – and it's not burning, it's a chemical process. There are no toxic emissions. They're at the pilot stage and they're trying to scale it up. They're quite confident that it will succeed, because of the work they've done with the US military."

The growth of megacities is posing a major challenge for sustainability planning. According to the *Far Eastern Economic Review*, Asia alone will have at least 10 megacities, including Mumbai (population 33 million), Shanghai (27 million), Karachi (26.5 million), Dhaka (26 million) and Jakarta (24.9 million). Miller welcomes some international attitudes, but not others. "The good news is that the government of China takes this very seriously and that the themes of the problems are the same all over the world – so, broad brush, we know how to create a city that has low impact.

"The bad news is when people think of a successful city as one where everyone has a car, if not two cars. I have heard a mayor from a developing megacity say this – and that is a mental challenge to get over. As these cities grow they look at the US as the symbol of success. We now know that that lifestyle is unsustainable, and we shouldn't have built the cities in those ways. That's a real challenge – we know what the solutions are, and we know we need a city built around public transit and walking and biking, with the car having its place but not running the city. And we're starting to see really good technologies on waste, heating and on cooling and energy generation. We see all that coming but really we need to capture the hearts and minds of people. It's not the technologies and practicalities, I think it's an aspirational issue."

FUTURE OF URBAN GROWTH

Given that projections indicate that the majority of future urban growth will be in developing countries, where the populations suffer malnutrition and lack of basic healthcare, Miller agrees that it is a constant struggle to make sure that long-term issues are not forgotten under the pressure of immediate concerns. "It means you have to fight to make sure sustainability issues are front of mind. Obviously basic nutrition has to take priority. But these cities are literally growing as we speak and the buildings we build now are probably going to be here in 80 years. I think from the perspective of the national governments and mayors, and international institutions, this should be top of mind. So if the World Bank invests in infrastructure, it should be investing in resilient sustainable infrastructure. The good news is that international institutions like the World Bank, the United Nations Environment Programme, the United Nations itself and the OECD are taking these issues seriously, and that will certainly help in the political realm. In China they are building sustainable cities out of nothing. It's more of a challenge where they are seeing a huge population influx, where people are just trying to get some basic standards of living, but it's not an insurmountable one. Cities know that they need good urban planning just to survive, let alone prosper, so I think you can marry that with sustainability in a very positive and important way." ■

MEASURING A **SUSTAINABLE LONDON**





By **John Plowman**, Chair, and **Paul Toyne**, Commissioner, London Sustainable Development Commission

The Mayor of London, Boris Johnson, has talked of making London the world's best big city. To improve London's chances of achieving this, it is necessary first to know what this would mean in economic, environmental and social terms; then assess the current situation; and, lastly, measure progress against resulting actions to achieve this.

How do you capture the dynamic, vibrant, culturally diverse, sometimes chaotic, kaleidoscopic place that is London? The London Sustainable Development Commission (LSDC) supports the Mayor's aspirations for the UK's capital, and believes that as part of being 'best' we should work to make London the benchmark for sustainable cities by 2020.

The LSDC's fourth *Quality of Life Indicators* report (QoL), published early in 2013, is an attempt to measure progress. It shows a snapshot of how things have changed since our last report in 2009. Our analysis of 33 indicators helps to reveal the picture. These range across the economic, social and environmental spectrum and include life expectancy, income inequalities, CO_2 levels, GDP and bird populations, among others.

Of course this is not the whole story. We would like to have gone wider and deeper, for example exploring issues of public health such as obesity and diabetes, and drilling down further from city to borough level. Some figures conceal telling variations that reflect London's remarkable diversity and differing rates of progress in different parts of the city. We would also have liked to say more about how London compares with other big cities globally but comparable datasets are not available.

INTERPRETING THE DATA

The challenge for the LSDC is to draw the right conclusions from the indicators. Many are best understood in the context of a combination of other indicators, whether they cover for example, social cohesion, climate adaptation or the green economy. We are doing further research to better understand these relationships. Even if we could measure everything, immeasurables such as policy commitments, perceptions and expectations play a part, so the indicators provide pointers, not prescriptions for action.



The London Sustainable Development Commission is based at City Hall, London

Fortunately technology – whether electric vehicles, renewable energy or recycling – is becoming more affordable, and the capacity to monitor and measure what is happening is becoming greater. We have the tools to make London a much better connected, more efficient, self-regulating, fairer, more intelligent city: one that demands a lot less support than the current heavy burden, equivalent to the output of 2.5 planets.

Moreover, the LSDC firmly believes that London's resilience and competitiveness depend crucially on its capacity to innovate and make the most efficient use of its resources. That will give it the competitive edge it needs to retain jobs and support the growth needed in an expanding city.

A CONTRIBUTION TO THE EVIDENCE

The latest report is a contribution to the evidence. It reveals that progress has been made in some areas, which is something to be celebrated. The challenge, though, is how to lessen the evident gap in social equality that leads to a poorer quality of life for many Londoners. We believe the jobs and growth agenda is critical to tackling this, but it must be linked to stronger environmental performance and increased citizen engagement.
In 2013, sustainable development matters more than ever in London. Recent events such as the global economic downturn and the riots of 2011 have taken their toll. Combined with longer-term issues – including climate change, increasing resource scarcity, over-consumption and population growth – these threaten to conspire to create a 'perfect storm' of quality of life challenges for the city. In contrast, we have just celebrated the most sustainable Olympic and Paralympic games ever.

Sustainable development offers an integrated economic, social and environmental framework for creating a London not only resilient to these challenges, but one that secures a good quality of life now and for its future citizens. What's more, as a global city, London is well positioned to act as a leader of sustainable urban living, demonstrating how a world city can succeed economically and socially in ways that enhance and protect the environment.

"We have the tools to make London a much better connected, more efficient, self-regulating, fairer, more intelligent city."

As far as we know London is the only major world city to produce such a comprehensive report examining all aspects of life across the three main themes of environment, economy and social progress.

The LSDC's QoL indicator set is designed to capture the breadth of challenges facing London and to provide a means to gauge how London is performing against a number of measures that are considered to be key factors in delivering a sustainable city that supports and enhances quality of life. They can also help alert policy-makers to unsustainable trends.

MOSTLY POSITIVE

Despite London's population increasing by more than 850,000 people in the last decade, CO_2 levels have fallen by almost one tonne per capita since 2009; traffic volumes dropped by 7 per cent between 2003 and 2010, with 1.5 billion fewer vehicle journeys between 2009 and 2012, and total household waste fell from 3.4 million tonnes in 2006-7 to 3 million tonnes in 2010-11.

In education, the proportion of pupils obtaining at least five GCSE passes at A*-C or equivalent has increased by 29 per cent since 2004. Life expectancy has also improved for both men and women, with males' life expectancy increasing to 79 years from 77.4 and females up to 83.3 years form 82. Both figures compared 2008-10 with 2004-06 data.

"The report shows that London leads the way when it comes to 'green jobs' in the UK"

Despite the economic downturn, employment levels have stabilised at around 69 per cent during the last three years and there is evidence that the employment rate for London has been increasing since mid 2009. However, one-year and three-year business survival rates are down and sixty per cent of London businesses started in 2007 were still trading three years later. London, however, has more new business start-ups than the UK average, despite falling survival rates.

However, not all areas of life have improved for Londoners during the past decade. The cost of childcare has risen while its availability has decreased. Between 2009 and 2011 the number of childcare places for under-eights per 100 children had declined by just over 4 per cent, and London has the highest childcare costs of all regions in the UK.

The affordability of housing continues to be a problem – affordability has more than halved in the capital since 1997 and London homes were also 37 per cent less affordable than the national average.

VIBRANT CREATIVITY

Meanwhile, the report shows that London leads the way when it comes to 'green jobs' in the UK. The capital has a 19 per cent market share in the sector in the UK and 0.7 per cent of global market share. Jobs in the green economy sector rose slightly between 2008-09 and 2009-10, despite the economic downturn.

London is also a highly creative city. In 2012, 22.9 per cent of firms in London reported introducing product innovations, a rise from 20 per cent in 2009. In the same year, 13.2 per cent of London firms reported introducing process innovations, also a rise since 2009 when levels were at nine per cent.

As Londoners and London residents, sustaining the best possible quality of life is something the Commission is passionate about. Improving it without losing the unique and vibrant identity of this city is key. The challenge remains to transform London into a more sustainable city – one that will safeguard us against potential environmental, social and economic disruption that will affect our health, well-being, community spirit and economic prosperity.

"London is well positioned to act as a leader of sustainable urban living."

Despite the general evidence pointing to overall quality of life improvements there are large variations borough by borough, for instance in life expectancy. For London to make real progress we need to ensure the quality of life improves for all Londoners, regardless of gender,

A BETTER QUALITY OF LIFE

The LSDC's vision is presented in A Sustainable Development Framework for London. In practice, achieving a better quality of life is about:

- Having access to quality education, jobs, services, housing and leisure
- Living in an environment that is healthy, resilient and stable now and into the future
- Living and working within a society that is democratic, just, engaged, diverse, responsible, supportive and vibrant
- Being fulfilled, healthy and with sufficient personal resources to enjoy life.

Whether as individuals, communities, businesses or governments, our journey towards sustainability means we need to think about the social, economic and environmental impacts of everything we do. We must make the most out of available opportunities, designing out negative impacts and minimising them as a last resort.

"We need to ensure the quality of life improves for all Londoners, regardless of gender, background and where they live ."

background and where they live – the goal must be for an inclusive approach offering opportunities for all.

Economic, social and environmental issues are often viewed in isolation and traded off against each other. However, the Commission supports a more holistic approach, considering them in an integrated way to better support the achievement of long-term sustainable development.

FUTURE WORK

Based on the results from the QoL indicators, the Commission has identified four key cross-cutting issues that need further work and analysis:

- Stimulating sustainable economic growth
- Mitigating climate change
- Improving equal life opportunities; and
- Strengthening community cohesion.

The QoL report sets out some significant challenges for London, many of which are global in nature. The global economic recession, issues around social cohesion and climate change are all causes for concern. However, within these challenges there are key indicators that show that London has the potential, through building on its strengths, to become a national and global leader in terms of recovery. For example Gross Value Added, which is the measure of the total value of goods and services produced by the economy, is 68 per cent above the UK average. There are more business start-ups, and innovation is higher than anywhere else in the country.

The report also reveals some significant interplay between these issues, which in themselves present opportunities. For example, nearly all of London's emissions are on the way down and the requirement for further reductions directly supports the need to develop the already growing low carbon and environmental sector.

With expertise drawn from London's environmental, social and business community, the LSDC is ideally placed to provide the advice and support required to make the most of these opportunities. Using this report, which provides a unique insight into the broad range of issues affecting London, the Commission will focus its energies on specific pieces of work that will make a difference in the short and medium term, and stimulate long-term thinking that brings together public, private and third sectors; attracts in private sector support; and drives forward the jobs and growth agenda.

"London has the potential, through building on its strengths, to become a national and global leader in terms of recovery."

The Commission is currently working on the prioritisation of issues and has identified:

- **Green entrepreneurs in London**, and the barriers and opportunities facing them. This has been driven by the QoL report which shows that green growth has been good for London during the recession. Given that fact, then this project will focus on green entrepreneurs to help drive the jobs and growth agenda for London.

- **Closed Loop systems and the circular economy.** The Commission sees initial work as a springboard to wider work and discussion on economic efficiencies, technical skills and employment opportunities to be gained from applying Closed Loop thinking and business interest and innovation to wider resource use. From the Olympics and Paralympics, lessons can be drawn from the re-use and minimisation of waste in construction circles, but also in other areas. The Commission's understanding is that Closed Loop thinking can be broadened for wider business and societal benefit, including how London uses resources efficiently and continues to position itself as a leading example of action on the benefits of sustainability. The initial phase of work will focus on the potential for creating a secondary materials economy for London.

"The Commission will focus its energies on specific pieces of work that will make a difference in the short and medium term, and stimulate long-term thinking."

As a Commission we will look at how we can help the Mayor and others realise this in the coming years. Commissioners, who are drawn from a wide range of backgrounds, and who are all actively engaged in promoting sustainability in their companies, organisations or communities, look forward to playing their part in London's sustainable future.

The LSDC's fourth *Quality of Life Indicators* report can be found at http://www.londonsdc.org/lsdc/research.aspx. ■



John Plowman *is Chair, London Sustainable Development Commission. John spent his civil service career in a number of departments including Defence, the Cabinet Office and the Foreign and Commonwealth Office, as well as the Departments of the Environment and Transport. His responsibilities included regional policy and planning; environmental, social and regional policy negotiations in Brussels; chair of the UK Biodiversity Group; and Regional Director for the Departments of Environment and Transport in North West England, including the brief for housing and urban regeneration. He was responsible for cleaner vehicles and safety and latterly interim chair of the Driver and Vehicle Operator Group at the Department for Transport. Since leaving the civil service he has run a successful consultancy specialising in ethical governance, safety and sustainability. He has also worked on low carbon mobility with DEFRA's Sustainable Development Commission.*

Paul Toyne *is LSDC Commissioner and Group Sustainability Director, WSP Group. Paul has a diverse background of academic research in environment science, campaigning for the World Wildlife Fund and running a corporate social responsibility consultancy. He has worked extensively with governments in the UK, the EU and globally, as well as private sector and non-governmental groups, on the development of policy on issues of sustainable trade and the environment. He currently manages the sustainability performance for WSP, a global design and engineering consultancy that specialises in both the natural and built environment. Paul chairs and participates in various forums for property and construction that aim to improve the sustainability of the built environment. Prior to WSP, Paul was Head of Sustainability for Bovis Lend Lease UK, a major construction and project management contractor, and was the architect of its award-winning sustainability programme.*

The ***London Sustainable Development Commission*** *(LSDC) was established in 2002 to advise the Mayor of London on making London an exemplary sustainable world city. The Commission is made up of individual experts from the economic, social, environmental and London governance sectors. Commissioners give their time voluntarily, promoting sustainable development, embedding sustainability into London-wide strategies, and helping make sustainability a meaningful and understandable concept for all Londoners.*

URBAN SUSTAINABILITY IN THE **EUROPEAN UNION**



By **Karl Falkenberg**, Director-General, Directorate-General for the Environment, European Commission

Three quarters of Europeans live in cities, and accordingly, their quality of life and the quality of their environment depends upon how cities look and how they function. European urban areas face a number of environmental challenges and although the scale and intensity of the problems vary between cities, a common set of issues can be identified.

Many cities are confronted with poor air quality, high volumes of traffic and congestion, rising levels of greenhouse gas emissions and ambient noise, a scarcity of quiet areas for sport, play and recreation, urban sprawl and large volumes of waste and wastewater. Demographic changes due to the consequences of economic stagnation in terms of job creation and social progress, and the tangible effects of climate change are recent additions to the list.

These are serious challenges that have significant impacts on health, the environment and the local economy. Like all environmental challenges they are also interdependent, with many issues having an impact on other areas. Finally they touch people's lives at a very concrete level – the way they make business, the air they breathe, the way they move and their daily surroundings – making it necessary to involve everyone, citizens, businesses, local, national and regional authorities in decision-making. What is more, what happens on the local level also influences wider levels, in terms of environmental impacts that know no borders, and policy decisions. Effective responses to these challenges at local level are critical for achieving the smart, sustainable, inclusive growth and society envisaged in the Europe 2020 Strategy.

This is why integrated environmental management is key to urban sustainability.

AN INTEGRATED APPROACH TO URBAN ENVIRONMENTAL MANAGEMENT

Because the environmental, economic, social and cultural aspects of urban life are all interwoven, success in urban management can only be achieved through an integrated approach.

Cyclists along Norr Mälarstrand just outside the City Hall in central Stockholm



© Svartpunkt AB

Integrated urban policies can nurture a consistent approach to urban sustainability. Measures for environmental protection must be combined with those for physical urban renewal, integrated spatial planning, economic development, education and social inclusion. Strong partnerships between local citizens, civil society, the local economy and the various levels of government are a pre-requisite to ensure coherency and effective action.

This integrated approach pays multiple dividends. Improving ambient air quality means reducing greenhouse gas emissions. Making urban transport more sustainable implies carefully considering land use and planning to avoid urban sprawl. Increasing biodiversity and green space can help prevent noise and protect quiet areas, and improving waste management can contribute to increased energy efficiency.

Each city needs to have a clearly defined, widely understood and supported environmental long-term vision for the municipality, as part of a broader commitment to urban sustainability. This vision needs to be reflected in different strategies and action plans, which include objectives and targets for individual sectors such as climate change and energy, transport, green areas, nature, air, noise, water, eco-innovation.

"Integrated urban policies can nurture a consistent approach to urban sustainability."

On the other hand all stakeholders (government, business, academia, citizens including young people) should be invited to participate in the development of the city's environmental vision and associated strategies and action plans. Involving citizens in urban planning helps ensure sustainable economic development and plays a vital role in providing well-planned and well-governed cities. As citizens are deeply affected by urban planning, authorities need to make sure that they are involved and offered a forum where they can express their opinions. This requires practical arrangements like management circles, obligatory sustainability assessments (assessment of environmental, social and economic effects of policy proposals), project structures, promoting of skills or periodic evaluations. Citizen participation is not only the most effective way of involving people in local dynamics – it's also a right. The EU is a signatory to the Aarhus Convention on access to information, public participation in

environmental decision-making and access to justice, which enshrines the right of citizens to participate in urban planning processes.

HOW DOES THE EUROPEAN COMMISSION PROMOTE THIS INTEGRATION?

An integrated approach to urban environmental management is the building block of EU urban sustainability policies. The Thematic Strategy on the Urban Environment (2006) outlines the European Commission's commitment to support and encourage Europe's towns and cities to adopt a more integrated approach to urban management. The need for better integration at urban level has also been reflected in the 7th Environmental Action Programme (2014-2020) recently proposed by the European Commission. The proposal aims to see a majority of cities in the EU implementing policies for sustainable urban planning and design by 2020, and it promotes a coherent, integrated approach to sustainable urban development.

The European Union also encourages urban sustainability and integration through a number of initiatives. **The European Green Capital Award** recognises and rewards local efforts to improve the environment, the economy and the quality of life of growing urban populations. It also acts as a platform for exchange of ideas and opportunities. It encourages people and cities to learn from one another to devise solutions to city problems.

To date, the European Green Capital Award has been bestowed on five cities – Stockholm (2010), Hamburg (2011), Vitoria-Gasteiz (2012), Nantes (2013) and Copenhagen (2014). These winning green capitals have proven that cities can strike a balance between economic growth, environmental protection and quality of life. And they have achieved this through integrating these elements in their decision-making.

For example the medium-sized city of Vitoria-Gasteiz has been very good at involving its citizens in the local decision-making process. Winning the European Capital Award in 2012 created a sense of belonging and pride among its citizens that spurred a wave of participation in green activities: 143 citizens participated in the volunteer program Ekolabora, 204 citizen initiatives applied for green subsidies, 703 local businesses signed a 'green deal' with the mayor, and more than 3,000 citizens visited the green factories.

The European Commission also supports cities in the exchange and application of good practices to improve energy efficiency and promote low-carbon business and economic development, through the **Covenant of Mayors**. More than 1,900 European cities have committed to go beyond the EU emission reduction targets of a 20 % cut in CO2 emissions by 2020 – through the development and implementation of Sustainable Energy Action Plans under the Covenant of Mayors. These local commitments are integrated in a more global reflection and policy action. The Commission also provides measures to identify emissions reduction opportunities – including better energy efficiency in buildings and green mobility – and funding to help them come to fruition.

"More than 1,900 European cities have committed to go beyond the EU emission reduction targets of a 20 % cut in CO2 emissions ."

Green buildings that require less energy for lighting, heating and cooling through clever use of glass and innovative air flow systems are an important component of the effort to achieve efficient and sustainable European cities. The Commission promotes green buildings through several measures including the Energy Performance of Buildings Directive, which sets minimum standards requiring Member States to make new and existing buildings more energy efficient. The European Commission's Green Building Programme supports this, encouraging renewable energy to be integrated into non-residential buildings.

Frankfurt's German Passive House Standard is an excellent example to follow. In 2005 ABG Frankfurt Holdings decided that all new buildings would be consistently constructed as low energy passive houses, which means that their heating energy needs must be less than 15 KWh/m2. The company pioneered the launch of passive house technology in multi-storey homes, and Frankfurt now holds the European record for the number of buildings constructed to passive house standards.



A number of important **practical tools** also exist to strengthen protection of the urban environment in promoting more integration.

One of them is an Integrated Environmental Management System (IEMS) – a strong voluntary commitment by the city to act on its environmental problems. A well-developed IEMS helps avoid conflicts by considering the competing demands between various policy areas and initiatives (economic well-being, competitiveness, health, environment, spatial planning), and by setting long-term goals.

An IEMS is often linked to a Local Agenda 21 initiative. Under the 1994 Aalborg Charter of European Cities & Towns towards Sustainability, many European cities committed to engage in preparing these local action plans towards sustainability; to date, more than 5000 Local Agenda 21 strategies have been developed in Europe.


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EU guidance on IEMS in urban areas provides best practice examples and experiences. In developing their IEMS, many urban areas may also follow the guidelines set out in the EU Regulation for a voluntary Eco-Management and Audit Scheme (EMAS).

The EU has also developed two mandatory procedures for cities to **assess the potential environmental impacts** of their plans programmes and policies. They enable cities to ensure that environmental consideration is given to plans likely to have significant effect on the environment such as road building projects. These tools are the Strategic Environmental Assessment Directive for public plans and programmes, and the Environmental Impact Assessment Directive for certain public and private projects.

Tracking progress through self-evaluation and critical analysis is essential if Europe is to stay on top of its environmental challenges. The EU has developed guidelines and tools for this such as Local Evaluation 21, an online self-assessment tool for participating cities to gauge the progress of their sustainable development processes.

"The Roadmap to a Resource Efficient Europe launched by the Commission in 2011 outlines how we can transform Europe's economy into a sustainable one."

HOW WILL INTEGRATION OF URBAN SUSTAINABILITY CONTRIBUTE TO ACHIEVING EU POLICY PRIORITIES

Resource efficiency

To function efficiently, cities and towns need to lower their use of scarce natural resources. Resource efficiency is based on the ideal of an integrated, closed-loop economic system that manages resources from cradle to cradle.

The Roadmap to a Resource Efficient Europe launched by the Commission in 2011 outlines how we can transform Europe's economy into a sustainable one by increasing resource productivity and decoupling economic growth from resource use and its environmental impact. It illustrates how policies inter-relate and build on each other. Turning waste into a resource through recycling, improving buildings' energy efficiency, ensuring energy efficient mobility are some of the actions put forward in the roadmap.

Cities have a key role to play in the economic transformation toward resource efficiency. They

have a number of instruments in their hands, such as green public procurement, waste and water management, improved mobility, housing improvements, stimulating eco-product markets, and urban planning. We are also starting to talk about urban mining. You can get 100 times more gold from a tonne of discarded mobile phones than from a tonne of gold mine ore.

Green infrastructure and efficient land use are also important to become more resource efficient. Cities benefit in many ways when they establish networks of high quality green spaces, using nature to deliver multiple benefits. In the EU, green infrastructure projects financed through our LIFE+ programme (www. http://ec.europa.eu/environment/life/index.htm) have shown that ecosystem enhancement can go hand in hand with, for example, protection against flooding, and support for the tourism sector. The deployment of green infrastructure creates jobs for integrated planning in urban areas, for the construction of green roofs and walls, planting and maintaining the city's forests and park systems, for the restoration of brown field sites and opening up river courses flowing through the city. Investing in green infrastructure also saves money – it is more resilient and often cheaper than purely technical solutions in the long run.

Air quality

Many of the air problems we experience today are related to cities, with their dense population, high level of economic activity, and intense traffic. It is in cities that local and European challenges come together. Urban pollution is partly a matter of local emissions, but those emissions rest on a background concentration stemming from other parts of the same Member State, or from transboundary sources. We need to work at all levels of decision-making, from local to European to address this issue effectively, also by tapping the full potential of international cooperation . The more integrated the approach, the more efficient the decisions will be.

Despite progress in recent years, several air quality standards are still widely exceeded in the EU's most densely populated areas, especially from pollutants such as particulate matter, ground-level ozone, and nitrogen dioxide. Janez Potočnik, the European Commissioner for the Environment, has declared 2013 the "Year of Air". So we are in the process of reviewing the Commission's air policy, with a focus on finding ways to improve the quality of the air we breathe. Based on the review, that involves extensive consultations of a wide range of actors, including citizens and local authorities, the Commission will propose measures to improve its policies.

As citizen concern about air quality grows, the demand for low emission products and processes can be expected to increase dramatically. In that respect air quality policy is therefore not only an environmental objective, but also an economic opportunity and a driver for innovation. A strengthened air quality regime in the EU will actually benefit European competitiveness. And cities will have to play their role of engines of the economy, places of connectivity, creativity and innovation.

CONCLUSION

If we want cities to become more sustainable we need to motivate and encourage them to take an integrated approach to policy delivery in all dimensions, with more horizontal integration between environmental sectoral policies, and vertical integration between levels of governance at the local, national, regional and European levels, while ensuring the involvement of all stakeholders. The European Commission provides many tools and frameworks (including proactive initiatives and funding) to help Member States to promote this integration, laying the foundations for a sustainable future. ■

Karl Falkenberg *has a long experience as a negotiator in the European Commission. In 1990, he served as foreign policy advisor to EU President Jacques Delors, with particular focus on the German unification process. From 2005 to 2008 he coordinated all bilateral trade policies as Deputy Director General and in January 2009, he took up the position of Director General of the Environment, covering the EU's environmental policy in both its domestic and international dimensions.*

The ***Directorate-General for the Environment*** *is one of the more than 40 Directorates-General and services that make up the European Commission. Commonly referred to as DG Environment, the objective of the Directorate-General is to protect, preserve and improve the environment for present and future generations. To achieve this it proposes policies that ensure a high level of environmental protection in the European Union and that preserve the quality of life of EU citizens.*

COMMITMENT TO **SUSTAINABLE ENERGY IN EUROPEAN CITIES**



By **Kristina Dely**, Head of Office, Covenant of Mayors

The Covenant of Mayors is the mainstream European initiative involving cities in climate mitigation via a more sustainable use of energy. Launched by the European Commission in 2008, the Covenant is a voluntary commitment by cities to go beyond the EU's energy and climate objectives and reduce their CO_2 emissions.

More than three-quarters of the European population live in cities, where about 70 per cent of the energy is consumed. In this context, local authorities clearly have a major role to play in sustainable energy management to reach the European objective of a 20 per cent CO_2 reduction by 2020.

In May 2013, the initiative includes over 4,500 local authorities from 47 countries, representing all the 27 member states of the European Union and others. Through the commitment of their local authorities, a staggering 165 million citizens are now involved in the Covenant of Mayors. Recognised as a leading example of multi-level governance, the Covenant of Mayors is an unprecedented bottom-up, participative and democratic movement of cities supported from the top by all EU institutions, empowering local authorities in their decentralised energy management.

The vast interest in the Covenant of Mayors initiative from local and regional authorities is easy to understand. They not only are consumers of energy in their public buildings or in the transports they operate, but they are also producers of energy via district heating and cogeneration, as well as regulators (they can levy local taxes, give construction permits, etc.). Closest to their citizens, they can also motivate them and the local stakeholders to change behaviour. By taking ownership of their local energy management, local authorities can make a real difference for the welfare of their citizens: avoiding costly imported and wasted energy and keeping money at home.

PRACTICAL APPLICATION

This initiative is not just gesture politics. As part of their commitment, local authorities agree to compile within a year a baseline emissions inventory (BEI) and to formulate a Sustainable



Alan Coleman, Councillor, Cork (Ireland), Zbigniew Michniowski, Deputy-Mayor, Bielsko-Biala (Poland) and Philip Lowe, Director-General for Energy, European Commission

Energy Action Plan (SEAP) – a comprehensive set of actions in the fields of transport, housing, public lighting and urban development in general. As of May 2013, around 2,700 SEAPs have been adopted by municipal councils and are now under implementation.

To help signatories develop their action plans, a comprehensive support framework has been put in place by the Covenant of Mayors Office (CoMO), together with the Joint Research Centre of the European Commission and experienced cities and regions. The web portal of the Covenant exists in over 30 languages and provides visibility to SEAP implementation actions via a catalogue of Benchmarks of Excellence. Through the Covenant extranet, webinars and e-learning tools, signatories can share their experience and receive direct assistance on administrative and technical questions as well as funding instruments. At a national level, a network of Covenant Territorial Coordinators and Supporters is in place to provide targeted assistance to local authorities.

"By taking ownership of their local energy management, local authorities can make a real difference for the welfare of their citizens."

Moreover, different forms of financial assistance have been set up to support the Covenant

signatories. The European Local Energy Assistance (ELENA) facility was launched in December 2009 by the European Commission and the European Investment Bank. ELENA offers EU grants for technical assistance to prepare bankable investment projects. In July 2012, the city of Birmingham was granted €1.5 million to improve the insulation of some 60,000 homes with energy-saving equipment such as boilers, improved insulation or solar panels. More recently, in January 2013, the French agglomeration of Nancy received an ELENA loan agreement of €55 million to finance the acquisition of high performance buses and the construction of a new bus line.

EXPANDING HORIZONS

The success of the Covenant goes far beyond the EU borders. In 2012 two new Covenant of Mayors Offices opened their doors in Ukraine (Lviv) and Georgia (Tbilisi) as part of CoMO-EAST. This Eastern partnership aims to support local authorities in Eastern Europe, the Caucasus and Central Asia to reduce their dependency on fossil fuels, improve the security of energy supply, and contribute more actively to climate change mitigation. Currently there are 43 signatories in the CoMO-EAST region. A similar partnership is under development for the Mediterranean region. The municipality of Salé in Morocco and the city of Gaza in the Palestinian Territories have recently joined the initiative, looking for new partnership opportunities with European cities.

Since February 2012 the Covenant of Mayors is also the pivotal structure for the EU-China urbanisation partnership. In October 2013, the second EU-China Mayors Forum will take place in Beijing, bringing together European and Chinese cities joining efforts to reach greater sustainability in urban areas. The urbanisation partnership aims at enhancing bilateral cooperation in areas such as urban planning, energy supply and demand management, development of 'green' digital cities, mobility, inclusion of migrants and management of water and waste.

WHAT IS NEXT?

Five years after its launch, the Covenant of Mayors is reaching a critical point. After a successful experimental phase, the initiative has to further prove its credibility via the implementation of sound action plans and massive investments in sustainability programmes on the ground. This year, 2013, it is important to take stock of the results achieved by the early signatories and map out the progress made by each individual city or region.

"It is important to take stock of the results achieved by the early signatories and map out the progress made by each individual city or region."

The multi-level governance model of the Covenant of Mayors has been inspirational in and outside Europe for different policy areas. Can such a governance model be replicated to other policy initiatives and regions? The challenge is huge and only time can tell. Meanwhile, the Covenant of Mayors Office will continue supporting its 4,500 signatories in implementing ambitious sustainable energy projects to reach the European energy objectives. ■

__Kristina Dely__ has headed the Covenant of Mayors Office (CoMO) since its establishment in January 2009. The office – comprising five major European associations of local authorities – coordinates the Covenant of Mayors. Formerly, Kristina was in charge of European Affairs at Energy Cities (www.energy-cities.eu), a European association representing 1000 local authorities from 30 countries. Kristina holds a Masters degree in economy and environmental management from Budapest University of Economics and Lyon Management School.

The __Covenant of Mayors__ is the mainstream European initiative involving cities in climate mitigation via a more sustainable use of energy (www.eumayors.eu). Launched by the European Commission in 2008, it is a voluntary commitment by cities to go beyond the EU's energy and climate objectives and reduce their CO2 emissions by at least 20 per cent by 2020 via enhanced energy efficiency and renewable energy use in their territories. In May 2013, the initiative includes over 4,500 local authorities from 47 countries, representing all 27 member states of the European Union and many others.

A SMALL COUNTRY, A GREAT EXAMPLE

INTERVIEW WITH **JO VANDEBERGH,** CEO, ERTZBERG

The first residential building on the continent to receive the "outstanding" Breeam certificate. In London, in the first place spot on the podium, to receive the 2013 Breeam International Award. A Sustainable Partnership Award for a bold yet exemplary, innovative and inspiring partnership with a civil society organisation that provides more opportunities for the underprivileged. In Leuven, a small city just a stone's throw from Brussels, Jo Vandebergh shows Europe how you can score high in terms of sustainability, innovation and social commitment with a vision and entrepreneurship.

Jo Vandebergh works for the urban development firm Ertzberg, where he designs, inspires and serves as a driving force for the team. Our discussion with the always passionate, socially committed and enthusiastic Vandebergh reflects the personality of the CEO - chief enabling officer: it's a rapid fire discussion barely leaving us the time to actually ask a question. Vandebergh is the brains behind the holistic vision for ushering Leuven - a provincial capital and renowned university city near Brussels - into the 21st century. Vandebergh helped establish "Leuven Klimaatneutraal 2030" (Leuven climate-neutral 2030) and is the driving force behind the Belgian Sustainable Building Council, a cross-disciplinary knowledge institution that wants to put Belgium on the map of sustainable building. Preferably as prominently as possible.

Why is he so committed to ecological and sustainable social entrepreneurship?
Jo Vandebergh: "Our generation has created an ecological liability, which I feel very ashamed about. I am committed to helping to reduce this ecological liability that was created over several decades. I do this from my own limited perspective and in the knowledge that not everybody is equally committed to change at all times. When we started to think about the new Tweewaters neighbourhood, I became even more aware of this liability because Tweewaters is in my own biotope, in my own city. So I felt that we needed a radically different approach."

How can we truly switch to a more sustainable society?
"The first level on which you can work towards more sustainability is climate neutrality. Several European cities are currently doing this.



It's easy to set a date, but how they expect to achieve this climate neutrality is an entirely different matter. The biggest problem is that people who are not used to working together suddenly find themselves having to work with others. That was my experience when we established the Belgian Sustainable Building Council, when developing our own Tweewaters community and in the framework of 'Leuven Klimaatneutraal 2030'. That is why I immediately developed a blueprint for the organisational structure of Leuven Klimaatneutraal 2030. The second level is the holistic approach: here we start from the premise that all the aspects that are inherent to our society are closely interwoven. This is not a case of an 'either-or' story, but of an 'and-and' story. In the frame of such a holistic approach, we tackle the use of space, the use of materials, as well as energy, consumption, waste, mobility, services, etc."

And how do you get to the highest level?
"The highest level concerns the entire lifecycle analysis, of all your services and products, the so-called LCAs. The lifecycle analysis maps everything, down to the micro-level: social housing, the use of toxic substances, energy, water consumption, maintenance…. Everything is mapped, from the excavation to the dismantling. But this also presupposes some form of control. And that puts you on the highest level for implementing sustainability. In Tweewaters, we implement sustainability on the second level, the holistic approach, and we test Tweewaters against the third level insofar as this is already currently possible because we are still at the beginning of the LCAs."

As a social entrepreneur, you are a frontrunner in every field. How do you do this?
"We start by developing a vision as soon as possible in every transition project and claiming the leadership. A clear organisational structure enables us to work with others and make decisions about sustainable entrepreneurship together with all the multidisciplinary stakeholders: the government, knowledge institutions, businesses, civil society, etc. And we are selective: we only commit to projects if we can maintain the focus on the content. We want to manage the multidisciplinary team and achieve the objectives that were set, but Ertzberg will never again adopt the role of contractor as well as developer when developing a project. If you manage a team of builders with 40 different nationalities on a construction site, then this will distract you from the real matter at hand. So the two are irreconcilable."

Several countries already have a Sustainable Building Council. Belgium is only getting started now?
"Belgium is a small and very complex country. We have a long-standing culture of consultation because we have three different, co-existing communities. But don't be mistaken: we have a great deal of knowledge and ambition. The fact that Brussels is currently the third greenest capital in Europe is not a coincidence. As of 2015, every public or private new-build in the city will be a passive building. In Leuven - a mere 20 minutes from Brussels - you can currently admire the most sustainable residential building in Europe. Our Sustainable Building Council may be starting out in last place, but hopes to achieve first place soon."

What is the key theme of your strategy and your vision?
"The fact that in the near future we can somewhat reduce the ecological liability, as one, which we created together in the past decades." ■

THE WARSAW WAY TO **CLIMATE PROTECTION**



By **Hanna Gronkiewicz-Waltz**, Mayor, City of Warsaw, Poland

This year the City of Warsaw has the privilege of hosting the 19th Conference of the Parties of the United Nations Framework Convention on Climate Change, a testimony to the city's commitment to the Convention and its contribution in advancing the urgent struggle against global climate change.

A couple of years ago the City of Warsaw, aspiring to become the 'green metropolis', set itself a goal of ensuring a high standard of living for its inhabitants in conditions of sustainable development and respect for the natural environment. Like other cities, we are anxious to confront the issues related to climate protection, because we are aware of the risks from the negative effects of progressive climate change stimulated by civilisation's development.

Warsaw is one of the greenest large cities in Europe, with forests, parks and arable lands covering 47 per cent of its area. As to climate and energy, our city was one of the first four Polish signatories of the Covenant of Mayors, an initiative under the patronage of the European Commission, associating European local governments acting to limit climate change. In 2011 Warsaw City Council adopted the resulting Sustainable Energy Action Plan, which envisages reducing CO_2 emissions and energy consumption in Warsaw by 20 per cent by 2020, and also increasing renewables' share of energy to 20 per cent by the same year. Achieving these ambitious goals requires multiple actions in different fields of city activities, undertaken in cooperation with various stakeholders, both internal and external.

PUBLIC TRANSPORT

In Warsaw, transport currently accounts for 15 per cent of the total greenhouse gas emissions. Passenger cars produce the largest share of emissions from transport; 40 per cent of all journeys take place in individual vehicles. This mode of travel accounts for 80 per cent of the emissions produced by local transport, and is the most difficult to deal with in terms of reduction of CO_2 emissions – even though public transport has a high (60 per cent) share of all journeys. The City of Warsaw is responding by modernising infrastructure and vehicles used in public transport, with the aim



of encouraging people to use other means of transport than private cars. Recent investments in the ongoing strengthening and upgrading of Warsaw public transport include the purchase of 186 trams with energy recovery systems, 273 modern buses, 35 six-coach underground train units, and – the largest outlay of all – the construction of our second underground line. Further purchases and extensions of the second underground line are planned.

Another initiative by the City of Warsaw is the combined public transport ticket which offers a special tariff option: holders of these tickets are entitled to travel by both bus, tram and suburban train throughout the area of Warsaw and neighbouring municipalities.

ELECTRIC VEHICLES

Both in public and private transport, we aim to support the development of e-mobility and other alternative, energy-efficient propulsions. This is why in Warsaw we have created an 'E-Mobil' cluster, which is aimed at environmentally-friendly transport, including electric and hybrid vehicles. This is an example of a joint initiative by scientific institutions, local government, associations and companies operating in the Warsaw area, working to create a platform-initiating development of innovative technologies, including demonstration programmes and implementation tools.

"Both in public and private transport, we aim to support the development of e-mobility and other alternative, energy-efficient propulsion."



Currently, in accordance with worldwide trends, we plan to support the wide adoption of hybrid and electric vehicles. Not only will this contribute to decreasing emissions of greenhouse gases and pollutants, but it will also lower the level of noise in the city. Moreover, due to the future capability of transmitting electricity from batteries of e-vehicles back to the grid, this innovation will vastly improve the energy security of the Warsaw metropolis in case of blackouts.

SMART AND EFFICIENT BUILDINGS

The next important activities undertaken by City of Warsaw concern the housing sector. In 2008 the housing resources of Warsaw were almost 800,000 apartments, which were responsible for high levels of CO_2 emissions due to the high demand in this sector for heat and electricity.

Expenditures associated with the maintenance of buildings are relatively higher than in most European Union countries. This results mainly from the fact that a large part of Warsaw's housing resources are constructed with inefficient technologies, in particular panel buildings of prefabricated concrete.

We have ambitious plans for mass thermal retrofits of city buildings, preferably with financing investments from future savings in an Energy Performance Contracting formula. We have been working continuously in this field, but there is still plenty of potential to reduce heat consumption. To illustrate the matter, Warsaw currently consumes around 13 terawatt hours (TWh) of heating energy annually, while further retrofits in the housing sector will save more than 2 TWh out of this amount. Therefore, Warsaw plans comprehensive action on thermal retrofits, supporting and enhancing energy-efficient buildings, making use of new funds available in the next EU financial perspective (2014-2020).

Among others, our city participates in the EU OPEN HOUSE project on creating new



methodology for assessing the sustainability of buildings. We have been also exchanging knowledge on this topic with energy-efficient buildings and districts within the EU CASCADE project; also, E3SoHo and ICE-WISH projects are being implemented to help reduce energy consumption in social housing. All the collected information and data will contribute to a project to be launched in 2013. One of the buildings owned by the municipal tram company will be extended and modernised in order to host both the company's office and archive for the Warsaw City Hall. The idea is to create a near-passive house with energy use not exceeding 15 kWh per square metre. To achieve this the project must be carried out with close attention to detail, by insulation of walls, roof, floors and substructure, improving ventilation system, doors and windows – and last but not least, by modernisation of the heating system and adopting equipment that uses renewable energy sources. The roof of the building will be planted with greenery to create a green roof, aiming at enhancing the natural habitat and retaining water. The building will provide experience for the development of other buildings owned by the Warsaw City Hall and by municipal units and companies.

"Warsaw plans comprehensive action on thermal retrofits, supporting and enhancing energy-efficient buildings."

In addition to work on buildings in different parts of the city, we also plan to focus part of our sustainable development activities in one selected area which will serve as a model for other parts of Warsaw to follow in the more distant future. Therefore, the City of Warsaw has accepted the concept of an exhaustive

project currently titled the 'Low-Carbon Area'. Within the framework of the project – which follows such world-leading projects as Stockholm's Hammarby district or Berlin's EUROPACITY – we plan to create a city area that will feature solutions in the areas of energy efficiency, the natural environment and low greenhouse gas emissions, as well as in the field of urban planning, energy networks, buildings construction, transport, waste management, and water and waste water management.

FURTHER SUSTAINABLE DEVELOPMENT PROJECTS

Other projects under development in the broadly-defined sustainability field are being conducted by the City of Warsaw and its partners. These are outlined in the following paragraphs.

Cogeneration of electricity and heat. Further development is being undertaken of our local system of producing electric energy and heat in cogeneration, with heat resulting from fuel combustion in power plants providing a centralised heating system that satisfies around 80 per cent of the city's demand. Cogeneration allows us to save 30 per cent of fuel compared with separate production of heat and electricity, and also to lower CO_2 emissions by around 1.5 million tonnes annually.

Waste water treatment. Modernisation and expansion of the Czajka waste water treatment plant is already virtually complete. This is the largest current environmental investment in Europe, with a total value amounting to almost €900 million. It includes a sludge-to-energy plant using biogas in energy production processes. The plant handles treatment of 100 per cent of Warsaw's waste water, reducing by 60 per cent the nitrogen and phosphorus that reaches the Baltic Sea via the Vistula River.

Modernisation of street lighting. In Warsaw there are 114,000 existing light points, of which 5,000 now require full modernisation and 27,000 partial modernisation. This will allow annual energy consumption to be reduced from 95 to 22 gigawatt hours, and CO_2 emissions by 20,000 tonnes.

Solid waste incineration. Modernisation of the existing municipal ZUSOK solid waste incineration plant is being undertaken. This investment will give us a major boost as an additional source of electric energy and network heat. Moreover, there are future plans for another such plant, probably by a private investor cooperating with the city. Both investments will lead to solid waste satisfying 8 per cent of our energy demand, while more than 75 per cent of municipal waste will be undergoing incineration.

"We plan to focus part of our sustainable development activities in one selected area which will serve as a model for other parts of Warsaw to follow in the more distant future."

COOPERATION IS THE KEY

We realise that we are still at the beginning of our path to achieving our goals, and that there is much more to be done. We also know that in long term we will be successful only if countries, cities and citizens cooperate together in tackling climate changes. I believe that COP19 will bring us closer to such agreement. ■

Hanna Gronkiewicz-Waltz was elected Mayor of the City of Warsaw in 2006 and re-elected in 2010. After gaining her Doctorate in Law, she became an expert advisor for the Sejm (the lower chamber of the Polish Parliament) and Senate, and became President of the National Bank of Poland in 1992, strengthening the independence of the Bank, and leading the regulation of the banking system and the redenomination of the złoty. Between 2001 and 2005 she was Vice-president of the European Bank for Reconstruction and Development. Currently, she is a Professor at Warsaw University and the Cardinal Stefan Wyszynski University in Warsaw, in the Faculty of Law and Administration. Since September 2005, Dr Gronkiewicz-Waltz has been a Member of the Polish Parliament and the Chairwoman of the State Treasury Commission. Since June 2006, she has also performed the function of vice-president of the Civic Platform. Since November, 2012 she is the President of EUROCITIES and is also the author of over 40 publications.

LAHTI IS SERIOUS ABOUT GETTING GREEN






LAHTI IS SERIOUS ABOUT GETTING GREEN

The city of Lahti has an ideal logistic location in the heart of Southern Finland. It is a city centre for an economic area encompassing over 200,000 people. During last two decades Lahti has evolved from an industrial town into a hub for jobs in the environmental sector and industrial design. The surrounding ridges and lake landscapes provide a natural and verdant living environment for its residents.

COMMITTED TO CHANGE

The Lahti strategy defines the success factors that create a path to city's vision to be "a vital, attractive, and environment-oriented city". Lahti has been profiled as a Green City where the city-wide sustainable development is combined with shared targets, environmental expertise, co-operation and positioning in the core of cleantech business. The commitment to sustainability is underscored by the ambitious target to halve Lahti's CO2 emissions from 1990 level by 2025.

EFFICIENT AND UNIQUE SOLUTIONS

Lahti has been a pioneer in the development and use of technologies aimed at the utilisation of waste materials. Päijät-Häme Waste Disposal Ltd. handles approximately 200,000 tons of waste annually, and over 90 % of the waste received is reclaimed. The investment in sorting waste has culminated in the new CHP plant of Lahti Energy Ltd. that utilises the next-generation gasification technology to convert waste materials into heat and electricity. The greener local CHP production is the essential tool in the Lahti's climate change mitigation toolbox.

SUSTAINABLE URBAN LIVING IN PRACTICE

Lahti uses different sustainable measures to make land use planning, buildings, transportation, purchases, and consumption more climate friendly. The city centre is undergoing brisk development, and several large sustainable housing areas will be built in the next few years. Lahti is actively searching innovative solutions to build and renovate buildings as resource efficiently and energy efficiently as possible. The role of cars is reduced by offering residents high-quality pedestrian and bicycle routes, and greener public transportation system. In Lahti the compact urban structure is integrated with natural environment so that every city-dweller lives under 800 metres way from green recreational areas.

A PLATFORM FOR CHANGE

Green City Lahti offers an attractive city-scale development, piloting and research platform Finnish and international business and research partners. The city has a solid foundation in cleantech business, thanks to extensive research and a concentration of cleantech companies. Lahti Region Development LADEC Ltd. co-ordinates the activities of the Finnish Cleantech Cluster. Lahti is also the organiser and venue for the much-respected Cleantech Venture Day. ■

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URBAN ECOLOGY IN **OSLO**



By **Stian Berger Røsland**, Governing Mayor, Oslo, Norway

Oslo's sustainability initiatives range from implementing energy efficiency upgrades and targeting aggressive greenhouse gas emissions reductions to reducing waste streams through comprehensive management, as well as the pursuit of a progressive transport policy that includes electric vehicles as well as biogas production and hydrogen fuels. The city, which currently holds the record for the European continent's smallest per capita carbon footprint, aims to be a sustainable urban community where everyone has a right to clean air, clean water and access to attractive outdoor recreation areas.

Oslo is surrounded by green forest hills and the blue Oslo fjord, and the citizens of Oslo live in close contact with nature. Oslo has invested in preserving its natural habitat; two-thirds of the area within the city boundary is forest, parks and lakes. Oslo is also a compact, highly accessible city. It is easy to move around by public transport and rentable city bikes are available all over the city centre. In 2007 *Reader's Digest* ranked Oslo as number two on a list of the world's greenest, most liveable cities. This year Oslo was selected as the Norwegian finalist in the Earth Hour City Challenge.

POWERED BY NATURE

Today, Oslo has low emissions per capita compared with other Norwegian and Scandinavian cities: around 2.3 tonnes of CO_2 equivalent per person in 2009. One of the reasons for this is the large proportion of hydro power in the energy supply. This is partly due to Norway's rich hydro resources, but is also a result of forward planning by the city's politicians.

At the end of the 19th century the municipalities of the former Oslo, Christiania and Akershus, started to invest in hydro power in order to secure the future. The first hydro power plant was completed in 1900. With a yearly production of around 20 gigawatt-hours, it was meant to guarantee the power supply of the capital 'for ever after'. Today E-CO Energi is one of Norway's leading energy groups, producing 9.7 terawatt-hours yearly, more than the total consumption of electricity in the capital. The City of Oslo owns 100 per cent of the parent company.

THE URBAN ECOLOGY PROGRAMME

The City of Oslo has adopted a focused and long-term approach to improving the environment. Oslo's status as an international sustainable city

was confirmed when it reached the finals of the European Green Capital Award in 2010/11.

Clear overall targets establish the framework for taking effective and successful action to help the environment. The city will actively put into force approved strategies and plans and implement them in the Master Municipal Plan and other policy documents, such as the Urban Ecology Programme (2016-2025). The Climate Action Plan 2012-2015 will ensure that priority measures are implemented so that the city's main environmental policy goals are achieved.

The implementation of the Urban Ecology Programme has so far spawned a number of environmental projects and has proved to be a powerful instrument in creating a sustainable city. It has thus provided the foundation for large sustainability initiatives such as the enhanced recycling scheme in Oslo, the phasing out of oil heating in municipal buildings, the tendering for low emission (subsequently zero emission) vehicles in the municipal vehicle fleet, and the introduction of environmental certification, of which the 'Eco Lighthouse' is a prime example.

CLEANING UP OUR OWN COURTYARD

The City of Oslo is working with the central government, NGOs and the business sector to improve its environment and reduce its ecological footprint. Thus it has been of great importance to practice the principle of leading by example. We use environmental management systems and certification as the primary tool for achieving a greener economy in both the public and private sectors. Eco Lighthouse was established by key organisations in the private and public sectors, including the City of Oslo, and is currently the most widely used license for environmental certification in Norway. In November 2012, to strengthen Oslo's work on sustainable public procurement, the city joined ICLEI's sustainable procurement campaign Procura+.

The City of Oslo strives to engage with all its 43,000 employees through eco-certification of all work places, including departments, companies, schools, kindergartens and other units. Over 350 municipal units and over 250 businesses in Oslo are now eco-certified. The eco-certification systems in use are ISO 14001 for large departments and companies, and the Norwegian Eco-lighthouse for small and medium-sized units and businesses.

To obtain eco-certification the municipal units must:

- Reduce their energy consumption and upgrade to use of sustainable energy sources if necessary
- Reduce their use of car and air transport, and change to eco-friendly modes of transport
- Reduce their use of materials, increase recycling and waste reduction, and thus decrease waste generation
- Practice EcoProcura sustainable procurement
- Report on their environmental performance with regard to these and other indicators.

"Over 350 municipal units and over 250 businesses in Oslo are now eco-certified."

Some of the most important recent policy decisions and activities include the phasing out of the use of oil heating in the municipality's houses and buildings, the introduction of passive house standards in all municipal buildings from 2014, the phasing out of fossil vehicles for municipal use by 2015, the implementation of procurement standards for climate neutral waste collection vehicles, and the introduction of biofuel in buses by the transport company Ruter, which plans, coordinates, orders and markets public transport in Oslo and Akershus.

INTEGRATED WASTE AND ENERGY

In 2006, Oslo City Council approved a project which takes an integrated approach to the city's climate, waste management and renewable energy objectives. The project involves the introduction of source separation and the recycling of organic household waste and plastic packaging by 2011. Municipal waste in Oslo is sorted and either reused, recycled, composted or incinerated. Five per cent is sent to landfill. Recovered energy is supplied to the district heating network. Two of Oslo's landfill sites no longer receive waste for disposal. Landfill gas is collected from these sites and used for producing either electricity or heat. Extended source separation of food waste and plastic packaging has been introduced in stages and now covers the whole city. A centralised plan for optical sorting of the three fractions has been built, thereby enabling a simple and efficient collection system for waste resources from households in Oslo.




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An anaerobic treatment plant in the Oslo region produces biogas from organic household waste and bio-fertiliser for the benefit of agriculture in the region. The biogas is to be upgraded for use in buses and vehicles. Oslo's new biogas plant will produce enough biogas to fuel 170 buses and will thus reduce CO_2 emissions by 10,000 tonnes a year. The plant will further produce bio-fertiliser for around 100 medium-sized farms. For every kilo of plastic that is recycled, CO_2 emissions are reduced by around 2 kg. Recycling requires less energy than the production of new plastic.

CHALLENGES IN REDUCING EMISSIONS

By 2030 the City of Oslo aims to have reduced its greenhouse gas (GHG) emissions by 50 per cent compared with 1990 levels. The key steps for achieving this target are linked to the phasing out of oil-fired heating and the reduction of emissions from road transport. All use of fossil fuels for central heating is being phased out and by 2020 there should be zero emissions from the heating of buildings. The City of Oslo will play a part in helping the utility company reach its target of eliminating the use of fossil fuel in its district heating system by 2016.

"By 2020 there should be zero emissions from the heating of buildings."

Although Oslo has very low direct emissions of GHG compared with other European cities, we face a comparatively harder task to achieve our reduction target. As both the City of Oslo and the greater urban area are rapidly growing, there is huge pressure on the transport system, both in regard to commuting and the movement of freight within the city. The target of reducing GHG emission by 50 per cent from 1990 to 2030 indicates that we have to reach a per capita emission target of around 0.7 tonnes of CO_2 equivalent by 2030. That means we need to have:

- Fossil free heating
- Zero-emission electricity consumption
- Significant decarbonising of emissions from private and commercial transport.

Thus, the City of Oslo is facing today the next mitigation challenges of European cities, which have already made an immense effort to switch from high intensive carbon energy production to low intensive energy production and energy savings. In Oslo, however, the fuel switching option to reduce GHG emissions can only include decarbonising. Additionally, energy savings only partly imply GHG reductions. In order to secure these ambitious targets we primarily have to target innovative and new solutions to zero emission transport in our city region. This is challenging both with regard to the mayoral powers available and the innovative force of the urban community. As a city Oslo is prepared to act. Like all cities, it will need to be empowered, engaged and resourced in order to achieve sustainable decarbonisation.

ENABLING ECO-MOBILITY

Road transport contributes 55 per cent of overall direct emissions and is thus the largest source of GHG emissions in Oslo. Oslo seeks to meet its steadily growing transport needs through increased supply of public services allied to the reduction of private car use. Oslo also works to promote low or zero fossil fuel consumption in motorised transport.

The main climate strategies related to transport are:

- Developing a compact city with growth near public transport nodes and axes
- Improving public transport
- Facilitating the transition to green vehicles in Oslo
- Switching to zero emission cars in Oslo
- City bikes in Oslo
- Car sharing.

The core requirement for the City of Oslo is to secure green public transport for the growing population in the region. The number of public transport journeys has grown by more than 35 per cent in the period from 2005 to 2011, and the volume of car traffic has ceased expanding in the same period. This trend may be explained by modernisation, the increased frequency of public transport services and a reduction in the price of travel cards. Between 20 and 45 per cent of the revenues generated by the city's toll ring supplement other financing to cover investment and operating costs for public transport. In 2008 public transport use grew by 7 per cent and in the first half of 2009 rose again by 10 per cent. During the same period car use decreased by 4 per cent. More than 60 per cent of the energy used for public transport is renewable. Biogas from waste, together with biogas from waste water sludge, will be used as transport fuel and will replace diesel in buses.

"In 2008 public transport use grew by 7 per cent and in the first half of 2009 rose again by 10 per cent."

The city's toll ring has been crucial in facilitating the introduction of green vehicles in Oslo. The city is paving the way for the introduction of electric vehicles. Today there are around 5,500 electric cars in the Oslo urban area. Since 1999 public parking has been free for electric vehicles in Norway. Electric cars are given free passage through Oslo´s toll road system and are allowed to use lanes otherwise reserved for public transport. Through the Climate and Energy Fund the City of Oslo supports the establishment of charging stations. Oslo has installed around 500 charging stations for electric vehicles in the city where users can charge their vehicles for free.

CITIES ACT!

Cities have emerged as new and crucial stakeholders in combating climate change. It is important for Oslo that it learns from and interacts with other cities and cooperates with state authorities and civil society. We are proud to be a part of the C40 network, and to exchange experiences and learn from other cities which show leadership and are willing to take a stand over global warming. We intend to contribute actively to this network and are proud to stand shoulder to shoulder with other cities in the fight against climate change. ■

Stian Berger Røsland *is a Norwegian politician for the Conservative Party. He succeeded Erling Lae as Governing Mayor of Oslo in 2009. Røsland is master of law from the University of Oslo. He was commissioner of finance before assuming his current office. Before that, he worked briefly in the private sector as a lawyer.*

FUELLING THE FUTURE

BMH TECHNOLOGY OY

BMH Technology Oy, a Finnish materials handling company founded in 1929, is today an internationally recognised expert of turnkey solutions in waste refining and SRF (Solid Recovered Fuel) production plants as well as solid biomass handling systems for power plants and cement kilns.

SOLUTIONS

The flagship of the company is TYRANNOSAURUS® SRF Process which turns any combustible waste into SRF. BMH's waste-to-fuel process, the outcome of intense technology development, consists of heavy-duty, industrial design equipment: feeders, shredders, screens, separators, air classifiers and storage systems which all come with high availability and low lifetime costs.

Whether the fuel is SRF produced by TYRANNOSAURUS® Process or any bio solid fuel, wood waste, forest residue, bark, peat, woodchip, energy willow, hay pellet or coal, BMH Technology Oy provides the customers tailor-made TYRANNOSAURUS® Fuel Handling Solutions.

BMH Technology Oy supplies a full package including the design, construction, installation and service, and also makes modernisations of existing systems.

SUSTAINABLE ENERGY WORLDWIDE

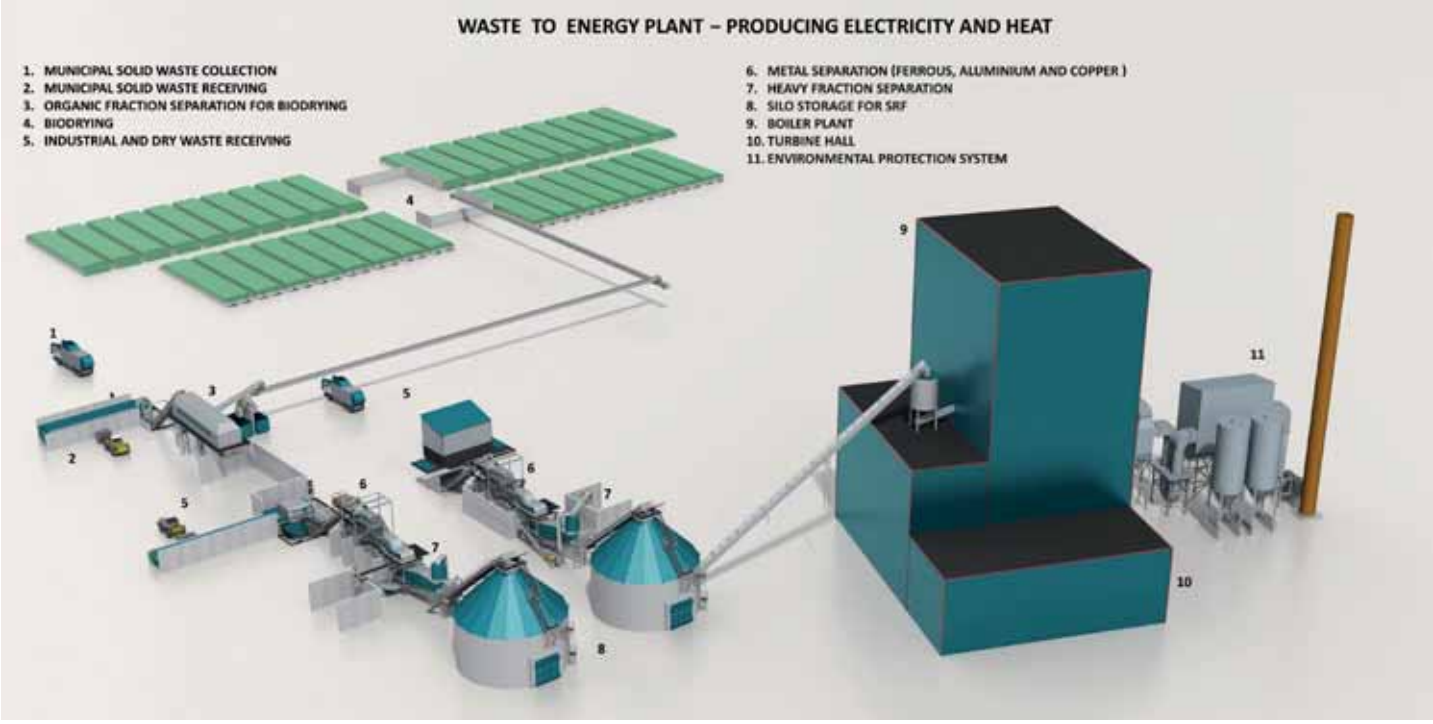
BMH's products are designed to help the world's metropolia which struggle with evergrowing waste mountains, and TYRANNOSAURUS® plants are already operating e.g. in Rome, Sao Paulo, New Delhi, Melbourne and Bangkok. The Bangkok waste-to-flame plant is the largest one in operation at the moment with two massive TYRANNOSAURUS® 9905 SRF production lines processing yearly over 750,000 tons of waste, and feeding the produced SRF directly to the adjacent cement kiln burners.

As for the current projects, the most voluminous one is in progress in Västerås, Sweden, where by 2014 three TYRANNOSAURUS® 9905 SRF production lines and the power boiler will be integrated into a complete waste-to-electricity plant, the world's biggest power plant (167 MW) running on SRF.

Over the years, BMH has done consistent pioneer work and gained a competitive edge in the emerging markets. The common denominator for these markets is that they have plenty of waste at their disposal, and need a lot of energy for producing cement to build new infrastructure. With BMH's sustainable bioenergy, waste refining, and recycling solutions energy can be produced efficiently anywhere in the world, without endangering the nature or accelerating the climate change. ■

BMH TECHNOLOGY

Website: www.bmh.fi



SUSTAINABILITY AND QUALITY OF LIFE IN **HELSINKI, FINLAND**



By **Pekka Sauri**, Deputy Mayor, City of Helsinki, Finland

In Helsinki, environmental issues such as efficient use of energy and reduction of carbon dioxide emissions have been the basis of urban planning since the 1990's. Sustainability issues are crucial in the planning of new districts and in developing the public transport system. The key to success in sustainable urban planning is simple: ecological sustainability and quality of life are two sides of the same coin.

In the field of urban planning and land use, Helsinki aims at eco-efficiency by making the urban structure more compact, and by means of a state-of-the-art public transport system. In energy production, efficiency is as high as 90%, making it easier to achieve lower overall emissions.

Helsinki is a clean and green city where nature is present even in the city centre, with parks constituting 36 per cent of the land area. Residents place high value on these areas and are passionate about protecting them. Altogether there are 40 nature reserves in Helsinki, making up a total of 890 hectares. Three of them form part of the European Natura 2000 network.

The Helsinki Metropolitan Area is one of the cleanest metropolitan areas in Europe in terms of air quality. Over the past decades, good progress has been made in air quality management, and concentrations of sulphur dioxide, carbon monoxide and lead have decreased. Concentrations of other impurities have remained nearly unchanged or increased only slightly although the number of inhabitants, traffic volumes and energy production have increased substantially. Limit values set for nitrogen dioxide concentrations are exceeded in downtown Helsinki along the busiest streets or in street canyons. Air quality is assessed with the help of continuous and indicative measurements, dispersion modelling, and bioindicator monitoring. Up-to-date information on air quality is available on the map below and also by mobile phone.

Helsinki is taking decisive measures to prepare for a possible rise in sea level, and also for potential flooding, which may become more commonplace in future. However, at least for now, the phenomenon of the post-glacial rebound affecting Finnish coastal areas has compensated for any influence of climate change on the sea level in the region.



New waterfront areas are being built higher above sea level than in past decades. In Helsinki, the recommendation for new areas is that the lowest floor level should be at least three metres above sea level. In some of the newest city plans these minimum levels have been raised further - in the Kalasatama project the limit is 3.5 metres. In Helsinki, approximately 700 existing buildings are located lower than 2.5 metres above sea level. Flood embankments are planned for these areas.

PUBLIC TRANSPORT SYSTEMS

Helsinki invests in extensive, reliable and rapid public transport in which the needs of a variety of different user groups, such as children, the elderly and the disabled, are taken into consideration. According to a recent study by the automobile associations of 15 countries, these goals have been met very well. The public transport system of Helsinki has been ranked second in a comparison of 23 European cities. During the morning rush hour, 73 per cent of commuter traffic journeys into the city centre are made on public transport.

The public transport system of the Helsinki metropolitan area consists of various different types of transport. The metro and commuter trains form the basic network complemented by buses and, in the central city area, trams. All trains depart from Helsinki Central Station, stop next at Pasila station, and then continue from there in different directions.

Environmentally friendly trams have been a feature of the Helsinki cityscape since 1890. Unlike many cities in Europe and other parts of the world, Helsinki never discontinued tram traffic in the 1950's and 1960's. This seems now a wise decision, as tram and light rail systems are being rebuilt the world over. A metro carriage carrying hundreds of people uses, per passenger, only one-thirtieth of the energy needed for an automobile – without the emission of exhaust gases. In the near future, the number of people using rail traffic will increase, due to the construction of new housing near train and metro stations and to the extension of the metro and tram networks.

The metro has been a significant part of the public transport system of Helsinki since commencing operations in 1982. The line currently measures 21km, taking 23 minutes to travel from one end to the other. At present, a 14km extension reaching the Helsinki region's western suburbs is under construction, and the line is planned to be ready for operations in 2015. In addition, there are plans to extend the metro system even further east, as well as to the west and also to the airport.

In the central city area, trams are the main form of public transport, with the extensive tram network used daily by approximately 200,000 passengers. During the next 20 years, the network will be extended to reach several new residential areas.

The city has an extensive cycle route network that includes some 1,180 km of roads, tracks, paths or marked lanes specifically designated for cyclists, with 2,600 km in total covering the entire metropolitan area. There is also a large network of recreational pathways, 90 km of which run along the shoreline.

ENERGY PRODUCTION

Helsinki's energy company Helsingin Energia produces electricity along with both district heating and cooling by co-generation in its power plants located in the city. Compared to separate production, this efficient process conserves a considerable amount of raw materials. In co-generation plants, the energy contained in the fuel can be almost completely utilised, with the efficiency figure reaching as high as 90%. Overall emissions are also substantially reduced. With co-generation of heat and electricity, Helsinki saves an amount of energy corresponding to the annual heating needs of approximately 270,000 detached houses. A total of 90 per cent of all heated space within city limits is connected to the district heating network.

In addition to co-generation, a process called tri-generation is used, with district cooling produced in the same process as heat and electricity. The production method has earned

"All wastewater from the Helsinki metropolitan area is treated efficiently in modern treatment facilities."

the power company a significant international acknowledgment in 2008, when it was placed first in the European Regional Champions Awards, receiving the acknowledgement from the European Parliament of being the world leader in cogeneration efficiency.

At present, Helsinki is investigating energy production that is less dependent on fossil fuels, aiming to increase the share of renewable energy from the current 6 per cent, to 20 per cent by 2020. By 2050, the city will be carbon neutral.

HIGH-QUALITY WASTEWATER PURIFICATION

All wastewater from the Helsinki metropolitan area is treated efficiently in modern treatment facilities then transported as newly clean water into the sea via a pipeline. The process is energy-efficient, with all by-products of the treatment also utilised efficiently.

Furthermore, Helsinki's wastewater treatment facilities have received international recognition for their demonstration of top-ranking environmental understanding. Finnish authorities also closely monitor cleaning results and possible environmental effects.

DEVELOPMENT ON BROWNFIELD SITES: JÄTKÄSAARI

The transfer of old cargo ports from inner city locations to a new port facility outside the city centre in 2008 provided excellent opportunities for brownfield development. The West Harbour area, or Jätkäsaari in Finnish, is planned according to the principles of sustainable development, with its central location in the city supporting these goals.

An efficient public transport network incorporating both trams and the metro will service this dense urban structure. Similar energy-efficient solutions found elsewhere in Helsinki will be favoured during construction.

Jätkäsaari is also home to the "City Block for Sustainable Construction" project of Sitra, the Finnish Innovation Fund. The goal of the project is to develop and demonstrate energy-efficient, innovative solutions for low-carbon or even carbon neutral urban design and construction.

As one of the primary ecological solutions in Jätkäsaari, waste management will be implemented in the form of an automated vacuum collection system. Sorted waste is suctioned through underground pipes to a local collection point, situated underground, in the northern part of Jätkäsaari.

The automated vacuum collection system brings less unsightliness, fewer odours and less noise than a traditional waste collection system. It is also more sanitary, more environmentally friendly and a safer solution for the neighbourhood.

The system will be adopted in the entire area now under construction. Bio-waste, cardboard, paper and mixed waste will be suctioned into different containers. The automated vacuum collection system has been in use already in several countries for nearly 50 years, with current systems being both very reliable and technically advanced.

In recent years, Helsinki has been placed near the top of international city rankings of both sustainability and quality of life. This is not a coincidence: ecological, social and economic sustainability go hand in hand. The goal of the city is to provide an optimal living environment for the citizens – the city should be both reliable and innovative, both fun and functional. According to the Helsinki Strategy for Global Responsibility approved by the City Council in 2012, what is good for the people living in the City of Helsinki should be good for the rest of the planet. This principle is the guideline for future planning in Helsinki. ■

Pekka Sauri *has been active in the municipal politics of Helsinki since mid-1980s. From 1993 to 2003 he was an elected member of the city council. In 2001 he became the chairman of the city council, and in 2003 he was appointed the deputy mayor of Helsinki, being the first Green politician to achieve such posts in any Finnish municipality. He was the party secretary of the Green League 1990—1991 and the chairman 1991—1993.*

ECO-CITIES GO GREENER WITH RENEWABLE ENERGY



Renewable energy accounts for ever increasing share of energy supply in Germany. Power plant in Bad Arolsen powers the local community with local renewable fuels.

With the environmental legislation tightening, cities around the world have to meet the growing energy demand and cope with rising production costs. With the latest power generation technology, it is possible to balance environmental compliance with economic performance.

In many countries and cities, the current infrastructure to generate power and heat is based on coal and heavy fuel oil. However, their usage is becoming more challenging due to their effect on climate change. Another major challenge that cities face is the ever-increasing amount of waste and how to handle waste streams sustainably.

In finding the most efficient and sustainable solutions, it is important that decision-makers, city planners, research institutes, universities and technology providers communicate and cooperate with each other, for example, through public-private partnerships. Encouraging new approaches are found in the Nordic countries where cities and local energy producers have successfully replaced fossil fuel energy flows with biomass and waste.

WASTE IS A VALUABLE FUEL

The view on waste is changing; what used to be a problem is now a valuable fuel. One ton of combustible waste contains the energy equivalent of approximately 300 liters of crude oil. Air pollution and the issue of hazardous emissions connected to combustion have been basically eliminated by modern environmental technology.

And what's more, waste can be utilized in energy production right where it accumulates. Instead of transporting fuel long distances, local waste can be used as a local fuel.

One of the cities that has actively made its energy production more sustainable is Borås in Sweden. Years ago, it set itself a goal to become a city free from fossil fuels. The transition from using

On the move for the environment - CO2 neutral energy production is possible.



oil and gas in district heating has been made in steps. A major leap towards a fossil-free city was taken in 2005 with the commissioning of a new waste-to-energy plant that features two 20 MWth Bubbling Fluidized Bed boilers. The plant's 200 GWh annual production of fossil-free energy has contributed to coming closer to the city's goal.

GREATER VALUE FROM WASTE THROUGHOUT THE WASTE STREAM

Well planned waste management can benefit cities in many ways. Lahti, Finland, is another city that has set high targets for sustainability. In April 2012, its energy company, Lahti Energy Ltd., started up the Kymijärvi II plant, the world's first gasification power plant running purely on sorted waste, in other words, solid recovered fuel (SRF). It produces 50 MW of electricity for the national grid and 90 MW of district heat for Lahti and its neighboring areas. According to the company's experience, gasification is the most energy-efficient way to utilize waste.

In Lahti, a new supply chain has been born around waste. Fuel payments have created a new market for fuel preparation, and the quality of SRF has improved. Tighter quality control benefits other SRF users as well, for example, material recycling of items such as metals. Fuel suppliers have been able to invest in new machinery, and operations have created approximately 100 new jobs in the supply chain.

The CO2 emissions were cut by 30% from 2011 to 2012, which is remarkable for a plant that has operated only since April 2011. The company's goal is to reduce CO2 emissions to half from the 1990 level by 2025 and help Lahti to seek the role of the leading green city in Finland.

FUEL FLEXIBILITY IN A KEY ROLE

Fuel flexibility is an integral part of Metso's waste-to-energy concept. The company is currently building the world's largest recovered-fuel-fired boiler for Mälarenergi's CHP plant in Västerås, Sweden. The new 167 MW boiler will utilize circulating fluidized bed technology, which is able to combust a very demanding fuel mix. Building a boiler that can burn more than one type of fuel provides Mälarenergi with considerable flexibility to accommodate changes in the fuel market.

SEVERAL CONVERSION TECHNOLOGIES TO CHOOSE FROM

All of these three cases feature Metso's technology. During the past ten years, the company has delivered more than 13 GWth of boiler capacity that utilizes renewable fuels and reduces emissions associated with fossil-fuel-fired boilers.

"This CO2 neutral energy production has helped to avoid 40 million tons of greenhouse gas emissions annually, corresponding to emissions from over 24 million cars," says Jyrki Holmala, President of Metso's Power business line. "This is possible thanks to our fluidized bed boiler and gasification technology and their ability to convert various renewable raw materials, such as forest residuals, non-food agro fuels and waste, into energy."

The world's largest biomass boilers come from Metso, but the company is also Europe's leading provider of medium- and small-scale power and heating plants using biomass and fuels derived from recycled waste.

All forms of renewable energy are needed to reduce greenhouse emissions and plan for greener future. In addition to waste, other local renewable fuels include various biomasses. Metso aims to create technology that can efficiently and sustainably utilize these local resources globally. To fully cover all possibilities, the company is constantly looking for ways to expand not only its technological base and geographical coverage but also to offer its comprehensive energy expertise for cities in their waste and energy challenges. ■

Website: www.metso.com

MALMÖ – FROM INDUSTRIAL WASTELAND TO SUSTAINABLE CITY



By **Ilmar Reepalu**, Mayor, City of Malmö, Sweden

Over the last decades Malmö, in the southern part of Sweden, has made a remarkable journey from an industrial city based on its shipyard and other heavy industries to a modern entity founded on knowledge and sustainability.

The transformation of the city of Malmö is especially obvious in the Western Harbour district, where polluted industrial areas have been replaced by office buildings and residential houses. The first development, Bo01, was designed to use and produce 100 per cent locally renewable energy over the course of a year. Buildings receive energy from solar, wind and a heat pump that extracts heat from an aquifer, facilitating seasonal storage of heat and cold water in the limestone strata underground.

The different stages in the Western Harbour have piloted different waste separation systems. While the first stage was equipped with vacuum systems, the later ones have waste grinders installed in all kitchens. The food waste is then gathered in storage tanks and transported for biogas production.

Bo01 was the first area to use a local green space factor to promote biodiversity, incorporating local vegetation, as well as rainwater through open storm water management and connection to the sea. The system was very successful; and since stage two, Flagghusen, the green space factor promoting 'green' roofs and walls (planted with vegetation) and biodiversity is included in the municipal Environmental Building Code.

The Western Harbour incorporates an eco-friendly transport system, with buses connecting the areas every five minutes. Bus stops feature real-time displays so passengers know when the next bus will arrive. Bicycle lanes are easily accessible and from the third stage, Fullriggaren, a new system has been developed to reduce the number of parking spaces and replace them with a car pool financed in the first years by the contractors.

The progress of development is continuing. The fourth stage, Kappseglaren, boasts among other things E.ON Smart Homes with a local smart grid. And the new areas Masthusen and Varvsstaden are being developed according to

BREEAM Communities. The Western Harbour area will not be fully developed until the 2030s, with 20,000 citizens and a similar number of working places.

A CLIMATE CONTRACT

Malmö is putting a lot of effort into making the expansion areas of the city sustainable. In southern Malmö the Hyllie area, with 9,000 new homes and workplaces, will be the most climate progressive area in the region – according to the new Climate Contract, signed at the beginning of 2011 by the City of Malmö, the energy company E.ON and the municipal authority VA SYD. The energy supply in Hyllie will be entirely from renewable or recycled sources by 2020. But for that to be conceivable there is a need for constructors also to be involved in the process. A very successful strategy that was first implemented in the Western Harbour area was the construction dialogue between the city and the construction companies. The tools of Construction Dialogues and the Environmental Building Code are used to reach a common understanding and road map for the building process in Hyllie.

REFURBISHING INTO SUSTAINABLE FORM

The city has also focused on transforming existing areas for more sustainability. One of the most striking examples of this is the Augustenborg district, where the city, together with the local housing, water and sewage company, has refurbished the area in close cooperation with the citizens into a more sustainable form. The project was launched in 1998 and the results so far indicate that Augustenborg has become an attractive, multicultural neighbourhood in which the turnover of tenancies has fallen by almost 20 per cent and the environmental impact has decreased to a similar degree.

Many of the houses in the area were run down, and the 1950s character of some of the buildings was damaged in the 1970s by covering the facades with external insulation and steel sheeting. This also had a negative effect on the internal environment in certain houses causing problems with damp, ventilation and temperature control.

To reclaim the look of the houses and improve energy efficiency and housing condition, the outer covering of the walls on some of the buildings has been removed and a new insulation layer has been covered with a skin of painted rendering. The appearance of the houses is now more like the original, and the energy efficiency has increased by about 10 per cent compared with the 1998 state of the buildings, or perhaps 35 per cent more than the original buildings.

Involving the residents of Augustenborg has been one of the crucial success factors of the refurbishment. Residents, pupils and people working in the area were engaged in the design of the outdoor environment, to create a new habitat while increasing the amenity value. Flowering perennials, native trees, fruit trees and wetlands are key features, while bat and bird boxes provide additional accommodation on the housing estate. Today, 15 years later, all the 30 gardens in Augustenborg have been renewed within the project.

One of the main problems highlighted by the residents in Augustenborg was the reccurring flooding of basements and parking lots during heavy rain. The storm water system has gone through a major change since then: green roofs and open storm water channels leading into ponds have diverted the flooding in the area, and have created a beautiful environment and a richer biodiversity. The houses have 2,100 sq metres of green roofs, as well as the large facility at the Botanical Roof Garden, which covers 9,000 sq metres.

There are today a total of 6 km of canals and water channels in Augustenborg. Ninety per cent of the storm water from roofs and hard surfaces is led into the open storm water system in the housing area.

Waste management and recycling has also been addressed in the area. Today there are 15 facilities with full recycling and composting for the 1,800 inhabitants of Augustenborg. The aim is that 90 per cent of the waste will be collected and recycled or re-used in some way. So far this figure has reached about 70 per cent. The houses were based on design ideas from some of the residents who had been involved in the initial recycling pilot and who visited recycling programmes in other Swedish cities.

The results of the Augustenborg project are astonishing; energy consumption has decreased, basement flooding has been prevented, and perhaps most important of all, the inhabitants are once again proud of living in the Augustenborg area.



APPLYING THE EXPERIENCE

Since we know that one of the largest challenges for the coming years is to refurbish the existing housing stock both in Malmö and the rest of Europe, the experiences from Augustenborg are invaluable. The City of Malmö has already started the implementation of some of the good examples in city districts such as Rosengård and Lindängen. In Rosengård the City of Malmö is developing new methods for dialogue with the inhabitants; the ecological refurbishment is also creating the bicycle and pedestrian infrastructure to connect the area with the city centre.

The housing cooperative HSB Brf Hilda in Rosengård is implementing a unique renovation programme with very high sustainability targets for its 767 apartments. One of these targets is to reduce carbon dioxide emissions by replacing the ventilation system and installing photovoltaics on the roofs. Climate coaches inspire residents to a sustainable lifestyle, and new technology is combined with proven technology to achieve economic sustainability.

THE BICYCLE CITY

Malmö is today linked by 470 km of bicycle paths, containing more bicycle routes than any other Swedish city – in fact even more than its sister city Copenhagen, famous for its bicycle culture.

Cycling in Malmö is on the rise, with some 25 per cent of total transport journeys using this method. As much as 40 per cent of all commuting to work and school are undertaken by bicycle.

We even try to prioritise bicycles in our city. At 28 intersections in Malmö, a sensor system has been installed to grant cyclists priority. As cyclists approach an intersection that is not already crowded by car traffic, the lights quickly turn green to favour the cyclist.

Some of the journeys in Malmö will still require a car – but also these should be done sustainably. Malmö is now introducing mandatory food waste collection, to be turned into biogas. The biogas can power buses and cars in the city and already today all 177 city buses in Malmö run on a mix of compressed natural gas and biogas. The number of passenger cars driven on biogas is also increasing, and the City of Malmö municipal vehicle fleet will run entirely on biogas, electricity and hydrogen by 2015.

AMBITIOUS TARGETS

Since 2009 the City of Malmö has set itself one of the most ambitious climate targets in the world: by 2020, the city administration will be climate neutral; and by 2030 the whole city will run on 100 per cent renewable energy.







To reach these targets we need to work on all aspects of energy consumption. As well as transport, the heat delivered to our citizens in the district heating grid will have to be supplied with renewable resources. The electricity in the grid will also be produced renewably; and already today the Lillgrund wind farm, in the Öresund strait just outside Malmö, produces enough electricity for 60,000 households. The wind conditions in Malmö are extremely good and we believe that an expansion of wind power will be not only necessary but also beneficial for the city.

We know that our efforts to become a sustainable city are inspiring others, and we are very proud of what we have already achieved – although we have a long journey in front of us. The targets and progress on climate issues in Malmö have been also been acknowledged by other organisations, such as WWF Sweden, who appointed Malmö as the "Earth Hour Capital of Sweden 2011", and UN Habitat, who awarded the city the Scroll of Honour Award in 2010.

The city of Malmö has taken a holistic attitude to sustainability. Political ambition and leadership is strong, with goals set at a high level. The city departments cooperate with each other and with enterprises, universities and organisations. The aim is to use ecological development as a driving force for economic growth and social innovation – a challenge that includes and demands commitment from all actors in society. Using different cooperation methods and processes is therefore one important key to the achievement of these high targets. To develop a sustainable city is a team task; all actors taking responsibility for this are winners. ■

Ilmar Reepalu *was born 1943 in Estonia. He holds a Master of Science in Civil Engineering and Architecture from Chalmers University and a Supplementary Degree in Architecture from the Royal University College of Fine Arts. From 1970 to 1985 he worked as architect in Gothenburg, specialising in sustainable city planning. From 1985 to 1994 he was Vice Mayor of Malmö. Since 1994 he has been Chairman of the City Executive Board and Lord Mayor. He has been President of the Swedish Association of Local Authorities and Regions (1999-2007), and its Vice President since 2007. He has also been a member of the Policy Committee of the Council for European Municipalities and Regions (CEMR) since 2001, a member of the EU Committee of Regions since 2007, and the chairman of its Commission for Climate, Environment and Energy (ENVE).*

FREIBURG: CIVIL SOCIETY WORKING FOR A **GREENER FUTURE**



By **Dr Dieter Salomon**, Lord Mayor, City of Freiburg, Germany

Freiburg's priorities give a good foundation for urban policy – one based on sustainability as a guideline, and that understands sustainability as the core of its integrated strategy of urban development.

In 2007, the leaders of the G8 countries met in Heiligendamm on the German Baltic Sea coast to discuss, among other things, climate protection and nature conservation. While the focus of the world press was concentrated on this, many journalists wished to report on practical examples of Germany's cutting edge in environmental protection. Those who were looking for best practice examples in sustainability found them in Germany's most south-western corner, in Freiburg, and they told us: "You have got it all here!"

At the time of the G8 summit in Heiligendamm, Freiburg had already been travelling for a long time on the road to sustainable urban development – a policy which we dubbed 'Green City' in Freiburg, with the word 'green' standing as the internationally comprehensible term for sustainability, rather than for the political party. Freiburg is a university town with close to 230,000 inhabitants, situated in the border triangle between Germany, France and Switzerland. Freiburg can claim to have realised the significance of climate protection, of ecology and feasible strategies for sustainability early on and has put them into operation in many areas – and this long before the year 2002 when the people of Freiburg elected me as the first 'Green' Lord Mayor of a major city in German history. The Green City name is also appropriate for dedicated citizenship, one that understands itself

ACTIVE CITIZENSHIP

In December 2012, the city's environmental progress was acknowledged by the German Sustainability Award foundation, which rewarded Freiburg's efforts with the title of 'Germany's most sustainable major city'. The jury explained that its decision paid homage to Freiburg's remarkable and well-established active citizenship, as well as to the varied activities and measures with which politics and administration follow up on this commitment.



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as an important stakeholder in a policy geared towards sustainability and the quality of life. This holds just as true for the economic sector: Freiburg's environmental economy has developed into an important economic factor for both the city and the region, one that, in cooperation with science, generates new jobs geared to the future. As a strategy, Green City stands for the future of the city – or for the ideal of the city of the future.

In 2010, Freiburg was given the chance to showcase its potential as a city of the future at the World Expo in Shanghai. There, Freiburg was one of 50 capital cities to present itself in the context of a theme park, demonstrating through practical examples how social, economic and ecological future development can be realised in a sustainable way. The invitation to the Expo respected the fact that the city of Freiburg has progressed further on the road to sustainability than others – as is apparent in Freiburg's energy policy, in the consistent extension of Freiburg's public and regional transport, and in the city's ambitious climate protection goal.

INDEPENDENT COOPERATION

What many journalists had realised at the G8 summit back in 2007, and for which the city would come to win many awards in the following years, was this: we in Freiburg are blessed with a unique mix of political, economical and mental attitudes that encourage sustainable living and economic activity. An important incident in the 'Freiburg mix' was the historic experience of the prevention of the construction of a nuclear power plant by the citizens of the Upper Rhine region in 1970, an unprecedented and unrepeated event in Germany. The protests in the small community of Whyl, located about 25 km from Freiburg, gave the impulse for a citizens' initiative, eventually culminating in the foundation of Germany's Green Party. Today, about 40 years later, the people of Freiburg have grown into an environmentally conscious civil society working hand in hand with politics and the economy to realise the objective of a sustainable approach for their city.

However, a similarly crucial ingredient for the success of the Freiburg model is the experience and competence derived from being one of the internationally leading centres for the research and application of solar energy. The Fraunhofer Institute for Solar Energy Systems (ISE) alone employs approximately 1,200 people. The Fraunhofer ISE is the second largest research institute for solar energy in the world and develops the latest technologies and processes for the entire planet. Freiburg's focus on solar energy has created several more thousands of jobs in the fields of research, as well as in the service sector and in commerce, and has thus become a considerable economic factor.

All of the elements mentioned above have different ramifications in different policy fields:

The natural environment. The City of Freiburg regards its natural areas and land as vitally important, and we take great care in how we treat them. Nature and landscape protection areas take up half of the city's total surface. One-third of the city is covered with forest. Nonetheless, Freiburg is also one of the fastest growing cities in Germany and has a large demand for dwellings. In the past years interior was favoured over exterior development, allowing land consumption to be kept to an absolute low. However, the city has been forced to develop an area for a new part of town within the next decade, in order to address the high need for housing.

Energy policy. The city's energy policy is guided by the goals of the Local Energy Supply Concept already developed in 1986. Its mainstays are energy conservation, energy efficiency and the promotion

of renewable energies. All private households in Freiburg are supplied with eco power from regenerative sources or from combined heat and power generation. Currently, the city has two wind power facilities with several more in planning, and every public building has been equipped with a solar facility. A particularly spectacular example of a solar facility has been installed on the site of a former landfill. This is the second largest solar facility in the State of Baden-Württemberg, and also produces landfill gas (methane) for a block-type thermal power station which provides an entire area of town with heat and power. In addition to this, the city holds 32 per cent of the regional energy provider, called 'badenova'. This ecological energy company is charged with executing the local energy turnaround. Through its commitment for renewable energies, towards energy efficiency realised with block-type thermal power plants as well as power and heat generated from biomass, badenova has become an important agent of the local policy of sustainability.

Energy efficiency. Standards for heat insulation and energy efficiency in new buildings were already the rule in Freiburg long before the federal government introduced them to Germany. In the same spirit, the city is also stricter in its own requirements than those prescribed by federal law, precisely because this is the best way to realise the full potential for the reduction of CO_2 emissions. Prominent examples for this practice are two high-rise buildings from the 1960s which have been completely renovated to the passive house standard by the municipal subsidiary Freiburger Stadtbau, again for the first time in Germany.

Public transport. In terms of traffic, Freiburg has been following an integrated overall transport strategy for decades. This strategy gives express priority to environmentally friendly modes of transport and traffic. Seventy per cent of all journeys within the city are made not by car but with environmentally friendly means – by bicycle, on public transport or on foot. The city is consistently expanding its regional public transport infrastructure in order to reduce car traffic and consequently CO_2 emissions. Currently, two large projects are in the construction stage and three more are being planned. However, the city's trams are also one of the largest energy consumers – which is why they are powered exclusively with energy generated from regenerative sources.

LOCAL EFFORT FOR GLOBAL EFFECT

All the programmes mentioned above aim at the same objective: Freiburg wants to reduce its CO_2 emissions by 40 per cent by 2030. The city has already managed to achieve half of this: today the CO_2 emissions are over 20 per cent lower than in 1992, the year of the first world climate conference in Rio.

Thirty years ago the slogan 'Think globally – act locally' was coined in environmental policy. Today it is more true than ever, as there is no chance for us to reach our global objectives without taking action on the local scale first. This is why we extend the concept of sustainability to more than just ecological matters; we also pursue sustainable goals when dealing with its economy, with its social and cultural infrastructure, and with its public budgets. For example, the city has been reducing debt for many years in order to be able to turn over solid finances and balanced public accounts to coming generations. Providing people with good schools, and education to qualify them for the future, is another expression of Freiburg's sustainable policy.

Like many other cities in the world, Freiburg is on its way to becoming a sustainable city – which means we have not got there yet. Not only for Freiburg, sustainability is the most important key to the future, to ecological responsibility, for economic growth and for a high quality of urban life. This can only be achieved when politicians engage and involve those active citizens who identify with living in their city, and help them to make the objectives of sustainable development their own. There is a balance between sustainable thinking and action, acceptance and participation ■

Dr Dieter Salomon *was born in Melbourne, Australia and grew up in the Allgäu region, South Germany, since age four. From 1990 – 2000 he was a member of the city council of the City of Freiburg for Bündnis 90/ Die Grünen (Green Party) and in 1992 was elected member of the state parliament of Baden-Württemberg for the Green Party. In 2002 he was elected Lord Mayor of the City of Freiburg and was re-elected in 2010. Since 2003 he has been a member of the Presiding Board of the German Association of Towns and Cities (Deutscher Städtetag) and is also a member of the World Executive Committee at ICLEI-Local Governments for Sustainability.*

ENERGY EFFICIENCY: A VALUABLE RESOURCE



By **Kateri Callahan**, President and **Rodney Sobin**, Senior Policy Manager, Alliance to Save Energy

Energy efficiency is the world's most abundant, reliable, clean, and least expensive energy resource. Its supply is ubiquitous. It avoids rather than produces pollution. While it is not free, it is usually cheaper than fuels and power generation. Also it cannot be embargoed, manipulated by cartels, nor disrupted by distant (or not-so-distant) unrest.

Energy efficiency measures can be analysed in the same way as supply-based options. In various US states and elsewhere, energy utilities and their regulators evaluate both energy supply and demand-side resources – meaning energy efficiency and demand response (users reducing peak power demand) – to plan investments for assuring reliable, reasonable cost service. In parts of the USA, demand-side resources can be bid into electricity capacity markets just as generating plants are. Further, some places, such as Italy and the US state of Connecticut, have markets for energy savings certificates for meeting energy efficiency goals.

ECONOMICAL AND PRODUCTIVE

Many studies show that energy efficiency is the lowest cost energy resource. In the US electricity sector, the American Council for an Energy-Efficient Economy and others have calculated that energy efficiency measures often cost US$0.03 per kilowatt hour (kWh) saved as compared to US$0.07 to over US$0.13 per kWh for electricity supply. A Regulatory Assistance Project study of international utility-based energy efficiency best practices found, for example, that the cost of saving one kWh averaged €0.027 in Belgium's Flanders region and €0.056 in Denmark, both much lower than the cost of buying electricity.

"Many studies show that energy efficiency is the lowest cost energy resource."

Energy efficiency's cost-effectiveness is not limited to electricity. It applies to direct fuel

use in buildings, industry and transport as well. For instance, the Rocky Mountain Institute identified various heavy-truck efficiency measures – improvements in aerodynamics, wheels and tyres, engines, transmissions, auxiliary power, and weight – that could save US freight operations 1.7 million barrels of diesel fuel daily by 2050 at costs of under US$2.30 per US gallon (US$0.61 per litre), significantly less than current and anticipated diesel fuel prices.

"Energy efficiency's cost-effectiveness is not limited to electricity."

EFFICIENCY ENHANCES COMPETITIVENESS

The box below illustrates a few examples of how energy efficiency enhances the productivity and competitiveness of industry by saving money. While the examples, of which there are many more, are taken from manufacturing, cases abound from the housing, commercial buildings, municipal and public service (water, waste water, street lighting), transport and logistics, and agricultural sectors.

EFFICIENCY CUTS EMISSIONS COST-EFFECTIVELY

So what is the global scope for energy efficiency, and what can it contribute towards reining in greenhouse gas emissions? In 2007, McKinsey & Co analysed opportunities for energy productivity improvements to mitigate global energy demand growth and greenhouse gas emissions. The base case in *Curbing Global Energy Demand Growth: The Energy Productivity Opportunity* projected that anticipated 1 per cent annual energy productivity increases through 2020 would be overwhelmed, leading to 2.2 per cent and 2.4 per cent annual increases in world energy demand and CO_2 emissions, respectively.

However, the study also found major cost-effective opportunities to expand energy productivity across all economic sectors – industrial, residential, commercial, power, and transport. Looking only at options that provide at least a 10 per cent internal rate of return (IRR) and rely on existing technologies, the

ENERGY EFFICIENCY CAN SAVE MONEY AND IMPROVE PRODUCTIVITY

- Since 1990, the Dow Chemical Co has reduced production energy intensity per kg of product by 40 per cent, saving a cumulative US$24 billion and 5.2 quadrillion Btu (about 5 per cent of US annual energy use, or more than the annual energy use of the Netherlands). It also avoided the release of over 270 million tons of CO2 equivalent.
- Good piping design practices reduce by 69 per cent pumping energy required by a biotechnology plant in Singapore, while also reducing capital costs.
- India's Sun Flag Iron & Steel improved its energy efficiency over 26 per cent by installing waste heat recovery units to cogenerate electric power. It achieved considerable financial returns by reducing purchased electricity by almost half and, at times, exporting power to the electric grid.
- 3M, with operations in 65 countries, improved its energy productivity 22 per cent during 2005-09, saving US$100 million.
- The machining department of Delta Faucet Company's plant in Tennessee (USA) reduced its natural gas consumption by over 95 per cent and saves US$2,000 each month on chemicals by altering its cleaning processes.
- A Chinese petroleum refinery reduced electricity used in refining oil by 28 per cent by installing 34 variable-speed drives. The investment paid itself back in six months.
- Toyota South Africa Motors has implemented an energy management system across its South African plants, yielding annual savings of 1.37 million rand, including about 400,000 rand from optimisation of compressed air systems that required almost no capital cost.
- United Technologies reduced the energy intensity of its operations during 2003-07 by 45 per cent and greenhouse gas emissions 62 per cent during 2006-10, respectively, while sales rose 13 per cent.

"Gas emissions avoided from energy productivity improvements would provide as much as half the emissions abatement needed to stabilise CO_2."

McKinsey team found that investing US$170 billion per year (about 0.4 per cent of global GDP) through 2020 would more than halve the rate of world energy demand increase to less than 1 per cent per year without diminishing economic growth. By 2020 the resulting annual energy savings would amount to 135 quadrillion Btu (about 1.3 times current US consumption), or the equivalent of 64 million barrels of oil per day. Annual cost savings would be US$900 billion, yielding an average 17 per cent IRR.

The study also estimated that the greenhouse gas emissions avoided from energy productivity improvements would provide as much as half the emissions abatement needed to stabilise CO_2 concentrations in the range of 450 to 550 parts per million, the level believed necessary by many climatologists to cap global mean temperature increases to 2ºC.

McKinsey analysts found opportunities across the globe, with China (21 per cent) and the United States (18 per cent) having the greatest potential, and about two-thirds of the opportunities in developing economies.

This analysis and many others that show energy efficiency's economic benefits lead to the question of why so many seemingly attractive opportunities remain unrealised.

THE HURDLES CAN BE SURMOUNTED

Even if the failure of energy prices to reflect the externalities of environmental and social costs is disregarded, various market imperfections stand in the way of achieving cost-effective energy efficiency. Among these impediments are:

- **Lack of information.** Consumers and managers may not know enough about energy efficiency opportunities and their benefits. They may avoid new products and processes with which they are less familiar.
- **First cost, payback, and rate-of-return criteria.** High first cost of some measures can dissuade investment. Consumers and companies may demand quick payback and high rates of return that leave behind profitable efficiency opportunities.
- **Energy subsidies.** In some places energy subsidies and unmetered energy leads to undervaluation and overconsumption.
- **Split incentives.** The landlord-tenant example – landlord owns the building but the tenant pays the energy bill – is the best known of various cases where differing interests of different parties can lead to sub-optimal or just plain wasteful energy use.
- **Utility incentives not aligned with customer efficiency.** In many places electric and natural gas utilities have financial incentives to sell more energy rather than to help customers use energy effectively and efficiently.

"Various market imperfections stand in the way of achieving cost-effective energy efficiency."

Well-crafted policies, including information requirements such as vehicle and appliance energy labels and building energy use disclosure, can help surmount these impediments. Technical assistance, demonstrations and other approaches can also address the information gap. Fuel economy and appliance standards and building energy codes help ensure a minimum level of efficiency. Financial incentives, including tax concessions, can encourage early adopters of efficient technologies and practices. Such approaches as 'fee-bates' – for instance charging a fee for buying the least efficient cars while offering a rebate to buyers of the most efficient – can provide continuous incentives to increase efficiency.

The phase-out of energy subsidies, perhaps with support for efficiency measures to reduce cost

impacts, can provide rational price signals for energy use.

UTILITIES AS EFFICIENCY PARTNERS

In the United States, Canada and elsewhere, various states and provinces have energy savings incentives or requirements for electric and natural gas utilities. Various US states have energy efficiency resource standards that impose requisite savings goals on utilities. Some allow utilities to earn returns on customer efficiency programmes or offer financial bonuses. Public benefit charges in some states, and carbon auction funds in parts of the Northeastern USA, fund energy efficiency programmes. The Consortium for Energy Efficiency estimated that in 2010, programmes funded by customers of US and Canadian utilities saved 124,000 gigawatt-hours of electricity and 1.3 billion therms of natural gas, while avoiding 92 million tonnes of CO_2 emissions.

"Technical assistance, demonstrations and other approaches can also address the information gap."

Non-regulatory innovations also offer opportunity. Energy service companies (ESCOs) offer energy service performance contracts that provide savings guarantees and upfront capital in return for compensation from a portion of the client's energy savings. This saves money while allowing the client to implement efficiency upgrades without tapping into its own capital. Another innovation in New York City is the development of energy-aligned lease language to help address split incentives in leased buildings.

Many other energy-efficiency policies and practices offer opportunities, including policies to encourage research and development of new efficient technologies.

A WIN-WIN SOLUTION

Energy efficiency simultaneously enhances productivity, moderates costs, improves energy reliability and security, and avoids pollution and waste. Its potential is vast. To reiterate McKinsey's analysis, a modest annual investment, 0.4 per cent of global GDP or US$170 billion, can yield 17 per cent returns, saving US$900 billion a year by 2020 – and achieve up to half of needed greenhouse gas emissions reductions.





Energy efficiency is the win-win solution for achieving economically and environmentally sustainable growth in the 21st century. ■

***Kateri Callahan**, President of the Alliance to Save Energy, has more than 25 years' experience in policy advocacy, fundraising, coalition building, and organisational management. The Alliance's principal spokesperson before Congress, the media and conferences worldwide, Callahan was among the 23 inaugural inductees to the Energy Efficiency Hall of Fame in 2009.*

***Rodney Sobin** is Senior Policy Manager at the Alliance to Save Energy. He has over 20 years' experience in energy and environmental policy, innovation and commercialisation of technologies, and various energy efficiency-related topics. He holds two master's degrees from Washington University in St Louis, and a bachelor's degree from Cornell University.*

***The Alliance to Save Energy** was founded in 1977 as a bipartisan non-profit organisation by two US senators, Republican Charles Percy and Democrat Hubert Humphrey. The Alliance is a coalition of prominent business, government, environmental, and consumer leaders who promote the efficient and clean use of energy worldwide to benefit consumers, the environment, the economy, and national security. The Alliance conducts policy, communications, research, education, and market transformation initiatives in the USA and more than a dozen other countries.*

NET-ZERO **ENERGY BUILDINGS**

A COMPELLING CASE FOR ENERGY EFFICIENT BUILDINGS

Our cities consume enormous quantities of energy, with the heating and cooling of buildings accounting for more than 41% of total demand in Europe alone. This means buildings have a dramatic negative global environmental impact, which is unsustainable, given the world's predominant reliance on fossil fuels and their rapidly increasing costs.

It is clear that making buildings more energy efficient is essential, especially given ever more stringent energy efficiency codes and building regulations, but it is also a sound business investment that benefits both owners and occupiers. Fortunately thanks to advances in building technology, energy efficient building design is now more available and affordable than ever. The implementation of optimal cost energy saving building methods can provide building solutions with a reduction in capital cost or minimum capital cost uplift based on specific buildings. Energy efficient buildings are cheaper to run as well as they offer an attractive return on investment (ROI) for property owners, investors and tenants. Additional economic benefits for the property sector include higher rental income, maximisation of tenancy occupancy levels and future proofing property asset values. They can also enhance BREEAM, LEED, Greenstar, Estidama and other environmental assessments.

This makes a compelling case for energy efficient buildings, especially when it does not impinge on their aesthetics, their functionality or the comfort level of those inside. Creating striking looking buildings that are Net-Zero Energy at the same time is the golden bullet solution for everyone concerned with modern cities.

THE ROUTE TO NET-ZERO

With this in mind, Kingspan, the global leader in insulation and building envelope's products and solutions, introduced a three step process towards Net-Zero Energy Buildings (NZEBs), called the Route To Net-Zero (RTNZ).

A Net-Zero Energy Building is a building where, as a result of its very high level of energy efficiency, provision of on-site renewable energy systems and additional off-site measures, its overall annual primary energy consumption is equalled or exceeded by energy production related to renewable energy sources.

Beyond the obvious environmental benefits of NZEBs, they also offer reduced energy bills, increased building value, controlled costs and even energy security, with less reliance on variable, insecure sources.

The superior energy efficient products and sustainable systems that Kingspan offers are all designed to create stunning looking buildings with cost optimal solutions, meaning increased ease and speed of build, low energy and operating costs (towards Net-Zero Energy).

To achieve affordable NZEBs, a whole building life cycle cost assessment needs to be carried out. This will take into account the construction's capital cost, the costs of energy, maintenance and plant replacement throughout the building's life, and the income from energy generated by on-site low or zero carbon technologies.

Kingspan approaches the RTNZ using a clearly defined route, divided into three steps.



The first step, called 'envelopefirst™ and Optimised Services', is to optimise the insulation and air tightness performance of the building envelope for its intended life, to at least comply with building codes, while also ensuring the building's services are geared to energy efficient operation. It is of the utmost importance that the building envelope is appropriate before embarking on other energy efficient measures. The envelope must offer thermal performance suitable to the local climate.

But it is not just the building envelope that must be considered at this stage, it is important to take a holistic approach to energy efficiency. Important elements such as a building's day-lighting design must always be carefully considered, taking location and climate into account. Kingspan's daylight systems can be incorporated into building



New offices' building in Peterborough, UK, which has taken full advantage of Kingspan Insulated Panels' wide range of building envelope & PV systems, and safety solutions, becoming the first commercial property to be certified to BREEAM 'Excellent' under the new building assessment method.



In 2011, Kingspan Insulated Panels celebrated the completion of the next phase of its RTNZ with the installation of 2,900m^2 of Kingspan PV Roof Mounted System on the roof of its manufacturing facility at Holywell, UK.

designs to further reduce energy consumption, by reducing the need for electric lighting. Energy efficient internal building services with intelligent controls must also be included at this stage.

Kingspan Insulated Panels' building envelope products and solutions provide enhanced thermal conductivity with low air permeability to ensure thermal performance robustness throughout the building's lifecycle. The wide range of Kingspan roof, wall and façade insulated panel systems, including day-lighting, come in various colours and finishes to suit any design requirements. All products and solutions ensure low energy consumption as well as initial capital outlays for heating and cooling plant systems.

With the building envelope correctly specified and optimal building services incorporated into the design, the second step is called 'Insulate & Generate'. At this stage, additional enhancements to the building fabric are introduced and renewable energy systems are added to further reduce its overall energy footprint. Low or zero carbon technologies such as Kingspan PV (PhotoVoltaic) Roof Mounted Systems are perfectly suited to help reduce energy bills for buildings with large roof space. Likewise, Kingspan Sol-Air, a thermal air heating system that channels passive solar heat gain into the heating system, is perfectly suited for buildings with fresh air requirements. Other buildings may require different solutions, including solar thermal, wind and even heat pump technologies, all of which are available from one of the divisions of Kingspan.

'Insulate & Generate' further reduces the building's overall energy consumption. The energy saving solutions selected at this stage depend on a number of variables, including building type, internal demands, orientation, geographical location and climate.

The final step in the RTNZ is called 'Net-Zero Energy Buildings'. The purpose of this stage is to ensure that the overall annual performance of the building balances out. This usually involves enhancing the renewable energy producing technologies incorporated in the building, and may require investment in off-site energy saving schemes.

With the promise of increased energy security, higher lease and rental returns, green building accreditation, a reduced environmental impact, low lifetime running costs, enhanced marketability, increased productivity and a future-proof asset, the benefits to constructing, owning, operating or working in a Net-Zero Energy building are clear. Kingspan believes that the RTNZ is a path that everybody needs to follow, and one that savvy and cost-centric architects, specifiers, planners and developers are already embarking on.

With this in mind Kingspan is making sure its product range covers the full spectrum of requirements to meet these needs; from thermal efficient roof, wall and façade systems, through to PV solutions from the Insulated Panels division, to wind and solar thermal technologies from the Environmental division.

As the global leader in high performance building solutions, Kingspan is widely recognised in the industry for the high quality and performance of its products as well as its commitment to providing optimal cost energy saving solutions. And as a Group, Kingspan has embarked on its own RTNZ, committed to ensuring that all of its facilities worldwide are Net-Zero Energy by the year 2020. ■

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MEASURING CARBON
INTERVIEW WITH **JANE BURSTON**

The UK's National Physical Laboratory (NPL) is a vital institute dedicated to developing and applying the most accurate measurement standards in science and technology. Jane Burston, Head of the Centre for Carbon Measurement at the NPL, talks about the essential work being done in the field of low carbon technologies.

The National Physical Laboratory in south-west London comprises 36,000 square metres of purpose-built buildings that are specifically geared towards the science of accurate measurement. Within the grounds are 388 of the worlds most extensive and sophisticated measurement science laboratories. Here, more than 500 scientists are dedicated to finding the critical solutions for commercial research and development that will support business success across the UK and the globe. The mission is to provide the measurement capability that underpins prosperity and quality of life, and support areas such as medical advancement and environmental monitoring. The Centre for Carbon Measurement (CCM) at the NPL is focused on one of the greatest challenges facing the world today, global climate change. Active in the fields of carbon markets and accounting as well as scientific fields, the measurement work conducted aims to reduce uncertainties in climate data and help develop low carbon technology.

From local scale renewable energy projects through to industrial-sized nationwide implementation, the CCM makes sure that new technology does what it is meant to do, performing the real-world tests that give network operators the confidence to roll out such technologies. We spoke to Jane Burston about the history and work of the CCM.

As the UK's national measurement institute, the NPL is essentially a science and technology lab aimed at doing the same thing that it was established for more than 100 years ago. "Apparently, when he was doing the launch speech in 1902, the Prince of Wales said something along the lines of, 'The purpose of the NPL is to affect a union between science and commerce.' And that, in a



"More than 500 scientists are dedicated to finding the critical solutions for commercial research and development that will support business success ."



nutshell, is what the lab is for really – making sure that the academic development originated at NPL is applied to industry to improve the quality of life and economic development. So that's the NPL. The Centre for Carbon Measurement was set up in March 2012, to bring measurement science to the issue of climate change. There are three themes that we're working on to do that. One is climate data, which is for enhancing the understanding of climate change by ensuring that the people can have confidence in the data that is used for climate modelling. The second is carbon markets and accounting, which revolves around making sure that we have the processes and instruments in place to be able to implement policies to reduce carbon emissions. And the third area is low carbon technologies, which has two aims: helping to develop new technologies, and helping to develop the verification of their performance."

"Organic PVs are made from different, more flexible materials, which means they could have novel applications."

Burston gives some examples of how the work of the NPL is of direct use in the quest for carbon reduction. "We measure greenhouse gas emissions directly and help feed into the carbon footprinting system or 'inventory', which then allows companies to do desk-based calculations of their emissions. One example is a project we are working on for the UK's Department for Environment Food and Rural Affairs (Defra) to measure methane emissions from livestock. Being able to do this means that we can test the impact of interventions such as different feeds, or ways of looking after the animals, which might reduce the emissions. Another project we did recently was for a small hydro scheme planned for the Thames. We calculated the carbon embedded in the system and due to be used in its construction. The community group planning the scheme is now able to see how long the scheme has to run in order to become carbon negative – which was less than a year – and we were able to suggest ways of reducing the carbon footprint of the design by changing the materials used."



There are other success stories, as the NPL is able to help local scale new renewable sources grow into more substantial providers. "We're currently doing a lot of work with the organic photovoltaic (PV) industry. Commercially available solar panels are made from silicon. Organic PVs are made from different, more flexible materials, which means they could have novel applications – such as on films covering windows to power your computer, or on a backpack to charge your phone. It's predicted they'll be cheaper to produce as they could be 'printed' just like a newspaper. The challenge at the minute is that they're less efficient than silicon and with a shorter lifespan, so we're helping to determine why that's the case to feed into the design of future models. We've also got involved in discussions about what standards would be suitable for the industry once it reaches scale, so the public knows how this form of solar power compares with existing types.

"If you need to work out whether a small-size renewable energy technology will perform well on a city scale, and also not create any negative effects, you measure it! For example, you can test a solar panel in the lab, and in the real world, and be pretty sure that if deployed at scale then panels of the same quality and under the same conditions will work just as well. The challenges with scaling up renewables are all about the impact on the electricity grid infrastructure. We did a project recently to measure the impact of solar panels on things like voltage and power quality on the grid. Having real world monitoring devices – such as the digitiser we designed for the project – helps to inform how the energy input from current PV clusters is managed, and also how a future smart grid could be designed.

"At the NPL and the CCM we have a range of different equipment. A lot of the work that we do is connected to instruments that go on satellites – so although we're not dealing with the actual satellite itself, we perform the calibrations of the instruments on the satellite. These are obviously very small pieces of kit because they have to go up into space. In the emissions monitoring side of things, we have something called a DIAL van, which stands for Differential Absorption Lidar (light 'radar') – it's a mobile facility basically, a big articulated truck. There's a giant laser that points at sources of emissions, for example a landfill site, and it can detect emissions leaks and quantify the amount that's leaking. It reflects the light off the emissions and the signal back tells you about the emissions coming off.

"Although we're not dealing with the actual satellite itself, we perform the calibrations of the instruments."

"We have also developed a thermal imaging camera, the same type that is used in buildings to see where heat loss comes from. This was developed by applying a carbon dioxide filter to a normal video camera, which was simple but effective. That particular piece of kit can't tell you how much carbon dioxide is there, but it can tell you where it is. So you can see that the size of the equipment can go from a great big truck to a normal everyday video camera.

"As regards low carbon technologies, there is a range of equipment and labs that we have. One is the energy efficient lighting lab, which has a goniophotometer – it's basically a black room with a very high ceiling and it has lots of different equipment for measuring light."

Asked whether the business world is better than the politicians in making progress

towards climate change solutions, Burston makes the point that both are needed. "I was at a science conference that was part of the Doha Climate Change summit and there was a forum run by the United Nations Environment Programme. There were businesses there that said, 'Yes, we are getting on with it,' and from NPL's experience we know that is the case. But at the same time there was a broad acknowledgement that national and regional policies really boost emissions reductions when it comes to the application of the technology. For example, the EU banning incandescent light bulbs – would change have happened without that on such a scale? No.

"Manufacturers are driving additional innovation above and beyond European or national requirements, but there will only ever be a limited market for those technologies without regulation."

Economies and businesses can be notoriously slow to change and sluggish in adopting new models. Burston acknowledges that cities face stiff challenges in moving towards a low-carbon economy. "A lot of what we do is with the sort of technology that will be deployed in cities; and a lot of the rest of our work is with large single point source emitters, like power stations, and the deployment of the technologies. We engage in the technology development and the verification part, which is important to the existence of the technology and the uptake – but the really hard bit for cities is the fact that it requires behaviour change on a large scale. It needs very wide adoption – and for that you need to change hearts and minds."

"Energy security and rising oil prices are reasons in themselves to ensure more local and renewable generation assets are available."

Reducing carbon output and capturing carbon emissions is seen as a wealth generating opportunity for green technology businesses. Burston illustrates this with an anecdote. "It reminds me of an interesting theory by Professor Porter from the USA – I think that the theory is from the early 1990s. It's about how stricter environment regulation in a country actually supports innovation and enhances international competitiveness, because it forces businesses to adapt – then later, when everybody else is having strict environmental regulations applied, you'll already have developed the technology in your country and you'll be better placed to exploit the business opportunities. I think that China is recognising this, and if other countries don't start jumping on the same bandwagon, then they'll be likely to be left behind.

"As far as international work is concerned, the NPL is the UK's national measurement institute and is ultimately owned by the government – but it's not a government department. We do get government funding, but we take on commercial projects and we apply for funding through the technology strategy board. So we are an arms-length government organisation. Internationally, though, we are part of a network of other NMIs around the world, and at the same time we do take on a lot of work internationally. So with the DIAL van that we talked about earlier, we have done a lot of work out in Norway and continental Europe – measuring leaks or fugitive emissions from refineries or plants. And we also do a lot of work in the US directly for the Environmental Protection Agency, because we have some world leading technology."

Burston is positive about the likely progress in the energy sector and the sustainability industry in the next ten years. "Even without huge amounts of progress on an international climate change agreement you can still envisage the share of renewable energy going up significantly in the next decade. Energy security and rising oil prices are reasons in themselves to ensure more local and renewable generation assets are available. With that will come the need to balance out the intermittency of renewables. Gas generation or nuclear are both means of providing a stable base load, but other factors are likely to mean that energy storage starts to play a much larger role in ten years. What I can't predict is which type of storage solution will come to the fore." ■

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SWITCHING ON TO **ENERGY-EFFICIENT LIGHTING**



By **Laura Fuller**, UNEP/Global Environment Facility en.lighten initiative

As the cost of depleting natural resources continues to increase, new ways are needed to lessen the impact: investing in sustainable infrastructure and resource-efficient technologies in cities will deliver continued economic growth while minimising environmental degradation, reducing poverty, cutting greenhouse gases and improving well-being.

Of many options available today, one of the least expensive and easiest to implement is energy-efficient lighting. Electricity for lighting presently accounts for approximately 15 per cent of global power consumption and 5 per cent of worldwide CO_2 emissions annually. Current trends indicate that the global power demands for electrical lighting will be 60 – 70 per cent higher by 2030 if there is not a switch to efficient lighting.

On a global level, replacing the world's inefficient lighting would save US$110 billion in avoided electricity bills and avoid over 490 megatonnes of CO_2 emissions. If solar LED lanterns were used for off-grid lighting, they would displace 25.6 billion litres of kerosene and 1.4 million tons of candles each year, while significantly improving the health and safety of end users. The CO_2 savings potential for both on-grid and off-grid lighting in total is approximately 570 megatonnes. This is equivalent to the combined emissions of Australia, Belgium and Chile, or, the annual emissions of over 140 million mid-size cars.

Urgent global action is needed, specifically in developing and emerging economies where electricity demand and consumption is expected to increase rapidly. To respond to this need and to accelerate the global transition to environmentally sustainable lighting, the United Nations Environment Programme (UNEP) and leading lighting manufacturers Osram and Philips, with the support of the Global Environment Facility (GEF), in 2009 established the en.lighten initiative.

The initiative delivers a coordinated global strategy and provides technical support for the phase-out of inefficient incandescent lighting. The project has convened governments and international lighting experts from over 40



organisations to provide guidance on the development and successful implementation of National Efficient Lighting Strategies. A global target of 2016 has been set for all countries to have phased out, be in process of phasing out, or have policies in place to phase-out inefficient incandescent lamps. This will lead to a significant reduction in global greenhouse gas emissions, while increasing electrical lighting access to the urban poor in developing countries.

As part of the en.lighten initiative, the Global Efficient Lighting Partnership Programme, launched in 2011, encourages nations to work voluntarily with the en.lighten initiative to achieve a coordinated national or regional transition to efficient lighting. This programme focuses on direct policy and technical assistance to countries that have some efficient lighting policy elements in place and are ready to take rapid action to phase out inefficient lamps. The nearly 50 country partners (representing approximately 24 per cent of the world's population) already have some experience with supporting policies and activities, such as massive distributions of compact fluorescent lamps (CFLs). Some are now exploring opportunities for light-emitting diode (LED) and controls technology in both outdoor and indoor applications. These countries seek to make permanent changes to sustain energy and environmental benefits.

"These countries seek to make permanent changes to sustain energy and environmental benefits."

THE SWITCH OVER HAS ALREADY BEGUN

Gains have already been registered as a growing number of governments and regional bodies — such as Argentina, China, Colombia, the European Union, Malaysia, Mexico and the United States — have begun to mandate the phase out of inefficient lighting.

The Economic Community of West African States (ECOWAS), representing 15 countries, is implementing ambitious standards to phase-out inefficient lamps, which will save the region

approximately US$ 220 million in reduced electricity bills each year. Energy savings will be approximately 2.4 terawatt hours, equivalent to more than 6 per cent of total yearly electricity consumption. The savings would be enough to supply the total annual electricity consumption of at least 1.2 million households.

The Philippines Department of Energy has implemented a retrofitting project to promote the use of CFLs. The project aims to reduce the demand for electricity to eventually bring down the peak load demand and lower greenhouse gas emissions. A total of 150 government buildings in cities across the country, including national government agencies and state-run hospitals, and colleges and universities are being retrofitted, with another 8 million CFLs being distributed to end users through utilities, non-profit organisations and government agencies. The total potential annual savings is 82.8 million kilowatt hours, which translates to US$ 20 million in savings with an estimated CO_2 reduction of over 44 thousand tonnes. The Philippines is also conducting pilot demonstrations using LEDs and photovoltaic systems in off-grid communities.

In Cape Town, South Africa, the retrofit of low-income housing with solar water heaters and efficient lighting saved over 6,500 tonnes of 23.8 thousand tonnes of CO_2 per year, reduced electricity, cut respiratory illnesses by 75 per cent and created green jobs.

Many other nations could emulate these positive examples. Despite technological improvements and the impending climate threat, over 130 developing and emerging countries around the world have not taken steps towards the transition to energy-efficient lighting. Countries that have not made the shift may be unsure about how to begin their own transition, while others may be sceptical about the potential benefits or are lacking the necessary resources and capacity.

ENERGY-EFFICIENT LIGHTING IS MORE COST-EFFECTIVE

When it comes to lighting, inefficient incandescent lamps can still be found in most lighting sockets in cities of the developing world. Although they have the lowest initial purchase price, incandescent lamps have the greatest impact on the environment. An incandescent lamp emits (and wastes) as much as 95% of the electrical power it uses as heat. Incandescent lamps also have a short lifetime of about 1,000 hours and thus require frequent replacement.

Properly handled CFLs have much lower life-cycle costs than the incandescent lamps they have been designed to replace. A CFL can last up to 10,000 hours, nearly 10 times the life span of an incandescent bulb, and uses 75 per cent less electricity for the same amount of light.

"In Cape Town, South Africa, the retrofit of low-income housing ... saved over 6,500 tonnes... of CO2 a year"

The use of solid-state light emitting diode (LED) lighting is also increasing in new and existing applications, particularly in the commercial and industrial sectors as well as in outdoor lighting. Despite having higher initial costs compared to incandescent and fluorescent lamps, good quality LED lamps are proving to be more cost-effective and provide greater energy savings over time.

In some cities, LED lighting solutions are starting to be widely used for tunnels, street lighting, stadiums, and airports. LED lighting is also prominent in municipal structures where governments are using the technology in demonstration projects to showcase the benefits to businesses and consumers.

The higher initial capital cost of LED lighting solutions may appear prohibitive; however, LED light sources use 80 per cent less energy than most incandescent lamps. When used with controls, consumption can be reduced by an additional 40 per cent. Moreover, a good quality LED lamp installed in a home or business can last for more than 20 years!

BENEFITS FOR DEVELOPING COUNTRIES

The trend towards urbanisation has been accompanied by increased pressure on the environment and growing numbers of urban poor; however, unique opportunities exist for cities to lead the greening of the global economy by increasing resource productivity



and innovation, while achieving major financial savings and addressing environmental challenges. There is a major opportunity to ease the pressure on urban infrastructure requirements through the adoption of efficient lighting that will reduce carbon emissions, improve resource productivity, and avoid the resource-intensive urban development practices of the past.

Older cities have to retrofit and replace inefficient lighting infrastructure, but newer and expanding cities have the opportunity and advantage of 'getting it right the first time'. In this era of rising energy prices and scarce resources, adopting lighting systems that are less expensive on a life-cycle basis will pay off quickly and deliver benefits for decades to come.

For many countries experiencing rapid economic and social growth, the increasing consumption of electricity is creating an ever-widening gap between supply and demand. This demand is not being met due to the high cost of new power generation capacity and increasing fuel prices. Electricity brown-outs and blackouts impact investor confidence and negatively impact families, as well as the productivity of businesses that depend on electricity for services.

"Moving to efficient lighting can rapidly and significantly improve the reliability of the electricity system"

Energy efficiency is the fastest and most cost-effective way to reduce electricity demand. Moving to efficient lighting can rapidly and significantly improve the reliability of the electricity system without having to build



Lavaur Town Hall, France: located in the Pyrenees in Southwestern France, the town hall demonstrates a range of LED products from Thorn Lighting including ten 600mm LED Thornline battens

expensive generation facilities. For example, India would be able to deliver electricity to at least 20 million households from the power saved from replacing all existing inefficient lighting with energy-efficient alternatives. In a time of global recession, avoiding the construction of new power plants is financially critical to any country.

With a global transition to efficient lighting, over 250 large coal power plants (500 MW capacity each) could be retired. The operating cost savings could be reallocated to social services and infrastructure projects such as schools, hospitals and roads. It would also allow for expansion of electrical services into underserviced areas and help to improve reliability of electrical services in existing areas. Realising billions of dollars in saved electricity costs would boost economies and create green jobs. Improved access to electricity for millions of people will lead to increased productivity, income and improvement in quality of life for the urban poor.

Few actions could reduce carbon emissions as inexpensively and easily as the rapid transition to energy-efficient lighting, making this one of the most effective and economically advantageous ways to combat climate change to benefit urban communities around the world. ■

Laura Fuller *is the Communications Officer for the for the UN Environment Programme (UNEP)/Global Environment Facility (GEF) en.lighten initiative. In this capacity, she is responsible for directing global, national and regional communications activities to raise the profile of the en.lighten initiative with partner countries and international stakeholders. Prior to joining UNEP, Ms. Fuller was the head of marketing communications and information for Osram Sylvania Ltd. in Toronto, Canada.*

The ***en.lighten*** *initiative was established in 2009 to accelerate a global market transformation to environmentally sustainable, energy efficient lighting technologies. The aim is to rapidly reduce greenhouse gas emissions and the release of mercury from fossil fuel combustion. It is a public-private partnership led by the United Nations Environment Porgramme (UNEP) and the Global Environment Facility (GEF) in collaboration with Philips Lighting, OSRAM, and the National Lighting Test Centre of China. 48 countries spanning Africa, Asia, Europe, Latin America, the Caribbean and the Middle East, have joined the en.lighten initiative's Global Efficient Lighting Partnership Programme to achieve a coordinated global transition to efficient lighting.*

INTELLIGENT LIGHTING FOR SMART AND LIVEABLE CITIES



By **Harry Verhaar**, Head of Global Public and Government Affairs, Philips Lighting

A century ago, less than 10 per cent of the world's population lived in an urban environment. By the start of the 21st century this figure had risen to over 50 per cent, and by 2050 over two-thirds of us will be living in cities. Faced with this rapid urbanisation, municipal authorities recognise the need to create safe, smart, vibrant and environmentally sound city environments. Intelligent, energy-efficient lighting can help them achieve this ambition – but there is no time to lose.

Many of the new city dwellers can be found in emerging economies like China, India and Africa, where conurbations of over 10 million inhabitants are becoming increasingly prevalent. At the same time, cities in developed regions like Europe and North America are having to adapt, as the post-industrial age and an accompanying shift toward a service economy change the very nature of city life. Furthermore, advances in human development and public health have resulted in a global population that is living longer.

Urban growth and transformation on this scale offers tremendous opportunities for economic and social development, but also presents huge challenges, especially in these times of financial and resource constraints. Quality of life (citizens' health and well-being), the promotion of commerce and tourism, and historic preservation are all high on municipal agendas. At the same time, towns and cities are keen to reduce their ecological impact: urban environments contribute heavily to the demand for, and cost of, energy, while also affecting the balance of nature through (light) pollution and waste.

INTELLIGENT LIGHTING

As a leading innovator in the field of health and well-being, with a mission to improve the quality of life through meaningful innovations and the vision to strive for a healthier and more sustainable world, Philips is committed to providing intelligent people-focused solutions that help build truly liveable cities.

As lighting goes digital, we are incorporating our innovative LED light sources, luminaires, smart lighting controls and software in fully integrated, intelligent solutions for cities. Intelligent lighting provides the right amount



Dynamic LED lighting of Miami Tower, USA



of light precisely where and when it is needed. This enables municipal authorities to save energy and maintenance costs, and to reduce obtrusive light, while making urban spaces safer and more attractive, thus also strengthening city branding. Instead of continuously replacing lamps and components, product delivery will increasingly be directed towards software and controllability, thereby adding new value through improved lighting services.

ENERGY EFFICIENCY

Today, cities consume over 70 per cent of the world's energy supply, a figure that will only increase over time. Going forward, how will these cities manage to meet the growing demand for energy while keeping costs under control?

Lighting accounts for 19 per cent of the world's electricity consumption, with some 60 per cent of this used by commercial and public buildings in cities, and around 15 per cent by street lighting. Significant savings are possible – on average 40 per cent – simply by switching to energy-efficient lighting technologies such as LED. On a global level the potential savings amount to €128 billion (US$165 billion) in reduced electricity cost and 670 million tonnes of CO_2, or the equivalent of 642 power plants. Philips aims to improve the energy efficiency of all the products it brings to market by 50 per cent in the period 2010-2015.

INNOVATING FUTURE-PROOF SOLUTIONS

Together with a range of strategic partners from both the public and private sector, Philips is constantly working on innovative, integrated lighting solutions to help build intelligently connected cities. Our CityTouch online outdoor lighting management system is a case in point.

With steeply rising urban populations, it is clear that static, passive streetlights cannot keep pace with the lives we lead. Liveable cities require lighting that can adjust to the ebb and flow of traffic and urban activity. CityTouch enables dynamic, intelligent and flexible control of lighting city-wide. Combined with LED-based fixtures, it can save up to 70 per cent on energy and maintenance costs in comparison with conventional lighting.

CityTouch allows users to manage all the lighting systems for an entire city from a single, intuitive online user interface. It provides easy, streamlined maintenance and oversight, with real-time status reports for each individual light point. Moreover, by making it possible to dim light points outside peak hours, detect failures and provide smart lighting workflow support, the system significantly reduces operating costs and energy usage – leading to lower energy bills, lower carbon emissions and less light pollution.

CityTouch also protects the city's infrastructure investment by adjusting seamlessly to new technologies and evolving needs. As they expand, cities using CityTouch can add new streets to the existing network. New lighting functionalities can also be easily incorporated. Also, CityTouch is the first control platform that is not bound to one hardware type or provider. This means that users have flexibility in choosing the products that best suit their city's requirements and budget.

INSPIRING ENVIRONMENTS

In addition to their capacity to slash energy bills and avoid greenhouse gas emissions, integrated LED-based lighting offers exceptional freedom in terms of controlled lighting effect – colour, dynamics – and design. This capability is driving a shift from 'quantitative' functional lighting towards 'qualitative' intelligent and emotive lighting that transforms urban environments, offering city residents and visitors safety and spectacle, uplifting and inspiring experiences.

WHITE LIGHT FOR SAFER STREETS

To hold on to both their private and corporate citizens, cities must provide safer streets for both motorists and pedestrians. Lighting can make a decisive contribution in this regard. For example, at the same light level, more than 80 per cent of people feel safer with bright white light than with traditional street-lighting solutions. The closest approximation to actual sunlight, white light is considered to be more authentic and comfortable: its high levels of perceived brightness and superior colour rendering help people feel safer and make it easier to distinguish objects, colours, shapes and other details.

At Rio+20 a report entitled *Lighting the Clean Revolution: The rise of LEDs and what it means for cities* (www.TheCleanRevolution.org/lighting-the-clean-revolution) was published, outlining the findings of LightSavers – an independent global pilot of LED lamps across 12 of the world's largest cities. These findings included the fact that a large majority of residents of pilot cities reported improved visibility and felt safer with LED-based white light.

Quite simply, high-quality intelligent lighting helps make a city safer and more attractive, enhancing its brand identity – the distinctive signature that defines its appeal and differentiates it from other cities. This is important not only for civic pride, but also to attract new residents, new businesses and inward investment that boost retailing, tourism and other boons to economic growth and employment.

THE URGENT NEED TO ACT

The intelligently connected, energy-efficient lighting solutions needed for a sustainable future are here today – the one thing we cannot afford is to delay their implementation. The current rate of renovation of existing infrastructure based on outdated, inefficient technology is simply too slow. We urge governments worldwide to act – by creating policy frameworks (governing, for instance, public procurement, total cost of ownership, and fiscal incentives) that stimulate clean, smart innovation, and by adopting more ambitious energy and resource efficiency performance standards. At the same time, they can lead by example by making their own public buildings, schools and streets smart and energy-efficient.

Such top-down change must be complemented by a bottom-up, sectoral approach, in which the business community and public stakeholders join forces in new public-private partnerships to accelerate the market penetration of innovative new technologies, products and services. Here too, the lighting industry provides a good example. The industry is working together to drive the global switch to energy-efficient lighting. In addition, the en.lighten public/private partnership between UNEP, the Global Environmental Facility, Philips, Osram and NLTC to promote the adoption of efficient lighting in developing and emerging countries, has created a virtual global sectoral market transition. This sectoral lighting industry approach also constitutes a welcome bottom-up contribution to the UNFCCC's ambitions to make progress on tackling climate change at COP18 in Qatar.

From a sustainability viewpoint we could also benefit greatly by moving financing mechanisms from 'lowest price tag' to 'life-cycle value'. This involves advancing new business models that balance operating expense and capital expenditure. For example, CityTouch's 'fee per light point per month' approach eliminates the need for upfront investment. The savings in energy and maintenance costs that are enabled by CityTouch can lead to best-in-class payback times of the investments in new energy-efficient lighting.

LOOKING FORWARD

There are indeed many significant challenges to be overcome, yet the prospect of safe, vibrant, eco-friendly cities is no illusion. We can achieve this. With a forward-looking agenda and a commitment to partnering with other change agents in both the private and public sectors, we at Philips are resolved to play our part – by continuing to deliver the intelligent lighting solutions that will help create the sustainable liveable cities of the future. ■

Harry Verhaar *has over 20 years of experience in the lighting industry, and is Head of Global Public & Government Affairs for Philips Lighting. He is responsible for the strategy, outreach and stakeholder management on energy & climate change, resource efficiency and sustainable development. He is an active member of The Climate Group; R20; WBCSD; World Green Building Council, and is a member of the Advisory Board of The Lisbon Council. Harry is a recipient of the 2011 UN Leader of Change Award, and has received the Carbon War Room's Gigaton award on behalf of Philips.*

THE **BUSINESS** CASE FOR **GREEN BUILDING**



By **Jane Henley**, Chief Executive Officer, World Green Building Council (WorldGBC)

In just a decade, the global green building movement has driven a dramatic shift in the way we interact with our buildings and what we expect from them.

"We shape our buildings; thereafter they shape us." Winston Churchill's words are a powerful reminder that our buildings have an extraordinary economic, social and environmental impact on the way we live. The first wave of environmentally-conscious building arose as a response to demand for energy and resource efficiency. Times have changed, and our focus on improving the environmental design, construction and performance of buildings has broadened. Today, we are beginning to understand that green buildings do more than enhance the environment. They reduce operating costs, improve asset value, mitigate risk, support jobs growth and improve the productivity, health and wellbeing of people who live and work in them.

And yet, many of these compelling financial and social benefits are hard to quantify. To address this, in March the World Green Building Council released the *Business Case for Green Building: A Review of the Costs and Benefits for Developers, Investors and Occupants*. This report

"This report synthesises all credible evidence of the financial and social value of green buildings into one definitive reference guide."

synthesises all credible evidence of the financial and social value of green buildings into one definitive reference guide.

The report looks at the costs and benefits to business in five categories: design costs; asset value; operational costs; workplace health and productivity; and risk mitigation. Using peer-reviewed evidence as the standard for our analysis and a steering committee of experts from around the world, the report examines the value of green building at each stage of the building lifecycle.



Flinders Medical Centre, Adelaide, Australia, has proved to be extremely popular since being commissioned in late 2009.



Hollywood House, a 1980s building in Woking, England, recently underwent a green makeover to improve its energy efficiency and is predicted to use 56 per cent less energy than before the refurbishment

IS THERE A BUSINESS CASE FOR GREEN BUILDING?

Firstly, while the perceived cost premium associated with green building has been an overriding barrier, this report finds conclusively that green design and construction doesn't need to cost more. A green building can be cost-neutral when compared to its conventional counterpart - provided that environmental strategies and programme management are integrated from the outset.

Our research found a significant gap between perceptions of cost premiums and reality. Industry professionals operate under the assumption that building green increases design and construction cost by 10-20 per cent - with some estimates as high as 29 per cent. In actual fact, our research reveals that the actual green building premium is in the range of minus 0.4 to 12.5 per cent. In other words, some green buildings are cheaper to build than non-green buildings, and even those with a premium cost far less than the perception.

Secondly, 'green' and value are now inextricably linked. A number of peer-reviewed studies from around the world show evidence of a connection between the green characteristics of buildings and the ability of these buildings to attract higher sale prices and rents in some markets. The evidence reveals a consistent pattern of premiums – although there is some significant variation in different markets. Certainly, in markets where green is more mainstream, there are indications of emerging 'brown discounts', where buildings that are not green may rent or sell for less.

"Energy savings in green buildings typically exceed any cost premiums associated with their design and construction."

In use, green buildings have been shown to save money through reduced energy and water consumption and lower long-term operations and maintenance costs. Energy savings in green buildings typically exceed any cost premiums associated with their design and construction within a reasonable payback period.


Exterior of Hollywood House, Woking

There is also an emerging body of evidence suggesting that the physical characteristics of office buildings and indoor environments can influence worker productivity and occupant health and well-being, resulting in bottom line benefits for businesses. Studies have found giving office workers individual temperature control leads to measured productivity gains of up to three per cent. That's just one measure! Improved ventilation can enhance productivity by up to 11 per cent, while better lighting has been found to boost productivity by as much as 23 per cent. Many more studies link access to the natural environment through daylight and operable windows to individual and organisational productivity, such as increased retail sales. One study found a 40 per cent increase in sales at a 73-store retail chain in California simply due to daylighting.

Our report also finds that occupants of other building types benefit from green design features. This includes an 8.5 per cent reduction in length of hospital stays in one study, as well as others indicating faster recovery rates in rooms with views of nature, and a 22 per cent reduction in need for pain medication when patients are in rooms with bright sunlight. A range of studies into schools has found that integrating green design principles into education facilities can increase school attendance by three days per student each year, boost test scores by up to 14 per cent and improve learning rate by as much as 26 per cent.

Finally, the report confirms that green buildings are 'future proofed' investments. Sustainability risk factors can significantly affect the rental income and the future value of real estate assets, thereby affecting the returns to investors. Increasing regulatory risk, coupled with changing investor and tenant preferences, may translate into risk of obsolescence for inefficient properties.

Until now, sustainability has been hard to sell to the people making the financial decisions for big companies – the chief financial officers. CFOs are not interested in technical information about photovoltaics or wind turbines, nor are they interested in the moral reasons why a company should consider sustainability. What they are interested in is how buildings can improve their bottom lines. *The Business Case for Green Building* lays it all there in black and white: sustainable buildings are just good business sense. ■

Jane Henley *is the Chief Executive Officer of the World Green Building Council, a role she assumed in February 2010. Previously, Jane was the founding Chief Executive Officer of the New Zealand Green Building Council, which she helped establish in 2005. She has also been on the boards of the WorldGBC and NZGBC. Jane is sits on a number of boards, is an active speaker and is passionate about business leading change. Jane is committed to driving market transformation that is underpinned by sound economic practices that simultaneously deliver financial, social and environmental benefits. Contact: jhenley@worldgbc.org*

The ***World Green Building Council*** *(WorldGBC) is a coalition of 96 national green building councils, making it the largest international organisation influencing the green building marketplace. The WorldGBC's mission is to facilitate the global transformation of the building industry towards sustainability through market driven mechanisms. The WorldGBC supports the creation successful GBCs and ensures they have the resources needed to prosper, advocates the important role of green buildings in mitigating global climate change and promotes effective building performance rating tools and the development of mandatory minimum standards for energy efficiency in buildings. See: www.worldgbc.org*

FOAMGLAS® CELLULAR GLASS THERMAL INSULATION

SUSTAINABILITY BY DURABILITY

FOAMGLAS® cellular glass insulation is an environmentally sound, socially responsible, and economically beneficial choice for your industrial, commercial or real estate projects. FOAMGLAS® insulation products are the key to Green Building:
- Environmental Stewardship
- Sustainability
- Energy Efficiency
- Healthy Air Quality
- Fire Safety.





Images, left to right:
ZVE Stuttgart-Vaihingen, FOAMGLAS® floor insulation
VM Bjerget, Copenhagen, BIG architects, FOAMGLAS® compact roof insulation

NATURAL RESOURCES

FOAMGLAS® cellular glass insulation is 100% glass. It is an insulating material composed of millions of completely closed glass cells. It is manufactured from sand, limestone, other natural occurring materials and selected recycling glass. Regarding emissions, production energy and resources FOAMGLAS® is at the leading edge ecologically, and the ratio between production energy and energy savings achieved by the use of cellular glass pays off for the environment and the client.

VERIFIED GREEN PERFORMANCE

Certifications for "Passive house" construction (Passive House Institute, Darmstadt), natureplus quality seal (Europe), DGNB label (Deutsche Gesellschaft für nachhaltiges Bauen) and enclosure in Green Spec® database (US) recognize that FOAMGLAS® products meet the most stringent requirements regarding environmental and health protection. FOAMGLAS® systems are certified to the French standards HQE (High Environmental Quality, Haute Qualitée Environnementale) and have EPD Environmental Product Declaration, IBU Germany).

OUTSTANDING PRODUCT CHARACTERISTICS

Unique product properties – inherent to glass – make that FOAMGLAS® is neither harmful to the environment nor to health. FOAMGLAS® is a mineral and incombustible building product (European fire rating A1) for thermal insulation with additional functions as the protection against moisture. It is a low emitting material and does not contain ozone depleting substances, flame retardants, VOC's or binding agents, deleterious to health. It does not give off mutagenic or carcinogenic substances or fibres. When used as interior insulation, this means no risks regarding indoor air quality. In terms of building biology FOAMGLAS® contributes to good residential hygiene, comfortable temperatures, well-being and healthy living.

FOR THE ENTIRE BUILDING ENVELOPE

FOAMGLAS® can be used as below grade insulation to protect bearing walls and foundation rafts on the outside, as façade and roof insulation. Terraces, parking decks and interior insulation for walls, floor and soffits – even under harsh humidity conditions – add to the many areas of application for this sustainable insulation material. FOAMGLAS® solutions are universally suited for renovation and new build, and meet the high demands of passive house standard.

FOAMGLAS® insulation has an exceptional durability. After many years in service, both the physical and thermal properties of this material have proven to remain constant. Real payback, in physical and thermal performance, for many years, is what our clients have come to expect from the global FOAMGLAS® insulation.

FOAMGLAS® is an insulation concept fit for the future that genuinely answers concerns for the environment. The system ensures that all demands on performance, durability, environmental integrity and sustainability are fulfilled. ■

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SUSTAINABILITY IN ARHCITECTURE
INTERVIEW WITH
PATRIK SCHUMACHER

A world renowned architect, professor, theorist and author, Schumacher is a company director and senior designer at Zaha Hadid Architects. He has been working alongside Hadid since 1988 and is credited as co-architect on many Zaha Hadid buildings. There can be few people better qualified to consider and contribute to the construction of tomorrow's cities.

A world-renowned architect, professor, theorist and author, Patrik Schumacher is intently focused on how the cities of tomorrow will look and function. He is a company director and senior designer at Zaha Hadid. Schumacher has been working alongside Hadid since 1988 and is credited as co-architect on many Zaha Hadid buildings. He is a fervent exponent and developer of the new architectural paradigm of parametricism.

Patrik Schumacher's MAXXI Centre of Contemporary Art and Architecture in Rome won the Stirling Prize in 2010, and his current master plan projects include Kartal Pendik in Istanbul and Singapore One North. A respected teacher, Schumacher has led courses at the Universities of Columbia, Illinois and Harvard, and he is at present tenured professor at Innsbruck University and Director of the Design Research Laboratory at the Architectural Association School of Architecture. There can be few people better qualified to consider and contribute to the construction of tomorrow's cities.

Architectural ideas exist in a highly intellectual realm, expressed and explained in complex theories. And yet the practical decisions about the procurement and implementation of the sustainable components of a city – including anything from zero carbon building materials to environmentally friendly air conditioning systems – have to be made by professionals in other disciplines, in consultation with architects. Schumacher believes that each major discipline and profession develops its own expert discourse. "Architecture – as discipline and profession – is in sharp demarcation from the sciences and engineering disciplines. The planning of sustainable cities involves several function systems including science, engineering, the political system, and architecture. Each of these function systems is led



by its own theories and criteria of success. No function system can substitute itself for the expert contribution of another function system. Architecture as a self-regulating discourse has to develop its own unique response in the face of political, scientific and engineering constraints, on the basis of its own accumulated wisdom and historically evolved and evolving discursive structures. I have contributed to this discourse – with specific reference to sustainability and the ecological challenge – in my 2010 article *The Parametric City*."

URBAN VITALITY

In his recent paper *My Kind of Town*, Schumacher describes his ideal city as "a place that offers the most dense communicative experience … an urban vitality based on a high density of diverse communicative offerings that allows (you) to be both randomly freewheeling and to become highly selective within a split second." The sustainability aspect of modern cities has to be integrated with the other design functions. "The environmental sustainability of the processes of the city's material production and reproduction is an important constraint for designers. As architects we are form givers and space shapers. We address environmental performance issues via spatial and morphological design decisions. This implies that our primary engagement with sustainability issues is with what engineers call passive systems. The engineer's own undisputed domain is the domain of machines and mechanical systems. Contemporary architecture must relearn the wisdom of the world's vernacular traditions that achieved climatic adaptation via passive systems, in the absence of mechanical systems like air conditioning. Contemporary architectural research – in particular under the auspices of the parametric paradigm – is investigating the culturally evolved environmental intelligence of traditional buildings – the same way it engages with bio-mimetic research trying to learn from the intelligent results of the biological evolution. The focus on passive systems keeps the environmental agenda fully within the architect's core competence as form giver. The ultimate end and expertise of the architect focuses on spatial form as a medium of communication, ordering social communication processes by orienting sentient, socialised actors. Engineers give us quantitative analyses about the physical performance of our designed morphologies and deliver the mechanical systems that – despite all passive intelligence – remain necessary to keep our physical bodies safe and comfortable.

"Architects need not worry about the machines that reside underground or under the hood. They are the engineer's responsibility. Architects must worry about spatial form and formal expression. Therefore a purely physical functioning is not enough. Architects must select and heighten the environmentally performing spaces into communicative spaces. This is the task of articulation. This task selectively uses and heightens the morphological and tectonic features that environmental performance suggests to give identity to the various spaces it designs for various activities and event scenarios. Traditional architecture proves that the double selection for adaptive performance and

communicative potential can succeed. The architect must select from his most sustainable options according to a communicative agenda. He must search for synergies between physical performance on the one hand and phenomenological identity and semiological eloquence on the other hand."

"The solution cannot involve the shutting down of the urban porosity and urban flow."

Built environments function via perception and comprehension. Schumacher has sympathy for city dwellers struggling with sustainability factors in an urban environment. "Nobody can escape from the global consequences of unsustainable processes. But the restrictions imposed by stringent sustainability criteria are felt and endured locally. We need to reckon with attempts to avoid these restrictions while trying to free ride on others' efforts to remain sustainable. Political or legal regulation is required. Architects' creativity has to search for architectural quality within this politically constrained search space or universe of possibilities.

PARAMETRICISM

In Schumacher's work he champions the 'parametric metropolis', citing it as imperative for multi-modal communication in future cities. "Parametricism is the primary current avant-garde movement in architecture and design and the coming epochal style of the 21st century. Its superiority lies in its repertoire and methodology that allows for a new level of adaptive versatility, spatial complexity and intricate order in the built environment. It achieves this by making all elements of the architectural composition parametrically malleable, i.e. the elements of the composition are modulated by form variables that allow for the establishment of affiliations and resonances between the different parts and spaces and in relation to the urban context. In parametricism, everything is made to interact with everything else, as one can observe in natural systems like organisms or ecosystems.

"Sustainability is both a challenge and an opportunity for parametric design. The imperative of energy saving must not imply that the shutters are coming down. The task is to create cities that sustainably adapt to the natural environment without arresting the progressive, developmental thrust of our civilisation. Cultural advancement has to continue. This is not only an end in itself but the sine qua non of our continued survival on spaceship earth. Continuous technological innovation is a necessary precondition for our ability to ascertain our ongoing ecological sustainability. Therefore the tightening of ecological constraints that impose themselves upon the design of cities must not constrain the vitality and productivity of the life processes they accommodate. Cities must continue to provide the living conditions that are favourable to innovative work.

"Thus before we can fully address the question of how to optimise our cities in terms of environmental engineering, we must answer the question of which urban patterns and architectural morphologies are most likely to vitalise and advance the productive life and communication processes everything else depends upon. The emerging 'network society' implies that the intensity of communication increases exponentially. That is why the solution cannot involve the shutting down of the urban porosity and urban flow. The new network society requires more variegated, complex, and densely integrated patterns of spatial ordering that are inherently multivalent and adaptive. The parametric designer invents and formulates correlations or rules akin to the laws of nature. Thus everything is potentially made to network and resonate with everything else.

"Now, to address the ecological challenge and the opportunities this entails for parametricism. The general paradigm of 'ecosystems' applies to both, and is embraced as a founding paradigm of parametricism. The same design concepts, techniques and tools of parametricism that allow contemporary architects to ramp up the communicative complexity of the built environment are also congenial to the agenda of optimising architectural forms with respect to ecological performance criteria. Morphological output variables can be programmed to respond to environmental input parameters. For instance, a data set such as a sun exposure map that maps the radiation-

intensities a façade is exposed to during a given time period can become the data-input for the adaptive modulation of a sun-shading system. As the system of shading elements wraps around the façade the spacing, shape and orientation of the individual elements gradually transform and adapt to the specific exposure conditions of their respective location on the façade. The result is a gradient, a continuously changing façade pattern that optimises sun-protection relative to light intake for each point on the façade. At the same time, this adaptive modulation gives the building an organic aesthetic that also makes the orientation of the building in the environment legible, and thus facilitates the comprehension and navigation of the urban environment. The differentiated articulation of the façade contains and transmits information about its position rather than remaining indifferent and blind. The same principle of conspicuous, adaptive variation and correlation is being applied to the activity and event parameters of the urban life process. The disorientating, generic neutrality and monotony of modernism gives way to the ecologically adaptive eloquence of parametricism. Thus parametricism selectively transposes ecological rationality into the agenda of tectonic articulation for the purposes of an information-rich, legible, eloquent built environment. By the way, the same concept of tectonic articulation also applies to the architect's selective/opportunistic utilisation of structural engineering rationality.

"I first fell in love with architecture when I saw the cool elegance and modernity work of Mies van der Rohe.

"Like every other function system architecture needs to adapt to and contribute to an evolving, progressing society."

Architecture seemed to be aspirational and able to contribute to and express human advancement.

"Like every other function system architecture needs to adapt to and contribute to an evolving, progressing society. To enable itself to do this adequately architecture must upgrade its intellectual resources. Maturana's theory of autopoiesis and specifically Luhmann's elaboration of Maturana's biological concept for sociology, as well as systems theory and complexity theory in general, enabled me to theorise architecture's societal function and resources anew. But there are of course many protagonists within the discipline of architecture whose contribution inspires and guides my work, above all Zaha Hadid. There is a lot of force projecting into the future, on all continents."

CRISIS IN MODERNISM

Challenged that architectural movements, such as 1960s high-rise buildings, have not always worked in practice, Schumacher makes two important points. "First of all I dispute that the high-rise housing estates of the 1960s were a mistake at the time of their conception. For instance, the notorious Park Hill housing estate in Sheffield – built as part of a slum clearing effort between 1957 and 1961 – was initially very successful. Twenty years later it started to degenerate into a problem estate. It was no longer an adequate solution for a society that was rapidly restructuring from a society based on fordist mass production to our post-fordist network society based on knowledge-intensive innovation and flexible specialisation. So all modernist architectural solutions became inadequate. The social housing estates – high-rise or low-rise – were further disadvantaged as monocultures or ghettos of the economically weak and dependent. But no fordist monocultures were viable any longer.

"No movement is immune to historical obsolence. Modernism started to experience its crisis and demise after half a century (1925–1975) of successful transformation of the global built environment. Parametricism is in its first decade. What lies beyond? No idea, but I know the next 20 years will allow us to make an important contribution to global urban environments, congenial to our contemporary network society.

"There is another point to be made. Modernism aligned itself with the historical move towards a more politically planned and controlled economy. This implied that its solutions could be imposed politically without requiring market testing and popular acceptance. Today's solutions

– including the solutions of parametricism – can only succeed in a market contest where they have to prove their adaptive pertinence every step on the way to success.

"The essential need for sustainable development fits in as an inescapable constraint on all human endeavours, among other such inescapable constraints – the need for economic viability, the need for health and safety, and so on. What has to be rejected is the idea that sustainable development implies a slowdown, a retrenchment from growth, and a simplification of social life. Society's development can only advance in the direction of increasing complexity, increasing density of communication, and increasing speed of social transformation."

Schumacher agrees emphatically that solutions provided by the private sector can increase the sustainability of cities. "In fact I think that all concrete solutions must be generated within the private sector, and they have to expose themselves to the 'democracy' of the market. The state bureaucracy can no longer direct societal processes beyond the setting of very general frameworks and rules. Society has become too complex to be planned from above. Solutions emerge first in an open discursive system of communications – the avant-garde segment of architecture – and then are tested by different architects in different real world projects in the market. I go further to propose that there is still too much exercise of political power and planning in the urban development process. The political authorities are trying to plan and determine too much. For instance they prescribe land use via land use zoning, and density via density zoning. I think these aspects of the urban process should be left to the market that can react more flexibly to societal requirements. Public planning might restrict itself to basic infrastructure planning.

"The disorientating, generic neutrality and monotony of modernism gives way to the ecologically adaptive eloquence of parametricism."

"My claim is that parametricism as epochal style will be capable of sustaining a complex urban order in the face of open ended, unpredictable market processes. The forms of order parametricism constructs are based on inventing associative logics that integrate multiple systems in multiple contexts via local affiliations, continuities and resonances rather than via global figures, symmetry and proportion. Order will be established not by a fixed global plan but by the hegemony of heuristic design principles: make all elements variable, always differentiate, always correlate as well as hunt for, extend and invent continuities and resonances. Among the general rules of the game, politics must establish sustainability criteria. However, there must be a lot of freedom for market actors, architects and engineers on how these might be met in concrete situations."

In principle, Schumacher thinks it is possible, in our lifetime, to see the creation of stable and sustainable economies, where social cohesion, inclusion, and equal opportunity for all is promoted and where any environmental and social damage or expense is borne by those generating it; and where efficient resource use is incentivised. "But I also think that this is a very difficult task, and when attained it will remain fragile, never to be taken for granted. Politics and economics are not my fields of expertise, but I am a life-long self-taught learner in matters of sociology, economics and politics. I prefer to observe, learn and integrate my experiences under the auspices of a radical free market (libertarian) outlook. I tend to agree with those who attribute the economic setbacks the advanced world is now suffering for more than four years since the 2008 meltdown to state interference in markets rather than to the markets themselves. My hypothesis is that the most advanced societies might now have reached a general cultural level that should make it possible to dare more freedom and to allow society to self-organise on the basis of more individual freedom and voluntary exchange and association, rather than to rely more and more on an

over-protective nanny state that tries to regulate everything. Such a politics would be more congenial to contemporary network society with its bottom-up, self-organising social processes. The so called 'carbon trade' – the trading of greenhouse gas emission rights – might serve as an example about how the political intentions framed in a general regulation can be made concrete in voluntary exchanges.

"This is broadly the direction of my current political outlook. However, my specific architectural commitments do not depend on my latest political hypothesis. Parametricism cannot be tied down to a particular political direction. Parametricism will be the epochal style of the 21st century network society whether it takes a political turn towards radical democracy, radical libertarianism or stays the course of current mainstream liberal democracy."

URBANISM

The growth of future megacities will make extraordinary demands on architectural design, which must then respond. "I think the physical concentration in megacities will continue for the foreseeable future. We have reached a stage of civilisation where all further progress depends upon the complex integration of many sophisticated, specialised forms of knowledge. Bottlenecks and problems are now for the most part in the communication area. The intensification of collaborative communication is a hallmark of contemporary network society. Telecommunication intensifies too. But this cannot satisfy the insatiable demand for more and more communication. The megacity becomes a giant, super-intense interface of communication.

"Paramount for architects will always be the life-enhancing, productivity-enhancing quality of the built environment."

"So if megacities are bound to grow, technical solutions must be found to solve the problems this entails: congestion, pollution etc. Urbanism can help, not by limiting the necessary or browsing movement to connect us, but by making sure we do not lose our time, energy and nerves within a disarticulated visual chaos, but are instead able to navigate elegantly through a complex, information-rich but well-ordered environment that allows us to find what we are looking for and to have lots of meaningful encounters and communicative experiences along the way.

"One notable challenge is how to maintain legible order in the face of an explosion of societal complexity and the multiplication of constraints and requirements. Paramount for architects will always be the life-enhancing, productivity-enhancing quality of the built environment. Sustainability is always a secondary demand: how we can achieve, sustain and progress this quality of life. Absolute sustainability would be a paradox. The sustainability of what? And we must add this turn of reflection here: More sustainable solutions can only be generated in high productivity environments. Architecture matters.

"The paradigm and epochal style of parametricism – like modernism before – claims universal relevance and competence with respect to the totality of the built environment and the world of artefacts. It does not intend to stop with the, for now, exceptional icons and manifesto achievements that characterise its avant-garde stage. Its inherent drive is all encompassing. Only what draws the mainstream in its wake has turned out to be truly avant-garde."

Schumacher gives a short list of his favourite cities and buildings. "Cities, let's see… London, New York, Tokyo, Hong Kong, Beijing, Rome. And buildings… our Galaxy project in Beijing, our MAXXI in Rome, Centre Pompidou, John Portman's Marriott hotel in New York's Times Square." And a favourite urban location? "NYU's urban 'campus' for its vitality – and then New York's Lincoln Centre for urban elegance.

Asked to choose which of his own achievements gives him the most pride, Schumacher cites the integration of theory, research and practice. ■



RETROFIT CASE STUDY: **UNITED NATIONS SECRETARIAT BUILDING**

On World Environmental Day of 2007, Secretary-General of the United Nations Ban Ki Moon envisioned that the United Nations' headquarters would "eventually become a globally acclaimed model of efficient use of energy and resources." To achieve this goal, a $2 billion dollar retrofit programme is currently in progress, bringing the United Nations' New York City headquarters into the 21st century.

Built in 1952 and designed by Oscar Niemeyer and Le Corbusier, the United Nations Secretariat Building epitomised modern design aesthetics and featured the world's first fully-glazed façade. In keeping with its history of revolutionary design, the renovated Secretariat Building now includes "design initiatives that touch upon multiple aspects of environmental sustainability" resulting in 50 per cent less energy consumption and produce 45 percent fewer greenhouse gas emissions[1].

Maximising the utilisation of natural light while maintaining occupants' exceptional views of the Manhattan skyline and the East River was a top priority. Floor plans were revised to create a full loop corridor around the core to optimises circulation and maximize the usage of the passive zone. Integral to this is the installation of an automated motorised window covering system for natural light management. By automating motorized blinds and shades, the Secretariat Building optimizes the flow of natural light and heat in accordance with interior and exterior environmental factors and occupant preferences.

Motorized window coverings automated with intelligent controls eliminate the drawbacks of fully-glazed facades such as glare and heat gain. Automating motorized blinds with sun sensors maximizes natural light levels ensures high Interior Environmental Quality (IEQ) while automatically eliminating bothersome glare for employees. Intelligent keypads are installed for each window zone. This enables office personnel to manually select from five defined window covering presets according to their personal comfort requirements. However, to balance employee comfort with energy efficiency, the system is programmed to return to the automated sun control mode at predefined times to ensure the most efficient system operation throughout the building.

Compared to similar buildings with static solutions such as films, fixed overhangs or manual window coverings, the Secretariat Building needs less artificial lighting, relies less on HVAC and can also implement an energy efficient demand/response programme thanks to the installation of automated window coverings.

In total, this retrofit is expected to save between $4 and $5 million dollars per year while still maintaining the Secretariat Building's iconic glass façade, solidifying the United Nations reputation as a model of sustainability and innovation[2]. ■

The United Nations Secretariat Building automated window covering solution consists of a Somfy Digital Network system with 5000 blinds and shades powered by Sonesse® 30 RS485 ultra-quiet motors, over 1000 Digital Keypads, and exterior Sunis WireFree RTS Sun Sensors. Blinds fabricated by Mariak were installed by City View Blinds and commissioned by Somfy Systems' LEED-certified Commercial Specification Team.

Since 1969, Somfy has been the global leader in the manufacture of motors and electronic controls for interior and exterior window coverings for both the commercial and residential markets and recently celebrated the production, throughout the world, of 100 million motors.

Somfy solutions are scalable, offered in low voltage, line voltage or wirefree options, and are perfect for projects of any size or budget.

For more information, please visit www.somfypro.com/commercial-building-solutions or email commercial_solutions_na@somfy.com.

[1] "Moving Towards a Climate Neutral UN," 2011 Edition, pg. 20
[2] "The Capital Mater Plan: Showcasing Sustainability in the Renovation UN HQ in NY"

BALANCING **PASSIVE** AND **ACTIVE STRATEGIES** FOR **GREEN BUILDINGS**




By **Serge Neuman**, Ph-D. Expert and opinion evangelist on green buildings and **Vivian Loftness**, Professor and former Head of the School of Architecture, Carnegie Mellon University

> Passive strategies include numerous domains: biophilia; urbanism; dynamic building enclosures, nature's free energy, and more… In fact, Architecture and Passive Strategies are intimately connected. One could even argue that passive strategies have engendered regional architectures and since then they nourish each other.

A common mistake is to think that "Active Solutions" and "Passive Strategies" have opposing meanings. This is an honest mistake since "Active" and "Passive" are indeed antonymic. However, "Passive Strategies" and "Active Solutions" are not the opposite sides of the same coin. There are static active solutions (such as an energy-saving light bulb) and dynamic passive strategies (such as daylight management with automated shading devices). Both are critical to a more sustainable built environment and debating active solutions against passive strategies leads to a dead-end for achieving true sustainability in buildings.

ACTIVE SOLUTIONS

In buildings, "Active Solutions" are engineered systems designed to generate and to control artificial environmental conditions for the occupants. These solutions are rightly characterized as "Active" as they require external power to operate.

However, the use of external power is not only a part of the building's active solutions, but a necessary provision for a long list of "plug loads" including computers and office equipment. The purpose of "plug loads" is not the building's environmental conditioning, but to support the occupants' tasks and lifestyle.

The combination of plug loads and active solutions are responsible for a buildings energy bill. Due to evolutions in workstyles and lifestyles, as well as efforts to improve the energy efficiency of active solutions, the weight of plug loads in the total electricity bill is continuously increasing. Even so, active conditioning systems are still responsible for more than two thirds of buildings total energy consumption (68% in residential. 73% in commercial). This energy is consumed in buildings to meet the Indoor Environmental Quality (IEQ) standards of each location. These



standards have been set to ensure that Buildings fulfill their raison d'être: supporting and protecting human's life and activities.

Indeed, Active solutions define the building's energy consumption today.

PASSIVE STRATEGIES

In buildings, "Passive Strategies" are designed to play with the natural environment for environmental conditioning and the benefit of the building occupants. The key word is "Strategy". "Strategy" does not belong to the world of technologies but to the one of tactic and therefore design.

Because there is this adjective "Passive", most people judge without knowing that the "Passive Strategies" are weak and inefficient. But, within the framework of human behavior, "nonviolent resistance" is a passive strategy and was proven to be very effective by Mohandas Gandhi; Martin Luther King… Game theory exposes that passive strategies are often an excellent option. And architecture has demonstrated over millennia the power of passive strategies.

"Passive strategies define the architecture of the building and vice-versa."

The way we dress is also a "Passive Strategy". The clothes we wear play with the environment for our benefit. Although it is not always about comfort, there is a good reason to wear wool, long sleeved clothing in winter and cotton, short sleeved clothing in summer. Truly, there is a

		Player 2 – The Building	
		Passive Strategy	Aggressive Strategy
Player 1 Mother Nature	Passive Strategy	Win – Win Considering the building well designed.	Lose – "Win" Considering the active solutions well defined.
	Aggressive strategy	"Win" – Win Player 2 conditions for not losing are met	"Lose" – "Win" Victory if Player 2 not damaged and useful
		"Win" – Lose Player 2 conditions for not losing are not met	"Lose" – Lose Nature overpass Active Solutions (Typical example: Katrina, Sandy…)

Table 1 – 10,000 foot view of the Game (result for 1st player written first)

"Passive Strategy" for Player 1 means that the natural conditions meet the winning conditions of player 2
"Aggressive Strategy" for Player 2 means to turn on the "Active Solutions"
("Win" means that the action of the other player has no impact or a positive one on the player's situation. Quote are added when the player might badly impact its own situation)
("Lose" means that the action of the other player badly impacts the player's situation. Quote are added when the player might badly impact its own situation.)
(In both cases, no assumption if impacts are final; irreversible or temporary. As the game is continuously played, the situation is continuously re-evaluated. To be noted that transitions are not noted here)

strong analogy between couture and architecture. In both realms, "Passive Strategies" should be defined accordingly to the same criteria (the activity (couture) = building usage (architecture); the season (couture) = climate (building); the body (couture) = building masses (architecture) …). The optimization of "Passive Strategies" is a complex task that must consider the building as a whole, and be initiated at the earliest phase of the building life-cycle, as specified in Integrated Project Delivery (IPD).

Passive strategies define the architecture of the building and vice-versa.

PASSIVE STRATEGIES OR ACTIVE SOLUTIONS?

Two centuries of inexpensive energies have deeply transformed the construction industry. Except for state of the art codes and regulations, today's business-as-usual gives the responsibility of IEQ to engineers. And while architects are convinced that engineers prevent them from expressing their art, engineers are convinced that architects do not know how to design buildings!

Underlying this confrontation between architects and engineers is the challenge of designing and operating a building well. Everything starts with the fundamental question: "Passive Strategies" or "Active Solutions" .

Game theory can be used to settle this question. The first player has to be Mother Nature. The other player is the Building to be designed or operated. They continuously play a game together, choosing at each instance if they will go for the passive strategy (i.e. strategy based on playing with the other player) or the aggressive one (i.e. strategy based on playing against the other player). The game ends when Human Beings cannot live anymore locally or globally with Player 1 - Mother Nature - or when they have no more interest in Player 2 - the Building. Because, the aggressive strategy for the Building is to turn

"Game theory exposes that passive strategies are often an excellent option. And architecture has demonstrated over millennia the power of passive strategies."

on its "Active Solutions", the question "Passive Strategies" or "Active Solutions" can be settled by looking for the tactic that keeps the game running as long as possible.

Obviously, Mother Nature plays her own game with little interest for anyone else. Some moves are not predictable, but many are predictable (gravity, sun path …). The climate for instance gives also significant insights. During the design phase, studying climate variations is the way to know when Mother Nature is more likely to provide a natural environment that meets the winning conditions of player 2 – the Building (i.e. plays the passive strategy)

The model described above is a simplified version of the one that would be used to fully design or operate a building. Nevertheless, its formulation exposes key results. Over the four combinations (see Table 1), only the "Passive Strategy"-"Passive Strategy" is a clear Win-Win. It's obviously the combination everyone would like to always experience. And yet, many buildings turn on their active solutions although the outdoor conditions are perfect. That's the combination of "Passive Strategy"-"Aggressive Strategy". There is no logic to playing this game. The economy, the environment and humanity are in a clear Lose-"Win" situation. This is not a sustainable situation and as long as human beings belong to Mother Nature, it is unacceptable.

The two other possible combinations in our model are when Mother Nature plays an "Aggressive Strategy". This is not only when severe weather or earthquakes destroy buildings, but simply the variability of nature that denies light for working at night. It can also be during a beautiful summer day when solar intensity causes overheating or sunburn and the building has to provide a safe haven. For this last case, the design of the correct window-to-wall ratio or the introduction of an automated solar shading device can address natures challenge. The first solution is a static passive strategy, while the second one is a dynamic passive strategy. This demonstrates that the combination "Aggressive Strategy"-"Passive Strategy" can be a "Win"-Win situation. But it can also be a "Win"-Lose situation as with the night example. Indeed, with today's knowledge, there's no passive strategy able to illuminate a working space with 500 lux during dark nights. However, an artificial light can. This "Aggressive Strategy"-"Aggressive Strategy" combination is a "Lose"-"Win" situation. Yet, even active solutions have limits. And there is little need to mention some extreme cases such as Hurricane Katrina or Sandy to recognize a "Lose"-Lose situation for the "Aggressive Strategy"-"Aggressive Strategy".

CONCLUSION

Business as usual is notoriously unsustainable. Technology is often seen as the solution, but the roots of the problem are beyond technology. The wrong approach to architecture is the design of buildings that fight the natural environment rather than embracing the natural and free energies available at their location. As illustrated with a simple model in Game Theory, the recipe for true Green Buildings is actually quite simple:

"Many buildings turn on their active solutions although the outdoor conditions are perfect."

1. Recycle. This is a pre-requisite for a true cradle to cradle economy, ensuring true green buildings.
2. Optimize the architecture with all Passive Strategies for the building to stay in the Win-Win situation as long as possible. When the building can no longer operate with passive strategies alone, it must have the lowest

"Too many codes and regulations are still preventing stakeholders from designing and operating buildings in harmony with the natural environment."

negative impact on both the occupants and Nature.

3. Enhance the natural energies and elements with minimalist active solutions when passive strategies are not efficient enough (this is the Mixed-Mode solution, a restrained version of a full "aggressive strategy")
4. Introduce the most efficient active solutions when mixed-mode is still not efficient enough.
5. Power the building with on-site generated renewable energies (= apply the rules defined for buildings to energy supply)
6. Power the building from the grid.

Unfortunately too many codes and regulations are still preventing stakeholders from designing and operating buildings in harmony with the natural environment. Since this means that each and every building is a special case, it may appear incompatible with the constraint that codes and regulations have to be generic. But modern codes do recognize the specificities of each building and climate and address the issue to some extent by asking for an hourly whole building simulation. The more advanced standards go one step further by assessing the quality of the building design thanks to an hourly whole building simulation where active solutions are set at 100% efficiency.

Achieving sustainability in the building industry requires the stakeholders to pay more attention to the building enclosure. Indeed, the building skin is the interface between the building and the building's natural environment. As such, its design is a key factor of success. At least ten performance goals are critical: (1)Access to the natural environment; 2) Daylighting; 3)Natural ventilation; 4)Heat loss/heat gain control; 5) solar control; 6) load balancing; 7) passive and active solar; 8) water; 3) enclosure life and 10) System integration) and twelve layers that have to be considered in a multi-dimensional space (one per degree of freedom of each sub-component + time).

The design and operation of a genuine green building engages the right collection of static, operable and dynamic passive strategies, diminishing the active (aggressive) solutions to a bare minimum. ■

"Achieving sustainability in the building industry requires the stakeholders to pay more attention to the building enclosure."

Serge Neuman *is currently working in the private sector and develops solutions for buildings to be genuinely green. He lectures on sustainability and green building strategies; has been an active independent expert for the European Commission since the FP 6 and is a member of several advisory boards worldwide.*

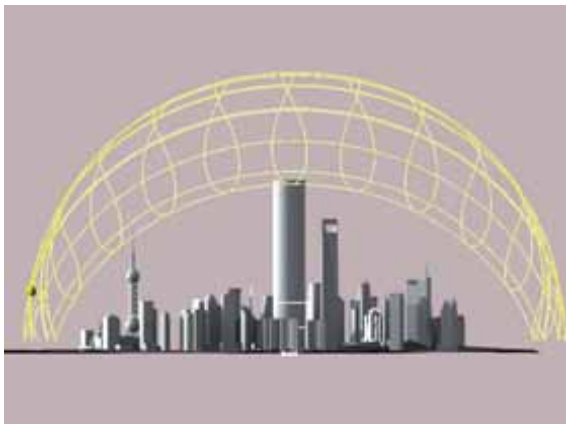
Vivian Loftness *is a University Professor and former Head of the School of Architecture at Carnegie Mellon University. She is an internationally renowned researcher, author and educator with over thirty years of focus on environmental design and sustainability. She is a registered architect and a Fellow of the American Institute of Architects.*

The ***School of Architecture at Carnegie Mellon University*** *has had a unique focus on sustainable urbanism since its inception in 1905 and is committed to exploring creative, integrated solutions to improve the quality of life in cities and the sustainability of the places we inhabit. The School of Architecture's innovative pedagogy introduces integrated project delivery methods and democratic decision-making processes, while simultaneously developing critical thinking skills to prepare the next generation of architects and urban designers.*

GREEN BUILDING DESIGN
STRATEGIES AND SOLUTIONS

The Sun continuously provides the Earth with 174 petawatts (174,000,000,000,000,000 W) of solar energy. That's one year of world electricity consumption each seven minutes!

To exploit solar energy, there are more options than photovoltaic and thermal solar panels. For millennia, architects have developed strategies to manage natural energies and elements in their natural states. These strategies are static (i.e. fixed); movable (i.e. operate by humans) or dynamic (i.e. automated). They are called passive strategies.



TRUE GREEN BUILDINGS ARE DESIGNED UPON PASSIVE STRATEGIES.

There's no greener energy than the one that is never to be generated! Therefore, the two greenest building design strategies are Recycling and Passive Strategies. By applying the right combination of passive strategies at the earliest stage of the design, architects and engineers reduce the energy requirements of the building down to its lowest level. HVAC and lighting can be "rightsized". Consequently, operating costs and possibly first cost are decreased. Moreover, due to the very nature of passive strategies, biophilia is enhanced.

The essence of bioclimatic architecture is to define the optimal combination of passive strategies for the building. Applying the latest technologies, SOMFY For Bioclimatic Facades is continuously revisiting the passive strategies to enhance their potentials. Today, not only can occupants control them for more comfort, but the building itself can control them to reduce its energy consumption without jeopardizing its Interior Environmental Quality (IEQ).

Green Buildings; Mitigation and Sustainability: Motivations & Opportunities are there. But the Resilience in the building sector has still to be broken.

Too many codes and regulations; too many stakeholders define buildings as constructions of compartmented closed volumes where optimal environmental conditions are maintained by several active systems defined and working independently. This 150 year old paradigm emerged during another era. Active solutions were to have access to unlimited resources to generate artificial environments. But the Earth is a finite world. So to save the paradigm, active solutions are requested to always do more with less! Inconveniently, it just postpones the conclusion.

Between business and CSR, SOMFY has dedicated experts to break the resilience "business as usual" has to turn green. Their mission is to promote green buildings; to inspire stakeholders with best practices in codes & regulations and state-of-the-art tools & processes. They assert: *a building is a unique construction that works as a whole in an outdoor environment full of free and natural energies and elements it can play with for the benefits of humans.* Do not hesitate to contact them. ■

SOMFY is the worldwide leader of its market. All over the world, its collaborators participate to define the best passive strategies for each project. SOMFY's researchers and engineers work to develop and manufacture always more efficient solutions to apply the dynamic passive strategies. They all work so people can live and work in healthy, safe, comfortable, attractive, economical, energy efficient and environmentally friendly places.

Website: www.somfy-architecture.com
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SUSTAINABLE RECONSTRUCTION IN **SENDAI, JAPAN**



By **Emiko Okuyama**, Mayor, City of Sendai, Japan

The City of Sendai in North Eastern Japan has embraced sustainable, low carbon development after the disastrous earthquake of March, 2011 and is becoming a disaster-resistant and environmentally friendly example of a sustainable city.

Sendai City is located in the Tohoku region of Japan. With the Pacific Ocean to the east, the Ou Mountains to the west, and the clean Hirosegawa River that runs through the city centre, Sendai is a city endowed with abundant natural bounty from the mountains and ocean. The main streets of downtown Sendai are lined with giant Zelkova trees, part of the beautiful natural environment the city has protected and nurtured with the help of its citizens. Roughly 60 per cent of Sendai's total land area of 786 sq km is forested, and downtown Sendai also abounds with roadside trees and parks, for which we are proud to be known as the City of Trees.

Sendai is the largest city in the Tohoku region with a population of 1.06 million, and the 11th largest city of over 1,740 cities, towns and villages in Japan. Conveniently located about 350 km north of Tokyo, or one hour and 30 minutes by bullet train, Sendai is also the economic centre of the Tohoku region.

Hirosegawa River, Sendai, 2005



DAMAGE AND RECOVERY

Sendai City was hit by the unprecedented Great East Japan Earthquake on 11 March 2011. The magnitude 9.0 earthquake and huge tsunami caused catastrophic damage in the coastal areas. In Japan, 15,000 lives were lost, and over 800 in Sendai. Many

Damage of Tsunami in Sendai



more citizens lost precious family members, homes and property. Sendai suffered an estimated 1.3 trillion yen (US$13 billion) in damage. However, the city had comparatively recently experienced the magnitude 7.4 1978 Miyagi earthquake, so for about 30 years we had been preparing for the next large earthquake through measures such as enhancing the earthquake-resistance of buildings. Earthquake damage to buildings in downtown Sendai was not as serious in the Great East Japan Earthquake as it might have been without these measures.

In regard to our recovery efforts, I would like to express again my gratitude for the support we received from all over the world. Buoyed up by this, the people of Sendai supported each other, somehow got back on their feet after this harrowing experience and are working together towards reconstruction. One of the famous supporters was the British singer Katherine Jenkins, who visited disaster-affected elementary schools in Sendai and encouraged the children with songs.

The earthquake and tsunami generated about 1.35 million tonnes of debris – four times the amount of waste Sendai generates in a year. By sorting waste at collection and temporary storage stages, we are able to dispose of and recycle waste quickly, and plan to have all waste disposed of within 2013. The development of relocation areas for citizens who lost homes in the disaster has been steadily progressing, and we are striving to make this area a new model for city planning by reducing the burden on the environment, improving disaster-resistance and energy efficiency, and incorporating ICT in the urban infrastructure.

COEXISTENCE WITH NATURE

Based on what we learned from the disaster, Sendai City embarked on vigorous efforts to become a sustainable, disaster-resistant city that coexists with nature. Sendai City's environmental protection and creation policies are based on the 'City of Trees Environmental Plan', designed to pass on the gifts of the forest to future generations. The City of Trees Environmental Plan 2011-2020 had been under review from 2009 to 2010 and was approved by the City Council directly after the disaster in March 2011.

While recognising global issues such as climate change and biodiversity, this plan combines the natural resources of Sendai City with its human, material, and economic resources in an effective and efficient way. We think it is important to create a dynamic city full of nature where future citizens can enjoy a high quality of life, and aim to create a sustainable city that integrates environment, society and business through the cooperation of citizens, businesses and government.

We feared that the earthquake might cause unavoidable interruptions or changes in the plan's goals, but we found that our environmental priorities had not changed after the disaster, and we have been able to coordinate implementation of the plan with the Sendai City Earthquake Disaster Reconstruction Plan as an ideal for reconstruction.

THE DISASTER RECONSTRUCTION PLAN

The Sendai City Earthquake Disaster Reconstruction Plan has the aim of creating a new level of environmentally-friendly and disaster-resistant city. The earthquake triggered multiple disasters over a wide area, including a tsunami of a scale that occurs only once every 1,000 years, and a nuclear disaster. We are left with many problems, but the tenacity and community ties we have cultivated and the power of the citizens to help themselves and each other have clearly been a great strength for us in overcoming these difficulties.

By mobilising the valuable experience and wisdom that supported each of our one million citizens in extreme circumstances, we can manage the emerging problems, adapting to the situation rather than inflexibly continuing as before. Resolving to 'move forward as one', we formulated the Sendai City Earthquake Disaster Reconstruction Plan in November 2011 and decided on a direction for Sendai's recovery, with 2015 as the target year.

When city infrastructure was disrupted by the earthquake, the experience of being unable to carry out the everyday activities we had taken for granted alerted us to the vulnerability of the city in the face of nature. Accordingly, in the Disaster Reconstruction Plan, we promote the construction of multiple defences aimed at disaster risk reduction and initiatives aimed at the development of new energy and environmental policies. With the fundamental ideal of a new level of disaster-resistant, environmentally-friendly city, we are promoting broad-based citizen power to bring about Sendai's recovery.

FUSING RECOVERY WITH LOW CARBON DEVELOPMENT

Naturally we are working hard to rebuild the lives of disaster victims, reclaim agricultural land damaged by the tsunami, and support the recovery of local businesses. But beyond restoring things that were lost, we are taking this opportunity to rebuild the city as more flexible and tenacious in four areas:

- Complex damage and issues
- Warnings about energy supply
- Encouraging self-help, independence and ties, and cooperation
- Starting reconstruction of the Tohoku region.

In the Reconstruction Plan, we have reconsidered energy sources from the point of view of securing

Figure 1.



energy in times of emergency and tackle the problem of creating a city, lifestyle and business style that will reduce the city's load on the environment by conserving electricity, reducing waste and promoting recycling. Our initiatives addressing these problems are in alignment with the policy set forth in the City of Trees Environmental Plan.

Thus, our city's recovery combines the sustainable, low-carbon city development stated in the City of Trees Environmental Plan and the disaster-resistant, safe city development aimed for in the Sendai City Earthquake Disaster Reconstruction Plan, as we resolutely aim to achieve a new level of resistance to disaster and environmental friendliness.

Sendai City is promoting ten flagship projects that bring to fruition the fundamental ideal of the Sendai City Earthquake Disaster Reconstruction Plan and provide traction for the recovery effort. Listed below are some of the projects that have an especially deep connection to the low-carbon city development aimed for in the City of Trees Environmental Plan, and the sustainable city development that is the theme of this article.

THE SENDAI MODEL DEVELOPMENT PROJECT

Sendai, as a city that has experienced an unprecedented disaster, can apply the lessons we have learned to the construction of a 'Sendai Model' for disaster prevention, and to share the results with the rest of Japan and the world. Some elements of the project are described below.

Emergency solar power. We are preparing 10kW-output solar power generators and

20kWh-capacity storage batteries at 200 places in the city, including designated refuge areas (schools etc.) and public facilities such as the City Hall. Besides cutting peak energy use, shifting energy use off peak, and reducing CO_2 emissions under normal circumstances, this system also supplies 24-hour sustainable energy in times of emergency. This unit also has a scalability not found in previous general-use renewable energy generation equipment, including a 'mobile battery' capability of receiving power from electric cars and easy-to-use attachments such as small wind power systems and portable power supplies.

Disaster prevention training. In order to raise the ability of our citizens to respond to disasters autonomously, we will cultivate Local Disaster Prevention Leaders who will become nuclei of community-based support.

These initiatives are still works in progress, but it is worth sharing the Sendai Model, not only with the rest of Japan but also with the cities of the world, with the hope that it will be useful as they construct their own disaster prevention and environmental plans and systems (www.city.sendai.jp).

ENERGY SAVING AND NEW ENERGY PROJECTS

In addition to safety in a disaster, we are striving for high energy efficiency in areas newly developed during reconstruction, by cooperating with private capital to avoid excessive dependence on any one type of energy. Three representative samples of these initiatives follow:

Optimising the energy portfolio. The aim is to include renewable energy and natural gas instead of relying only on conventional sources. The city is promoting initiatives that allow for both high energy efficiency and cost-effectiveness, not only in times of emergency, but every day.

Smart metering. Using ICT to track the energy consumption of each household provides information to encourage energy flexibility between households and energy conservation at the stage of housing reconstruction.

Next-generation energy R&D. We are promoting the creation of a next-generation energy R&D centre in the eastern coastal area of Sendai that was damaged by the tsunami. We aim to secure multiple energy sources, attract large-scale solar energy generation (mega solar) projects, and support the development of algal biomass research in cooperation with the local Tohoku University, research institutions and private enterprises.

THE NEXT STEPS

We, as a city of one million that experienced a magnitude 9.0 earthquake and tsunami unprecedented in the world, are steadily moving forward in our recovery plan with these projects as its pillars, aiming to elevate our city's disaster-response capability by focusing on what citizens can do in their communities.

At present, we are still in the middle of the process, and are pouring all our strength into recovery through the cooperation of our citizens, administration and private enterprises. We expect to see the results in the near future, but have already been recognised for our community-based approach to sustainable development when we were honoured to receive the German Sustainability Award 2012.

On 11 March 2013 it was two years since the disaster. During these years we have poured all our strength into Sendai's reconstruction. Citizen power – in other words the reserves of strength shown by each of our citizens, the power to take action independently, and the power of solidarity – is pulling Sendai's recovery along quickly. Our wish is to realise the unique potential of Sendai to become a disaster resistant, environmentally friendly city, and to continue to develop our sustainable City of Trees.

Finally, we hope to repay the warm support and cooperation we have received from the countries of the world by sharing these developments. I am sure there will be more opportunities for Sendai to host international conferences in the years to come, so please take the opportunity to come to see our recovery with your own eyes. ■

***Mayor Okuyama** joined the City of Sendai in 1975. In 1993, she became the director of the Women Planning Section of the Living Environment and Cultural Department, Community Affairs Bureau and continued to promote gender equality since. She became the Deputy Director General of the Community Affairs Bureau in 2003, and the Superintendent of the Sendai City Board of Education in 2005. She was appointed as the Vice Mayor of Sendai in 2007. Mayor Okuyama has served as Sendai's Mayor since August, 2009.*

CREATING SUSTAINABLE INTERIORS

As sustainability and caring for the environment become priorities for those charged with the interior design of domestic dwellings and commercial properties alike, so they are looking to manufacturers to arm them with materials that don't just look the part, but also have a part to play in our future too.

HEART OF STONE

OKITE is a specially engineered surfacing material, created from the perfect combination of three elements: quartz, polyester resin and natural pigments, by SEIEFFE Industrie, an Italian manufacturer which has its headquarters in Montesarchio and is a worldwide leader in the production of engineered stone slabs.

Made from around 93 per cent quartz and 7 per cent polyester resin, OKITE is available in slabs measuring 306cm x 140cm, with thicknesses ranging from 1.3cm, 2cm and 3cm and can be used for horizontal and vertical applications. It can also be customised to fit any project.

STRONG AND DURABLE

OKITE has an absorption rate of 0.022 per cent, with granite being the next closest at 0.2-1.0 pe rcent. Independent testing on its physical, mechanical and environmental properties has found that OKITE's strength and durability are unparalleled. OKITE does not require sealing or polishing, whilst being stronger and more durable that marble or granite, as well as much more resistant to cracking, staining or breaking than any other quarried stones. In fact only three minerals - diamond, sapphire and topaz - are stronger than OKITE.

Unlike marble or granite, OKITE does not require any special care or maintenance. It is resistant to staining, scratching and heat, will not absorb liquids and withstands limited exposure to normal cooking temperatures.

SUSTAINABLE INTERIORS

With routine care, the remarkably low-maintenance OKITE will preserve its looks and beauty for years to come. In addition to the product's proven performance qualities, OKITE fulfils both decorative and specific design needs for commercial, institutional and residential applications.

"Independent testing on its physical, mechanical and environmental properties has found that OKITE's strength and durability are unparalleled."

OKITE's versatility, beauty and outstanding performance qualities make it an extremely desirable and sought after surfacing material for all spectrums of the design industry. Originally conceived as a kitchen worktop, OKITE soon evolved into other interiors applications, such as bathrooms, floorings, and walls. Today, OKITE sets new standards in the world of quartz surfacing, and can meet the needs of the most demanding consumers. A perfect solution for home interiors, but also for contract.

CREATIVE EFFECTS

Available in a wide array of designs, patterns and colours, OKITE enables designers to push the boundaries of what is possible in terms of creativity. The latest design trends can be easily incorporated with this material, from curves for a more rounded look, slimline profiles for a minimalist finish, to built-up edges to create the illusion of a much thicker profile.

OKITE also offers designers the opportunity to make a visual impact in the commercial setting. OKITE's Pietre Preziose, which translates from the Italian as Precious Stones, is a quartz and



OKITE's Pietre Preziose is a quartz and polyester resin surfacing that enables the light to flow through, recreating the warm and sophisticated atmosphere of natural onyx without the staining, fragility and inconsistency often associated with this stone.



OKITE's Bianco Assuluto is a pure white quartz stone solid surface which offers a versatile kitchen worktop solution. Assoluto Bianco is more durable and scratch and stain resistant than natural materials such as granite and marble and doesn't require any special maintenance.



Combining all the beauty of the natural grain of wood with the durability of a composite worktop, OKITE's Effetto Legno Oak work surface Oak is a highly durable, smooth anti-bacterial surface.



With natural materials such as stone being increasingly used in interior design to create a high-end, luxurious finish, the Effetto Roccia worksurface from OKITE has the appearance of the real thing, but with practical and environmental benefits that are far superior.

polyester resin surfacing that allows light to flow through, recreating the warm and sophisticated atmosphere of natural onyx without the staining, fragility and inconsistency often associated with this stone. The result is a translucent surfacing material that creates a stunning, luminous ambience when backlit, perfect for use as a backdrop in public spaces such as hotel reception areas, or for creating a sense of drama in nightclub washrooms.

At the heart of OKITE there is a strong commitment to the planet. Sustainability is at the centre of everything the company does: from quartz derived from sustainable and high-quality resourcing, to the use of recycled glass, to the most efficient use of natural materials, to the manufacturer's sustainable production chain. At every stage of the production and delivery process, the company does all it can to minimise it impact on the planet. ■

For more details call +44 (0) 1992 470801 or visit www.okite.com.

SUSTAINABLE **SANITATION SOLUTIONS** IN BRAZIL



By **Gustavo Fruet**, Mayor of Curitiba, Brazil

Gustavo Fruet, Mayor of Curitiba, Brazil, maps out the general principles involved in planning the city's metropolitan area for the next 30 years, illustrated by the new measures on waste and water management.

Cities have always been on the cutting edge of innovation. Each one has played an important role over the years. Athens, for example, has innovated with the original idea of public space and democracy. Bruges, Venice, Antwerp, Genoa, Amsterdam, London, and Boston began the phenomenon of modern industrialisation. New York, Los Angeles and Silicon Valley are recognised as technology producers and disseminators. And again, reforesting is part of a natural evolution in cities' development.

People occupy the equivalent of 2 per cent of the land surface. They are responsible for 75 per cent of energy consumption and 80 per cent of greenhouse gases. In the world, 40 city-regions account for two-thirds of the global economy. In Brazil, nearly 70 per cent of the population live in urban centres.

Technology and people are the two main determinants of progress towards sustainability. However many technologies are created and developed, human behaviour must still improve to hold up the three pillars of sustainable development: social, economic (creative and green) and environmental.

Thinking in a better and sustainable world does not only depend on new technologies, but mainly on changes in human behaviour. Improving quality of life through protection of the environment should be taken as seriously by public service officers as issues like public security, health and education.

"Improving quality of life through protection of the environment should be taken as seriously as issues like public security, health and education."





CURITIBA'S WATER AND WASTE PLANS

Over the years, Curitiba has consolidated its reputation as a green city. The parks, plazas, and boulevards have been attracting visitors from all around the world. People from Curitiba are very proud of its rich natural diversity.

Fast population growth, however, exerts many pressures on planning a city, and management of the water supply and controlling waste are two of the most immediate. Effective measures must be taken to avoid the huge negative impact that can result from increasing numbers in an urban area.

Curitiba's planners have identified water and waste as needing critical attention, to some extent because different aspects are handled by different government departments. The new post of Environmental Sanitation Secretary should help to maintain a balance among the environment, companies and people. The idea is based on the National Sanitation Law, which states that issues such as solid waste cleaning and management, drainage and use of urban rainwater, sewage and water supply should be controlled by the same organisation.

Integrated planning facilitates funding, even from the federal and state governments which have funding lines in all these areas. The new administrative structure would connect the departments of Public Hygiene, Sanitation and Water Resources (today under the Environment Secretary), the department of Bridges and Drainage from the Construction Secretary, and also the department from the Health Secretary responsible for measuring drinking water quality. To preserve the rivers' water quality, a

"Fast population growth exerts many pressures on planning a city."

partnership must be carefully planned between citizens and City Hall to regulate the network connections between homes and the sewage treatment by the Paraná water and waste management company Sanepar.

One suggestion would be that the city hall would be responsible for the material, and the citizens for the workmanship. This programme should benefit families earning up to three minimum wages. Nowadays there is no public policy of incentives to enforce regulation; only fines are applied.

"The management of garbage must involve the whole of society."

EDUCATION FOR WASTE MANAGEMENT

Besides the public administration, the management of garbage must involve the whole of society – not just through proposals and debates, but with effective action.

The garbage which goes to the two landfills in Curitiba nowadays does not go through any kind

of selection. This means that, if the population does not separate recyclables from general waste at home, everything goes into a common grave.

Curitiba, which was an early international leader in garbage separation, is now in need of an inspiring campaign to motivate people to continue separating household waste. In 1989, under Jaime Lerner's administration, the 'Family Leaves' programme was launched into the homes in Curitiba; it was one of the largest advertising campaigns ever seen in our city. However, since then enthusiasm for garbage separation has flagged. The latest initiative happened in 2006.

Today Curitiba recycles about 20 per cent of all waste produced in the city. It is among the best rates in Brazil, but still far below the standards of the first world, which is over 30 per cent.

PARTNERSHIP

In a modern administration, environmental issues permeate planning decisions in all sectors of local government, with the purpose that every programme has its environmental viability analysed before action. It is essential that the planning system integrates all officers and administrators from the towns which form Greater Curitiba.

"In a modern administration, environmental issues permeate planning decisions in all sectors of local government."

From the point of view of the sanitation issue – which deals with matters related to public water supply, sewage, solid waste, and drainage – Curitiba's influence area is the Iguaçu River Basin and the Upper Ribeira. From the point of view of political institutions, the influence area is the Metropolitan Region of Curitiba.

In this perspective, Curitiba is not able to solve its problems alone. The city must build a partnership with all other towns around it in order to succeed. Rivers do not begin and end in Curitiba. The waste which goes into landfills is not only produced in Curitiba. The air we breathe is not only filtered by the trees from Curitiba. Pollution is not only produced by vehicles and companies from Curitiba. Therefore, respect, partnership and the spirit of collaboration among the mayors of all cities are essential in order to reach significant improvements in the quality of life for more than 3.3 million people who live in the whole area. ■

"The city must build a partnership with all other towns around it in order to succeed."

Gustavo Bonato Fruet *was born in Curitiba in 1963 and assumed his first public office in 1996 when he was elected to the council of Curitiba. Two years later, he was elected congressman, and in 2002 he was elected congressman for a second term. In 2006, he was re-elected with 210,674 votes, the highest tally of votes for a congressman in Paraná. In October 2012, he was elected Mayor of Curitiba to serve a term from 2013 to 2016. Mr Fruet's policies in his first months in office include the creation of a commission to plan for the future of the city's waste management system, with the vision of transforming Curitiba from an ecological capital into a centre for sustainable development. New initiatives include improvements in the areas of solid waste management, sewage and waste water treatment.*

Curitiba has been described as Brazil's green capital and is regarded by many as one of the world's best examples of green urban planning. In 2007 Curitiba came third on the list of the 15 Green Cities in the World according to the American magazine Grist, and the city has succeeded in introducing a Green Exchange employment programme for the benefit of the environment and socially deprived groups. Curitiba has set new standards of sustainable urban planning and demonstrated the city's contribution to the global agenda by holding an international summit in 2007 on urban planning and biodiversity for civic leaders from all over the world.

STRENGTHENING **URBAN WATER SYSTEMS** IN DEVELOPING COUNTRIES



By **Jeff Smith** for the International Water Management Institute (IWMI)

As future water supplies become increasingly threatened by climate change – characterised by increased flooding in some areas and drought in others – it will be even more critical for cities in developing countries to manage water efficiently and safely. In this article the author describes the work of the URAdapt project in Accra and Addis Ababa.

When city water doesn't flow, lower-income Ghanaians in the capital of Accra trudge along neighborhood streets and paths, carrying empty yellow palm oil containers and other vessels to fill with water. They stand in long lines at makeshift depots such as locations with water storage tanks.

When heavy rains cause flooding, there is a different challenge: water often overwhelms the storm and sewage systems. Flooding can inundate areas, damaging homes and shanties, increasing the prevalence of contaminated water and mosquitoes, and heightening the risk of cholera outbreaks.

About 40 per cent of Africa's 1 billion people now live in urban areas, according to the United Nations, and 60 per cent of those live in slums. In many cities across Africa, water and waste water management infrastructure lags far behind an increasing demand caused by a bulging population. The poor especially are vulnerable.

"A key element of URAdapt was its participatory process."

THE URADAPT PROJECT

International Water Management Institute (IWMI), a CGIAR Consortium centre based in Colombo, Sri Lanka, recently worked for nearly three years in Accra and Addis Ababa, Ethiopia, to develop adaptation strategies through a project called URAdapt. The programme was supported by Climate Change Adaptation in Africa, and jointly funded by the International Development Research Center (IDRC) of Canada and the United Kingdom's Department for International Development (DFID).

"It's about making African cities more resilient to climate change impacts," said Liqa Raschid, IWMI

A young girl crosses a polluted stream in the low-income neighborhood of Gbegbeyise in Accra, Ghana.



© Edmund Akoto-Danso, IWMI Ghana

Water and sanitation capacity already lag far behind demand in Africa. With climate change, human and livestock health are at even greater risk.



© Edmund Akoto-Danso, IWMI Ghana

senior consultant researcher. "Climate change aggravates the existing situation, particularly in cities where the water system is uncertain and the sanitation system is poorly managed. This exacerbates an already serious situation."

"Local universities helped run regional climate models to analyse historic climate data, and downscale the results to city and basin level."

After all, properly managed and treated water is central to the well-being of any city – critical to food security, good health and a vibrant market economy. Accra and Addis Ababa are typical African cities selected for their different geographic characteristics, Raschid said. In the case of Accra, water comes from two basins and its waste water is discharged untreated into the ocean, which is used for swimming, fishing and to attract tourism. Only a small amount of fresh water is used downstream for agriculture. Addis, meanwhile, is landlocked. Water is discharged with little treatment into the Akaki River, and ends up downstream where vegetables are grown and livestock is raised. The quality of the Akaki River has deteriorated over the past four decades and the trend is likely to continue, given the lack of planning and enforcement of pollution control regulations.

Raschid points out that the two cities have distinct problems pertaining to water resource management, so impacts and adaptation measures are different. "Governments really haven't paid attention to what happens to cities in relation to climate change, especially to poor urban dwellers living in low-lying areas."

PARTICIPATION BY STAKEHOLDERS

A key element of URAdapt was its participatory process to come up with solutions. Government officials, university researchers, sanitation managers, private industry groups and non-governmental organisations (NGOs) worked together to identify the most pertinent research issues, gather data and develop an urban water-management plan. Such buy-in also is necessary when trying to persuade governments to invest in water-management improvements.

"For identifying suitable adaptation options, participation of vulnerable groups is critical. In theory, this is possible to set up," Raschid said. "But in practice, they aren't organised so one is not always successful in including the marginalised and women." In Ghana, for example, the poor were represented by the People's Dialogue, an NGO that works in city slums.

SCALING DOWN THE MODELS

A second critical aspect to the project was to scale down global climate change models to the city level and the area basins. The models forecast how temperatures and rainfall are likely to change in the future. Raschid believes that it is something quite new to look at city-level changes. Researchers also conducted

If water resources were managed more efficiently, Addis Ababa in Ethiopa could be far more resilient to climate change



"Accra should distribute more water from the more plentiful Volta River system than the water-stressed Densu basin."

hydrological and urban water allocation modelling, and socio-economic studies of vulnerable communities.

For both Accra and Addis, local universities helped run regional climate models to analyse historic climate data, and downscale the results to city and basin level. For example, in Accra, the results were downscaled to 10 km by 10 km grids to simulate likely scenarios for the Densu River Basin, which supplies water to large portions of eastern Accra.

The most likely scenario predicted an increase in average temperatures of between 0.5 and 0.8°C by 2050, more erratic and extreme rainfall, and a tripling of drought events. The Densu basin is already considered 'water-stressed'.

In Ethiopia, urban flooding is occurring more frequently. Climate downscaling predicted a 37 per cent increase in extreme rainfall and floods by the 2030s, with larger impacts in the Addis area because of its crowded population of around 3 million. The models predict a 13 per cent increase in the annual flow volume of the Akaki River basin by the 2030s.

DRIVERS OF CHANGE

The project in essence examined climatic and non-climatic drivers in efforts to predict how both of these might play out. What does climate change mean to water availability and quality? How will it impact storm water runoff? Will there be more flooding? When it comes to a city's water cycle, all sorts of factors come into play, Raschid said: water supply, sanitation, the quality of water downstream, the possibilities of droughts or flash floods.

The project mapped out hotspots which have poor water supply and sanitation services, compounded by urban flooding. URAdapt studied in detail one of the hotspots in Accra – the poor, low-lying community of Gbegbeyise where flooding is a common issue. Researchers sampled stream water, soil and drinking water, and found that water contamination rose after flooding with increased readings of fecal coliforms, indicative of fecal pollution. In addition increased levels of Vibrio cholerae – which can potentially cause cholera – were found in drinking water sources.

"Sewage treatment already lags miles behind need in Addis."

"Climate change may aggravate already serious health risks in communities like Gbegbeyise," said Philip Amoah, an IWMI senior regional researcher based in Accra. The climate scenarios suggest that Accra needs to prepare for increased floods and droughts. Recommendations included redesigning drains to accommodate increased storm flows, additional upstream retention ponds, regular maintenance of existing drains and water collection systems, and more waste management in flood-prone areas. Accra also should distribute more water from the more plentiful Volta River system than the water-stressed Densu basin, and promote rainwater harvesting.

The national water utility – the Ghana Water Company – carries a lot of decision-making influence over Accra. Basin authorities exist, but without much power, according to Raschid. Overall, the system to manage water in basins and

between urban and rural needs is shaky, and the water isn't being used optimally, she said.

Some of the recommendations are similar for Addis: build retention ponds upstream to reduce flooding, expand city storm drains, promote water efficiency. URAdapt also recommended decentralising water treatment, monitoring water quality at key places on the river, introducing a tiered water tariff that encourages conservation, and installing an early flood warning system.

Sewage treatment already lags miles behind need in Addis, and farmers downstream rely on irrigation water which is heavily polluted. If changes are not made, treatment and drainage facilities could flood, leading to further water contamination, public health risks and an increase in sickness and death of cattle.

GOVERNMENT SUPPORT

IWMI researchers found that institutional change requires support from the superiors of the government officials and industry players involved in the project. Raschid said governments have to be persuaded about the importance of science to change public policy.

"Better regional planning also needs to occur, as well as support from the national government"

URAdapt's recommendations were endorsed by a national climate change committee in Accra and by the Water and Energy Ministry in Addis. But the strategic agenda for adaptation still needs follow-up action and funding and support from the highest levels of the government.

"For water supply, you have to work with the city of Accra," Raschid said, "but lots of decisions took place outside the city. Water is considered a national good and managed nationally."

In Ethiopia, Addis city authorities have decision-making power and are responsible for supplying

"Addis can become considerably more resilient to climate change even with a growing population."

water to growing towns around it. So URAdapt was able to integrate its research into the ongoing activities of the Addis Ababa Water and Sewerage Authority. But better regional planning also needs to occur, as well as support from the national government.

In Addis, climate change adaptation measures appeared to be ad hoc, with little long-term strategies in place. The research showed that if water resources are managed properly, Addis can become considerably more resilient to climate change even with a growing population, and that the solutions can be applied to other cities in Ethiopia.

URAdapt was designed to support science-based policy change, using a participatory process, and incorporating climate change forecasts downscaled to the city level. Connections were made between urban and rural needs. Ideally, the URAdapt principles can spread to other African cities. But more time and donor support will be needed to influence public policy decisions. The next steps will be critical to move from research into implementation. ■

Jeff Smith has worked as a journalist and media development trainer in Asia, Africa and the United States for the past 25 years. Most recently he has written about energy and its intersection with poverty, biodiversity and development for National Geographic.com. He is based in Colombo, Sri Lanka.

*The **International Water Management Institute** (IWMI) is one of 15 international research centres supported by the network of 60 governments, private foundations and international and regional organisations collectively known as CGIAR. It is a non-profit organisation with a staff of 350 and offices in over 10 countries across Asia and Africa and Headquarters in Colombo, Sri Lanka.*

ACCOUNTING FOR WATER LEAKAGE AND MEASURING PERFORMANCE





By **David Pearson**, Consultant, and **Allan Lambert**, Consultant, International Water Association Fellows Programme

As cities continue to expand and water scarcity intensifies there will be an increasing need to reduce inefficient use of water and minimise leakage. In this article the authors discuss progress in assessing water losses, and offer a comparison of available performance indicators and techniques for monitoring, managing and reducing losses to the minimum possible.

The need to be able to assess, judge and manage leakage within water distribution systems on a consistent and reliable basis is an issue that the International Water Association Water Loss Specialist Group (IWA-WLSG) and its predecessors have addressed since the late 1990s. The Group issues guidance documents on a regular basis and hosts a major international

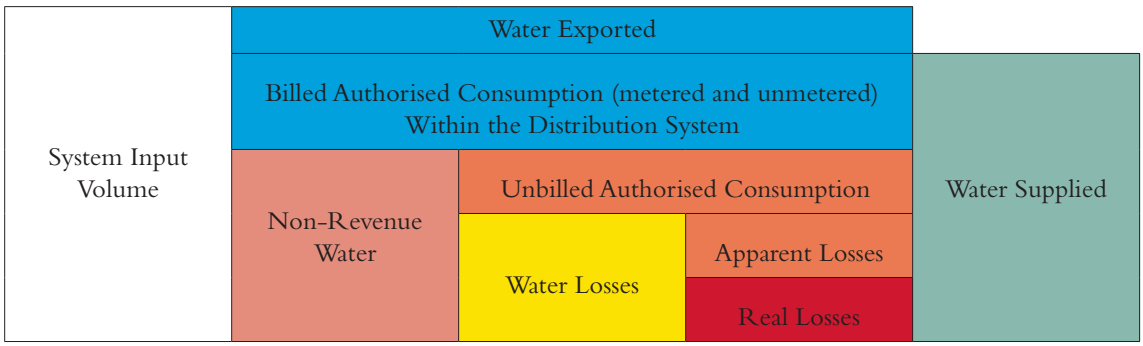


Figure 1: Simplified IWA Standard Water Balance
Source: Lambert, A O, and Hirner, W. 'Losses from Water Supply Systems: Standard Terminology and Recommended Performance Measures', IWA Blue Pages, October 2000.

conference on water loss biennially. These conferences have become important events; the most recent (Manila, 2012) attracted over 500 participants from over 60 countries, and clearly demonstrated that application of IWA-WLSG concepts has achieved and sustained major reductions in leakage in many utilities worldwide.

ASSESSING WATER LOST

Before 2000 there was no international standard calculation for assessing the water lost from distribution systems. Confusion was created by differences in the terminology used, the components of the calculations, and inconsistencies in the methodologies adopted. Figure 1 shows a simplified version of the standard IWA water balance introduced in 2000, which established consistent terminology and definitions to the various components of the assessment. Real losses include all leaks and overflows lost from the distribution system – all the other components of 'water supplied' represent consumption of one type or another.

PERFORMANCE INDICATORS FOR REAL LOSSES

The most appropriate measure to use to judge performance in real losses management depends on the purpose it is to be used for, as discussed in Lambert, A O, 'Water Loss Lost in Translation', Water and Waste Treatment, 2013. The traditional measures shown in Table 1 do not allow for most key attributes of a supply system that influence real losses; so they can be used for monitoring changes in performance within an individual utility (process benchmarking), but not for performance comparisons between utilities (metric benchmarking). The Infrastructure Leakage Index (ILI) is the only technical performance indicator specifically designed for performance comparisons between utilities and allows for all five key factors influencing real losses in Table 1.

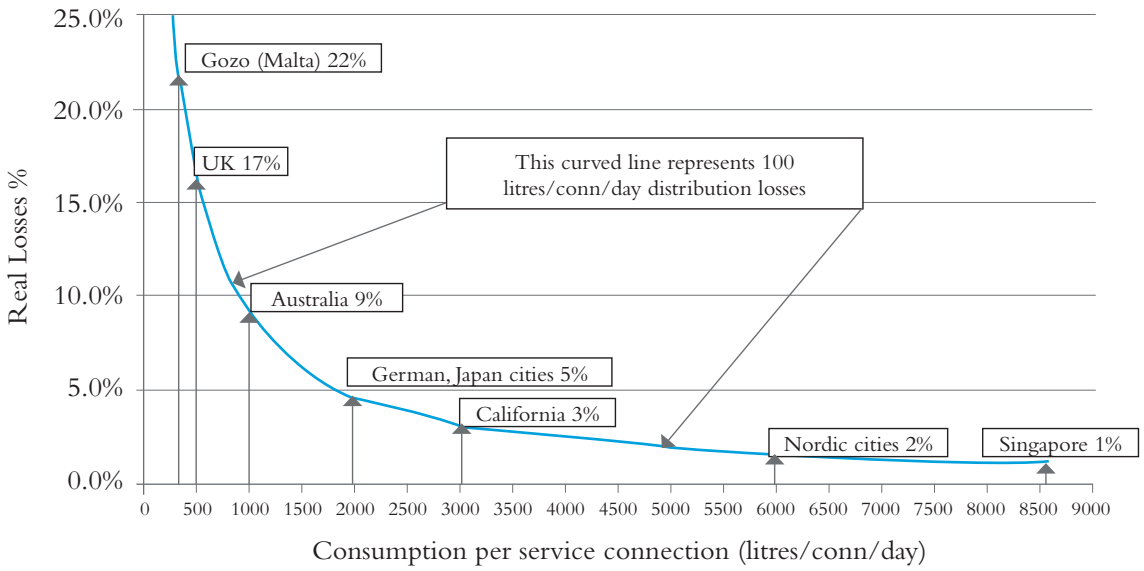
"Before 2000 there was no international standard calculation for assessing the water lost from distribution systems."

The use of percentage of volume into supply is still, unfortunately, often used by the media,

	Performance indicators (PIs) for real losses	Continuity of supply	Length of mains	Number of service connections	Location of customer meters on services	Average operating pressure
Traditional PIs for process benchmarking	% of volume input	No	No	No	No	No
	Litres/property/day	No	No	Only if 1 property/ conn	No	No
	Litres/service connection/day	No	No	Yes	No	No
	m^3/km mains/day	No	Yes	No	No	No
	m^3/km of system/day	No	Yes	Possibly	Yes	No
Metric PI	Infrastructure Leakage Index (ILI)	Yes	Yes	Yes	Yes	Yes

Table 1. Comparison of leakage performance indicators
Source: Lambert, A O, et al., 'A Review of Performance Indicators for Real Losses from Water Supply Systems', AQUA, Dec 1999'.

Figure 2. Real losses (%) as a function of consumption per connection
Source: Allan Lambert



"If consumption per service connection is reduced through water efficiency measures real losses rise in terms of percentage of system input."

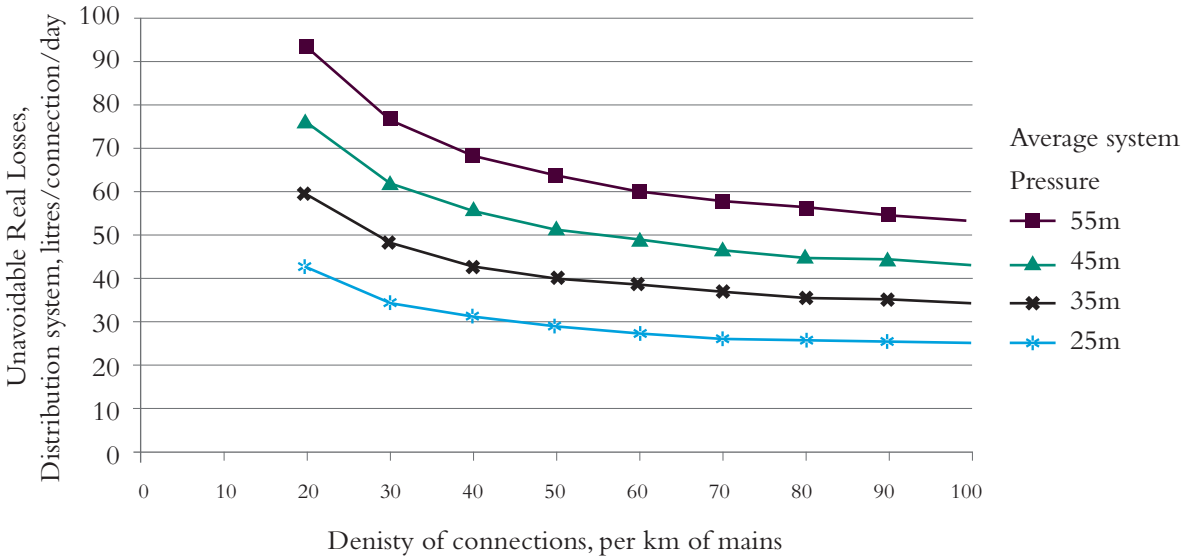
politicians and some technical commentators for metric benchmarking of real losses. The flaws in this can easily be seen from Figure 1 (does the percentage calculation include or exclude water exported?) and Figure 2, where exactly the same leakage management performance (say, 100 litres/service connection/day) can represent anything between 1 per cent and 22 per cent of volume into supply, depending on the consumption per connection. Also, if consumption per service connection is reduced through water efficiency measures such as rainwater harvesting, use of grey water, low flush toilets and shower heads etc., real losses rise in terms of percentage of system input, even though the volume of real losses in litres/connection/day is unchanged. This effect has been noted in some German utilities in recent years.

HOW LOW COULD YOU GO WITH LEAKAGE?

In order to address this issue, the IWA 1st Water Loss Task Force developed the concept of Unavoidable Annual Real Losses (UARL). These are the technical minimum real losses to be expected on any distribution system in good condition, given the mains length, number of service connections, customer meter location and operating pressure. The calculation is based on an auditable component analysis of efficiently managing the frequency and duration of different types of leaks (undetectable, reported, unreported) on different parts of the infrastructure. The ratio of the Current Annual Real Losses (CARL) to the UARL is the Infrastructure Leakage Index (ILI) in Table 1.

In most cities in high income countries with low leakage, component analysis shows that the greatest volume of annual real losses is associated with service connections, rather than mains. Figure 3 shows how UARL (equivalent to an ILI of 1), for distribution leakage in systems with customer meters at the property line, varies with density of service connections (per km of mains) and average pressure. When real losses are expressed in this way (rather than as percentages), UARL is seen to provide reliable predictions of the lowest achievable leakage in technically advanced cities.

Figure 3. Unavoidable annual real losses, customer meters located at property line
Source: Allan Lambert



An ILI close to 1 demonstrates that leakage management at the current operating pressure has reached the best technically achievable standard, allowing for the local system infrastructure characteristics and pressure. An ILI of 2 would imply that leakage was twice as high as the technical minimum. Both of these conclusions relate to the current operating pressure, as unnecessary excess pressure increases leak flow rates, new burst frequency, customer leakage, some components of consumption; and reduces infrastructure life.

Since the ILI concept was introduced in 2000, ILIs have been calculated for over 1,000 systems worldwide, as more and more countries have adopted the measure to assess and compare their performance in technical management of real losses. Austria and Germany are two of the latest countries to move to adopt the ILI, and Australia (WSAA) and America (AWWA) publish ILIs for named utilities. ILIs can also be categorised in performance bands (A to D) using a World Bank Institute Banding System which provides a general description of performance, and suggests priorities for activities to reduce leakage.

MANAGING REAL LOSSES

There are a number of ways of managing real losses. Figure 4 shows the four principal ways in diagrammatic form.

Pressure management is by far the most effective and efficient method of controlling leakage. In cities there can be a large number of multi-storey buildings. If pressures are maintained to provide supply to the higher floors of tall structures, then this will cause severe leakage on the distribution network. It is essential that regulations are introduced requiring low level tanks in multi-storey buildings so that system pressures can be minimised.

"ILIs can be categorised in performance bands (A to D) using a World Bank Institute Banding System ."

Good quality data, high data integrity, effective monitoring and clear management procedures are essential to the efficient reduction and management of real losses.

PLUMBING SYSTEMS

The measures described above have been aimed and designed for the distribution system, i.e. that part of the water supply network up to the point where customers take water. In many

places this is a customer meter often located at the edge of the street. In cities with many large blocks of flats the metering arrangement may vary depending on ownership and management of the block and the policy and practice of the utility. There may be a single meter at the edge of street, a bulk meter at the edge of street and sub-meters in each flat or just meters for each flat usually located in the common access area on each floor.

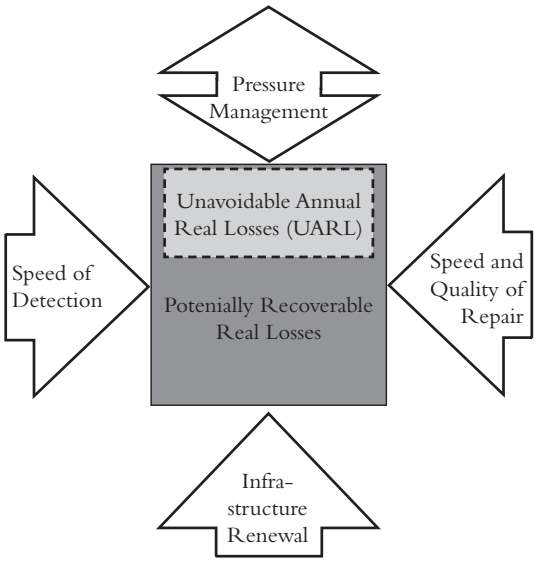
It is essential that the risk of losses or inefficient use within properties is not neglected just because the customer may be on a meter. Smart meters can be used to identify leakage on premises quickly and efficiently. By-laws or regulations exist in many countries for the purpose of controlling waste and misuse of water. Increasingly these measures are starting to drive water efficiency measures on new buildings and major refurbishment projects, supported by policy goals set at government level, for instance the UK government's code for sustainable homes.

"It is essential that the risk of losses or inefficient use within properties is not neglected just because the customer may be on a meter."

CONCLUSION

As cities grow in size, either from indigenous population growth or by migration from rural areas, the reduction of leakage to the lowest technically achievable levels will become increasingly important. It will therefore be essential to design urban systems to operate at low pressures, to meter all properties at locations which minimise leakage, and to ensure that losses are proactively monitored and managed and reduced to the minimum possible, using meaningful metric performance indicators. ■

Figure 4. The four basic methods of managing real losses
Source: David Pearson



__David Pearson__ is a chartered engineer with a BSc in Civil Engineering and a Diploma in Water Engineering. At the beginning of his carrier he worked mainly on water resource studies before moving into distribution operations as Regional Technical Manager for North West Water (now United Utilities). He was a member of the national leakage group and has been the client manager on a number of national research projects. After leaving United Utilities and setting up his own consultancy he has become a key member within the IWA Water Loss Specialist Group and has worked on the economics of leakage control, the pressure management and the apparent losses sub groups.

__Allan Lambert__ has over 50 years of experience in the Water Industry and was appointed to the IWA Fellows program in 2011 'in recognition of his extraordinary achievements'. He is a Fellow of CIWEM and a Past-President of the British Hydrological Society. He contributes to the work of the IWA Water Loss Specialist Group on a wide range of topics, with particular interests in performance indicators, economic intervention for active leakage control, and the many beneficial effects of pressure management. www.leakssuite.com

__International Water Association Fellows Programme__ was instituted in 2010 by the IWA Board of Directors to recognise the professional excellence of its members. The purpose of the programme is to recognise those members who have made a distinguished contribution to the field of water science, technology and management and solicit their help in continuing this work by acting as active ambassadors of the IWA.

SUSTAINABLE **WASTE MANAGEMENT** AND **WASTE-TO-ENERGY TECHNOLOGY**



By **Dr Edmund Fleck**, President, European Suppliers of Waste-to-Energy Technology (ESWET)

On the path to sustainability, a city needs to make well defined and regulated progress in terms of better waste management.

Where can we start? What breakthrough can solve all these challenges at the same time? Waste-to-energy is not the panacea, but it is a concrete technology already making a positive contribution to each one of these challenges in many cities around the world. Put in another way, the absence of a waste-to-energy plant greatly limits how sustainable a city can be.

BETTER WASTE MANAGEMENT

Cities constantly receive materials as goods and products that dwellers consume. Inevitably, the discarded material becomes waste. The waste hierarchy, defined in EU countries by the Waste Framework Directive, is a tool to guide waste management, and its proper application has been the key to success everywhere sustainable waste management exists. By prioritising waste reduction and re-use, the actual amount of waste to handle decreases.

Next, by favouring material recycling, including composting, of typically source-separated waste, the hierarchy ensures that waste can be materially repurposed if there is a demand.

Recyclables are valuable materials perceived as a resource both by informal recyclers who make a living from it, and by the growing number of companies trading them in an increasingly globalised market to satisfy various types of demand. But all the benefits of recycling cannot offset the associated question of what happens to material that is not valuable to any recycler. In every country, some waste will inevitably be left over.

In most countries, waste that is not formally or informally recycled ends up in landfills. With a few encouraging exceptions, this is true as much for the developed as for the emerging countries on every continent.

Is there a better solution than to bury or stack materials in landfills or dumps? How should this residual waste be treated? The last two steps of the hierarchy, which favour energy recovery in

Contrasting methods of waste disposal: a landfill, and a modern waste-to-energy plant





waste-to-energy plants instead of disposing of waste in landfills, are made quite clear in the two contrasting pictures shown in Figure 1.

Both pictures, taken in western Europe, represent the state of the art in both landfilling and waste-to-energy. It is worth keeping in mind that the landfill picture is only a mild representation of what happens in so many other locations under much worse conditions. On the other hand, all waste-to-energy plants built by ESWET members are equipped with the most advanced technology in terms of energy efficiency, material recovery and air quality control systems and can be – as pictured – elegant city landmarks.

PROTECTING AIR QUALITY

Waste-to-energy plants have the reliable technology capable of handling any type of residual non-hazardous waste. This is unlike installations that claim higher thermal treatment efficiencies but need extensive pre-treatment of waste, which usually involves increased energy consumption and adds an extra transport step for the refuse which still requires another solution elsewhere.

Waste-to-energy plants are clean thanks to efficient filters developed to handle the variety of substances found in waste. For instance, waste-to-energy plants are net dioxins sinks, meaning that they destroy and capture virtually all incoming dioxins and the resulting emissions, even in countries with many plants, are a negligible fraction of the national total. In 2011, 1.4 per cent of all dioxins emitted in Germany were from waste-to-energy plants, in comparison with 24 per cent from residential combustion including BBQs (www.umweltbundesamt.de). In cities with high background pollutant concentrations, the air coming from the stack can be cleaner than the air going into the plant. Further reducing emissions from trucking by integrating all waste treatment options within the borders of a city, as in many countries' 'ecopark' installations, brings the maximum advantage for waste management, as each stream is treated optimally.

Overall, managing all of a city's waste within its own borders has the great advantage of raising awareness among the population of what it discards every day. The improved efficiency of combining the sorting of recyclates and the recovery of the residual waste in one complex is also something to be showcased to the citizens, who need to better understand that efforts to improve recycling start with them, and that the waste which requires thermal treatment is handled in a responsible manner – in a visible waste-to-energy plant, not swept under the rug in a distant landfill.

In terms of materials, waste-to-energy plants enable the closing of the loop for some recyclable waste streams. Metals that have been put wrongly into the residual waste bin, or that are inseparable from other material such as plastic or wood, can be extracted from the bottom ash, after thermal treatment. In a landfill, these metals would have been permanently lost. Besides, the mineral fraction of the bottom ash is a re-usable construction material.

AN INTEGRAL PART OF THE ENERGY MIX

Waste-to-energy plants are a useful source of energy production and energy saving. Energy production, because these plants recover much more energy than what they consume to operate, hence acting like power plants. They can achieve very high efficiencies when connected to industrial heat consumers or district heating networks.

Energy saving, because the energy produced from waste offsets the use of fossil fuels whose remaining resources are becoming scarcer. The energy production of even the best operated landfills cannot be compared to the output from a waste-to-energy plant. This explains why trucking waste to distant landfills should be avoided completely. And while waste should ideally be treated in a local waste-to-energy plant, it still makes sense to divert waste from a local landfill to ship it to a waste-to-energy plant even if it is farther.

WASTE – THE LOW-HANGING FRUIT

Climate change and better energy supply are great challenges for cities. They can be partially addressed by the low-hanging fruit of improved waste management. Recycling and waste-to-energy go hand-in-hand for a better climate. For materials for which the most environmentally sound option is not recycling, waste-to-energy plants provide a solution, even better in urban areas where their energy output can be directly used by their neighbours.

Synergies in urban and sub-urban industrial clusters that include waste-to-energy plants provide an affordable, reliable, continuous supply of partially-renewable energy. Industries in many countries rely on waste to power their processes with steam or hot water. In an efficient industrial synergy, the refuse from Quebec City, Canada, powers a neighbouring paper mill. This energy could also be used in locations where seawater desalination is required to preserve fragile freshwater resources. Equally, waste-to-energy plants are well suited to treat the sewage sludge that would otherwise be landfilled.

Another visible contribution of waste-to-energy plants to sustainable energy in cities is seen on consumers' district heating bills: locally-available waste makes an affordable energy source in a city's heating mix. Residents of Copenhagen support waste-to-energy plants as a key component of their district heating system, as it brings down their heating costs. And such networks improve air quality when ridding buildings of individual, less efficient and more polluting solid or liquid fuel heating equipment, whose fossil or renewable combustibles are predictably often supplied by diesel-powered road transport. The example of substituting old boilers by district heating in the city of Changchun, China, shows that such systems can go a long way towards easing air pollution. The

"It is much cheaper to avoid 1 tonne of CO2 emissions through waste-to-energy than through renewable electricity production forms such as photovoltaic panels."

effect is even better if they are combined with waste-to-energy plants whose very efficient filters ensure maximised air quality and climate protection benefits.

Last but not least, the avoidance of landfilling means reduced emissions of methane, a gas that is, in mass, 25 times more potent than CO_2 when it comes to trapping heat, according to the Intergovernmental Panel on Climate IPCC. Besides, when it comes to reducing greenhouse gas emissions through energy generation, it is much cheaper to avoid 1 tonne of CO_2 emissions through waste-to-energy than through renewable electricity production forms such as photovoltaic panels (www.umweltbundesamt.de). Waste-to-energy is also a renewable energy source, in the sense that over 50 per cent of residual waste still consists of carbon-neutral biomass.

When adding up all the elements that make waste-to-energy a very useful tool towards a city's sustainability, it is not difficult to understand that among Mercer's top 10 most liveable cities for 2012, eight of them already have waste-to-energy plants handling their residual waste (www.mercer.com). Will your city join their ranks? ■

Dr Edmund Fleck has been President of ESWET since its foundation in 2004 and represents the association's member companies at the EU level and beyond. He has a background in engineering and has worked throughout his career for various large companies active in the energy and environment fields.

*ESWET is an association grouping the **European Suppliers of Waste-to-Energy Technology** and representing them at the EU level to help fostering the development and dissemination of waste-to-energy technologies. We seek to raise awareness of the positive implications of the technology both for the environment and the production of energy.*

CURING TRAFFIC CONGESTION: THE BENEFITS OF SUSTAINABLE TRANSPORT



By **Holger Dalkmann**, Director, EMBARQ

Urbanisation and the rise of the middle class is coming at a high cost, particularly congestion and its associated effects—increased road fatalities, air pollution, and greenhouse gas emissions. We have a window of opportunity to shift the current trends onto a more sustainable development path, which will not only improve people's lives, but help tackle the impacts of climate change.

The number of vehicles on the road has skyrocketed from 200 million in 1970 to more than 1 billion today, largely due to a growing global middle class. Road infrastructure has kept pace with this increase, and the result in most cities is unbearable congestion. This congestion not only aggravates city dwellers' lives, it also leads to a concerning loss of economic productivity. In Lima, Peru, for example, city residents spend an average of four hours per day commuting, causing a loss in productivity that amounts to roughly 10 per cent of GDP every year. Congestion in 439 U.S. urban areas cost about $85 billion in lost productivity in the year 2000. By 2009, this figure had risen to $115 billion. With 75 per cent of the global population expected to reside in cities by 2050, congestion is poised to worsen as motorisation rapidly increases and cities remain unable to expand the capacity of their road networks.

Cutting back on congestion is not only desirable, it is imperative if cities are to continue acting as global engines of growth. Traffic congestion is a frustration that is quickly spreading throughout the world's cities and impeding transport, a key factor in driving economic growth and enabling access. Sustainable transport systems could not only help alleviate congestion but could provide a suite of benefits that improve overall quality of life in cities across the world.

A HOLISTIC APPROACH

There are existing solutions, globally demonstrated, for alleviating congestion by avoiding individual motorised trips or making trips shorter, shifting to non-motorised transport or public transport and improving existing technologies. We call this holistic approach the "avoid, shift, improve" paradigm. We have observed encouraging signs; several countries are setting-up national programs for investing in

sustainable urban planning and transport. For instance Mexico, India, Brazil, and China have established national programs to support cities in the development of mass transit solutions. Mexico and Brazil have also passed new laws that link sustainable mobility with their climate change goals. And, in one of the most important voluntary commitments presented at the RIO+20 conference, eight major multi-lateral development banks pledged to allocate $175 billion of their portfolio to more sustainable transport solutions during the next decade.

While all these actions are aiming in the right direction, what we really need is a paradigm shift. We see interesting examples in many places around the world, but we need to scale up cities like Mexico, Guangzhou, Ahmedabad, Medellin, Guayaquil, Curitiba, and Bogotá to follow global cities like London, Paris, San Francisco, Shanghai, Amsterdam, Copenhagen and New York City, which have shown that it is possible to make structural changes in a short time span. However, isolated examples are not sufficient. The type of actions we have seen in these cities, such as improved spaces for pedestrians and bicycles, expanded mass transit and demand management measures to rationalise car use, need to be the norm and not the exception.

SUSTAINABLE TRANSPORT BENEFITS

In addition to helping cities cope with increasing congestion, sustainable transport under the "avoid, shift, improve" paradigm would bring an array of benefits to cities, including improved health and road safety, reduced greenhouse gas emissions, and increased access and poverty alleviation.

Health and Road Safety

Increasing the distance traveled in personal motorised vehicles escalates the exposure to traffic crash risk. Moving people through mass transit, walking, and biking can reduce the distance traveled in personal vehicles, thus reducing the exposure to crashes and traffic fatalities. A 7 percent reduction from the projected baseline of vehicle kilometers traveled, as suggested by the International Energy Agency, may result in 103,000 to 126,000 lives saved by 2020. This can be complemented with improvements in road design and operations to reduce crash risk, which can help multiply these numbers and achieve the goal of the Decade of Action in road safety to reduce traffic fatalities—counted at 1.3 million road traffic fatalities in 2010—by half by 2020.

"Mexico and Brazil have also passed new laws that link sustainable mobility with their climate change goals."

Decreased personal motorised vehicles would also mean a reduction in harmful air pollutants that contribute to respiratory illnesses. Every year 2.1 million people die prematurely as a result of exposure to air pollutants. New York City made great strides in improving air quality by creating people-friendly public spaces. For example, just a decade ago in Times Square, concentrations of nitrogen oxide (NOx) and nitrogen dioxide (NO2), two pollutants closely associated with traffic, were among the highest in the city. After the city closed this area to vehicles and converted it into a pedestrian walkway, NOx pollution levels decreased by 63 per cent, while NO2 levels decreased by 41 per cent.

Apart from fewer crashes and less air pollution, physical activity also improves with sustainable transport. About 3.2 million deaths annually are related to a lack of physical activity. Sustainable transport fosters more biking and walking, integrating exercise into daily life. Over the past decade, New York City has also added bike paths and other modifications to the streets to protect cyclists. As a result, the number of people who commute by bicycle has quadrupled since 2000.

Reducing Greenhouse Gas Emissions

Sustainable transport systems can also help reduce greenhouse gas emissions, of which 75 per cent of the world's total comes from cities. Public urban transport increases the efficiency of transport in cities, consequently reducing greenhouse gas emissions per capita.

EMBARQ developed two scenarios for the Indian city of Ahmedabad, who is projected to grow from 5.4 million inhabitants in 2013 to 13.2 million in 2041. There is a tremendous difference between the projections for a business-as-usual approach, in which city sprawl and car use increases, and the sustainable transport approach. In the business-as-usual model, projected emissions are 12.32 million tonnes of CO_2 per year and traffic fatalities are estimated at 5,232





per year. Comparatively, under a more sustainable transport and efficient urban development model, in which the city remains dense and compact, emissions are projected at only 1.97 million tonnes of CO_2 per year and traffic fatalities at 1,225 per year. This means that CO_2 emissions would be 6.25 times more and traffic fatalities would be 4.2 times more with the business-as-usual approach.

Globally, addressing growing transport demands with "business- as- usual" solutions would mean infrastructure costs of US$45 billion, to build 25 million kilometers of roads and up to 77,000 square kilometers of parking. If countries pursue "avoid, shift, improve" policies, not only can there be benefits to our global climate but this land transport infrastructure spending could decrease as much as US$20 trillion by 2050, as has been suggested by the International Energy Agency.

Access and Poverty Alleviation

Infrastructure that focuses on creating space for cars is often inaccessible to poorer classes, as they lack the funds to purchase a motorised vehicle. Making affordable public transport available to these poorer residents facilitates access to employment, education and other opportunities that would otherwise be difficult to attain across socio-economic categories.

For example, in Mexico, 75 per cent of the transport investments have been directed toward roads and car-centric approaches over the past decade. But Mexicans walk, bike, or use public transport for 75 per cent of their trips. This means that historically investment has focused on the minority. This is changing, with the implementation of a national program that supports mass transit in 40 cities. By focusing on the people's actual needs and implementing more sustainable transport options, higher degrees of poverty alleviation can be achieved. A recent introduction of a bus rapid transit corridor in Mexico City, Metrobus Line 3, shows that the lower income classes have received greater net benefits in the form of reduced travel times and travel costs than the higher income quintiles. This type of investment has proven progressive, as is also the case with other initiatives like improved pedestrian spaces and facilities for bicycling.

Transportation does not exist within a closed environment. Transport solutions must not only focus on moving people better, but improving the overall well-being of a city. Shifting from car-centric infrastructures to sustainable public transport, biking and walking can not only reduce congestion, but boost the health, environment, and quality of life in cities around the world. ■

Holger Dalkmann *has fifteen years of experience working in the field of transport, sustainability and climate change. He joined WRI in 2011 as the director for its EMBARQ programme. He provides strategic leadership and management for EMBARQ's global staff and partners, as well as direction for its fundraising and communication activities.*

EMBARQ *is a programme of the World Resources Institute in Washington, D.C. EMBARQ's mission is to catalyse and help implement sustainable transport solutions to improve quality of life in cities. Since 2002, the EMBARQ network has expanded to Mexico, Brazil, China, India, Turkey and the Andean Region, collaborating with local transport authorities to reduce pollution, improve public health, and create safe, accessible and attractive urban public spaces.*

KRAKÓW AS A MODEL FOR **SUSTAINABLE TRANSPORT DEVELOPMENT**



By **Professor Wiesław Starowicz**, Advisor to the Mayor of Kraków, Poland

In developing a municipal passenger service system it is vital to coordinate transport policy with spatial policy to achieve reductions in transport density. Poor decisions concerning the location, type and intensity of land use can render ineffective all the effort invested in making improvements. In large cities, the functioning of agglomerations and metropolitan areas is an issue that must be addressed.

Creating a cohesive municipal transport system is a complicated task, in which both external and internal factors must be accounted for. Among the external factors are carrying out a strategy of sustainable transport development, and also the necessity to balance the development of transport and of the urban environment as a whole. Internal conditions include ensuring smooth cooperation between municipal and regional transport, as well as taking advantage of the potential available in the rail mode.

Among the many changes in the social and economic system in Poland after 1989 was an accelerated adoption of motor transport, with all the costs and benefits that western countries had experienced for many years. Exponential growth in the number of cars caused increased congestion in road traffic, particularly during peak travel hours. As a result of the failure to undertake the necessary measures to deal with existing flaws in transport systems, the overloading of road networks in Poland became a growing problem. Street congestion resulted from high levels of personal car travel, encompassing ever-larger areas of the cities, along with longer periods of poor traffic flow and an increasing lack of parking spaces. This had a negative impact on quality of life issues, expressed not only in significant discomfort in travel, but also in deterioration of the natural environment and reduced traffic safety.

In recent times, public transport has adopted more beneficial operating methods. Enterprises have made changes to increase efficiency levels, abandoning inefficient business lines, etc. Bus fleets are being renewed. Contracts for transport services include quality of service clauses linked with the level of fees paid for services. Progress has improved in fee systems, as well as in methods of monitoring and steering traffic. Several cities

have taken notice of the potential in tramway (streetcar) transport, which is less subject to the influence of growing automobile traffic.

KRAKÓW'S TRANSPORT POLICY

In 1993, Kraków became the first Polish city to adopt a transport policy document, designed to follow the principles of sustainable development. The primary goal was to create conditions for more efficient and safe movement of people and goods, while limiting the impact of transport on the environment; and as a result to improve the accessibility of transport within the city's borders, as well as in the metropolitan area, the province and the country as a whole. Three particular aims were established:

- To ensure the city's transport system would function efficiently, so as to make it sustainable in the economic, environmental and social contexts
- To further strengthen the quality and increase the role of mass transport
- To develop an integrated metropolitan system ensuring accessibility in local, national and European transport schemes.

Several principles for implementing the policy were also defined:

- Cooperation and integration of various transport subsystems in the metropolitan area
- Expansion of a high-quality mass transport subsystem
- Expansion of rail-based infrastructure (with priority for rapid tramways)
- Expansion of road and parking infrastructure with priority given to construction of bypass elements
- Organisation of a load flow system based on a municipal logistics system (construction of logistics centres and optimisation of logistics chains)
- Development of a bicycle track network (with priority for downtown areas)
- Adaptation of infrastructure and transport means to the needs of the disabled
- Appropriation of funds for 'soft' elements of automobile transport infrastructure (including an advanced individual and collective traffic control system using modern technology).

In a short time, it has become possible to undertake a wide range of projects meeting the European Union's standards for urban development in respect of transport application and accessibility. These standards include introducing pedestrian zones and zones of restricted automobile access, alongside a dynamic development of mass transport in terms of both infrastructure and modernity of fleets.

In July 2007, the Kraków City Council adopted an updated transport policy. The passage of time and new conditions had necessitated a review of goals and priorities, as well as undertaking new projects. Proper management of a municipal transport system is considered one of the most important tasks for local government authorities, with a significant impact on the quality of life for residents and on the city's proper development. Kraków's transport policy aims for a balance between economic, environmental and social factors, resilient to the expansion of car use. The city's policies are coherent with those of the Polish government and the European Union.

PARTICIPATION IN CIVITAS-CARAVEL

In 2005, Kraków joined the CIVITAS initiative and the CARAVEL project, allowing it to undertake tests on a range of tools applied in modern transport policies based on sustainable city development. The CARAVEL project was an excellent compliment to the city's transport policy, and in many ways became the foundation for strategic updates.

It is useful to point out links between tasks accomplished under the CIVITAS-CARAVEL programme with the primary goals of the transport policy. Thus, the transition to environmentally-friendly vehicles includes the purchase of suitable vehicles (electric motors, hybrids, CNG, sulphur-free fuels), limitation of right-of-way in downtown areas to vehicles that fail to meet environmental standards, and an increase in the frequency and effectiveness of vehicle inspections.

The task of integrated access management and enforcing access restrictions complements the policy's assumptions, such as:

- Completing road investments already under way
- Selective construction of new elements in a road network designed to relieve densely-built areas of external transit traffic and downtown areas of inter-district traffic
- Accessibility zones (primarily through bans) for automobiles in various areas of the city
- Expansion of the territory given over to relaxed and slow traffic (30 km/h), and

Figure 1. The tramway network in Kraków



pedestrian zones free from automobiles
- Elimination of restrictions to pedestrian movement caused by automobiles (parking on pavements)
- Increasing the effectiveness of police and city guard traffic and parking interventions, and
- Construction of multi-storey car parks (including underground) in the downtown area to restore streets' primary function.

Importantly, the construction of parking facilities is not intended to increase the volume of parking in the downtown area, but rather to eliminate street-side parking to improve conditions for pedestrians and public transport.

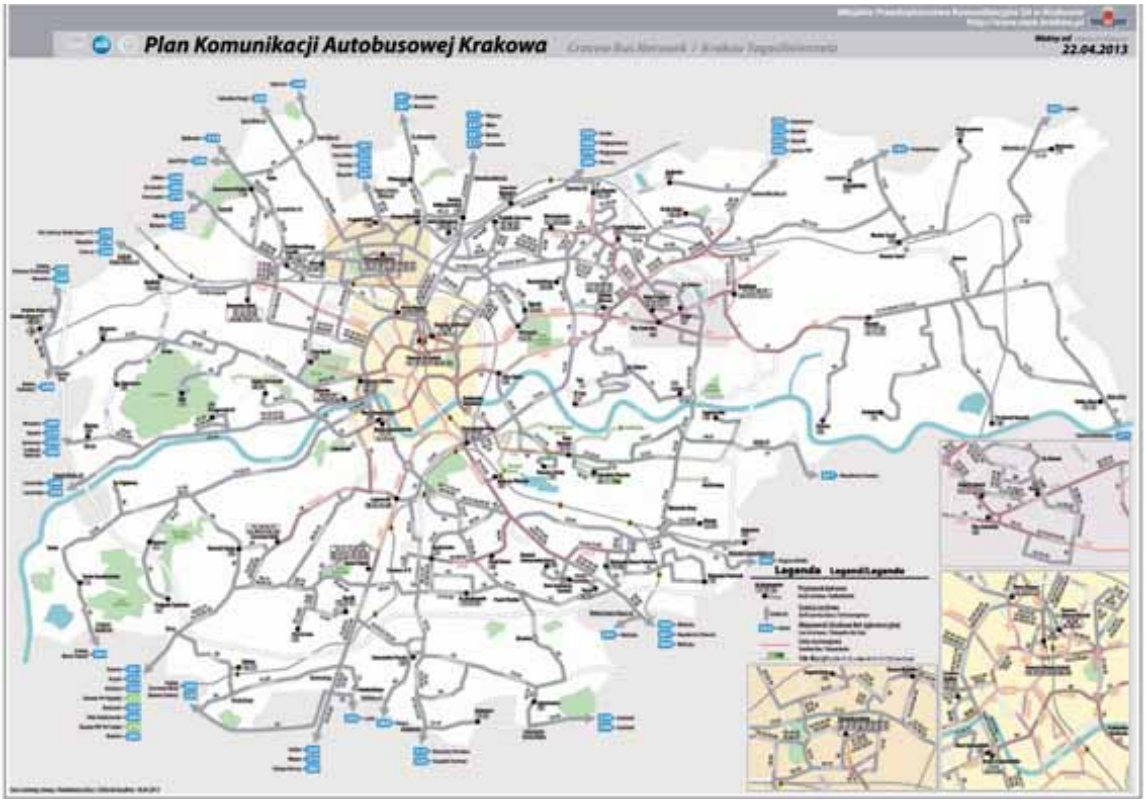
Another task, the construction of ecological corridors for efficient travel, will help in:
- The spatial and functional integration of the system (transfer nodes, joint timetables and a unified fee system with a view to introducing a ticket valid for all means of transport from all carriers serving the agglomeration)
- Adaptation of the mass transport system to the needs of disabled users
- Development of a passenger information system including details of traffic and approaching vehicles, and
- Reduction in threats to the personal safety of passengers (monitoring of vehicles, terminals and stops).

Reconstruction of Lubicz street and the implementation of new tram and bus stops are the first stages in performing this task. Of particular importance from this point of view are investments such as expansion of the Mogilski Roundabout, along with completion of a tunnel and a system of zonal traffic control, making it possible to call the Kraków Rapid Tramway the beginning of a metro line.

New forms of mobility associated with recreation – bus routes with special baggage capacity for bicycles – form a task linked to spatial and functional integration of a municipal mass transport subsystem with other subsystems (e.g. transfer parking for automobiles and bicycles, as well as the possibility to transport bicycles using mass transport), and a plan for the intensive expansion of bicycle routes and a city bicycle hire scheme.

Interesting experience has been gained from work on the 'tele-bus' task, aiming at mass transport on

Figure 2. Bus routes in Kraków



demand. It turns out that it is possible to reduce costs for mass transport, while expanding access in sparsely-populated areas. This subsystem is slated for expansion in the coming years.

The highly innovative carpooling and car-sharing tasks are attempts at understanding the possibilities for popularising group use of personal vehicles, including creating incentives for carrying more passengers while travelling in the city, and for reducing the number of privately-owned vehicles by establishing car hire.

Another initiative, the Mobility Forum, is the first attempt at a new approach to social consultations and exchanges of ideas concerning municipal transport in a more open and friendly format.

The CARAVEL project is also an excellent initiator of innovative ideas. This includes the introduction of a transport consultant into large workplaces, as well as an information and social education campaign promoting a culture of mobility – positive attitudes towards non-motorised transport (pedestrian and bicycle) alongside public mass transport and responsible, reduced use of personal vehicles. Additionally, of particular importance is that the CARAVEL project has made it possible to create a dozens-strong project team, as well as to establish close cooperation between partners both at home and abroad. The experiences and ties forged between experts in various fields, working in a range of municipal institutions, will bear fruit in the future in the execution of similar projects.

Many of the range of concepts, projects and tools will be continued or even expanded following the project's formal completion. Kraków will certainly continue its participation in projects of this type. Good evidence of this is our involvement in the CIVITAS-CATALIST project.

THE KRAKÓW MASS TRANSPORT NETWORK

The city covers an area of 327 sq km. Every day, 760,000 residents and 210,000 students make their way around. The motorisation ratio is about 550 personal vehicles per 1,000 residents. The share of public transport in city traffic is 62 per cent, and of personal vehicles, 38 per cent.

Within the Kraków transport network, 26 tram lines and 151 bus routes (including 60

agglomeration and 10 night routes) are in operation. Trams and buses visit nearly 2,800 stops. These lines are served by about 190 trams and 400 buses. The total length of tramway lines is 335 km, and of bus routes 1,900 km. Public transport is used annually by for about 350,000,000 journeys (around 1,000,000 every working day). Nearly all of Kraków's buses are low-floor units, and one in five is equipped with air conditioning. Nearly 60 tramcars (out of 200) offer a low floor.

Tramways cover an annual distance of around 13,000,000 km, and buses around 37,000,000 km. In the last five years the city's tram network has been extended by about eight kilometres. Tramcar stock is continually renovated and exchanged. The 50 latest-generation trams currently in use will be joined next year by another 24 high-capacity three-wagon units.

In 2008, the city ordered an initial feasibility study of rail-based transport as a solution for gradual implementation. It was assumed that the pre-metro subsystem should:

- Enrich the existing transport system with new routes while maintaining the current and planned conventional tram and rapid tramway networks
- Connect the city's central regions with peripheral regions with the highest capacity for traffic generation, taking into account the directions with greatest traffic volume
- Ensure links with current and existing stops and rail stations, especially with the Kraków main railway station and the car parks for a planned park and ride system
- Ensure the potential for execution in stages, making use of the current and planned tramway infrastructure
- Significantly reduce travel times, especially in connections with the city centre.

The study produced five potential versions, with a recommendation for the fifth, a multi-phase approach for a pre-metro line to a full two-line underground service, running east-west and north-south.

In 2008, integration of the transport systems of Kraków and 14 neighbouring districts was begun. Zone tickets were replaced by a reasonably priced agglomeration ticket. The fee system was unified, making it attractive for passengers and encouraging residents to make use of this form of transport. In 2010, two more districts expressed their desire to join the project.

Since 2009, two integrated ticket and fee systems have been introduced in cooperation with the regional rail authority. The first joint rail+city ticket was for the Krzeszowice–Kraków line. At present the joint ticket is valid on all rail lines within a radius of about 40 km from Kraków.

CONTINUING DEVELOPMENT

Priorities for mass transport vehicles are being continually expanded, with the following new developments:

- Separate street lanes for buses, also permitting taxis and special vehicle traffic (about 20 km)
- Rails integrated into the street surface with low separators from traffic lanes (about 10 km)
- Traffic management systems giving priority to tramcars at intersections with traffic signals
- Restriction in access to the downtown area for personal vehicles (limited movement and parking zones, parking fees, implementation of new traffic patterns)
- An efficient traffic management system (priority for public transport, anti-congestion measures, maintaining or restoring punctuality and regularity in the functioning of mass transport)
- Joint tram and bus stops, enabling quick transfers.

The application of priorities in mass transport has resulted in:

- The restoration of punctuality and regularity in transport circulation
- Increases in the attractiveness of mass transport
- Increases in passenger counts
- Reduction in the volume of travel by personal vehicles, particularly in the downtown area. ■

Wiesław Starowicz, *Professor in the Krakow Technical University. Deputy Mayor of the City of Krakow 2006 -2010. Actually he supervises the Team of Advisers to the Mayor of Krakow. Large experience in researches and planning of transport systems as well transport management in cities and regions. Many years of experience in managing business entities – chairing supervisory boards of communal and municipal companies in Krakow for 15 years.*

MAKING CITIES **ACCESSIBLE**







Cities are hubs for ideas, culture, economy, productivity, social development and much more. However, many challenges exist to maintaining cities, in particular in terms of mobility which has a direct impact on social and economic development as well as on quality of life.

Therefore, preserving and improving quality of life, developing economic competitiveness, as well as the social, cultural and touristic development are the primary objectives of municipalities, be it large ones or small ones.

In terms of traffic and congestion, aspects like the reduction of pollutants (particle matter PM10 or PM2,5, NOX, ozone, etc.), noise or carbon emissions (CO2) are of crucial importance. Accessibility is a key issue, be it for commuters, emergency services or deliveries. Road safety is also a central issue.

To achieve these goals it is necessary to impose rules and restrictions, to some degree, for the access and parking of vehicles and the transportation of goods in urban areas.

There is no doubt in fact that urban access management schemes influence the mobility behaviour of individuals and businesses more than any other measure; access management becomes an instrument to shape the fleet composition within the zone and to shape the mobility behaviour.

Changing the Behaviour of the citizen in the city, first of all, of those who drive vehicles should therefore be the real goal of an Urban Access management system.

The monetary aspect is one of the most effective drivers in changing behavior. By assigning a price to the access to city areas, drivers get aware of what they are doing and they start thinking of alternatives, like other transport modes or even other travel times if the peak hour is priced. The pricing scheme is an expression of the city's transport policy; polluter cars could be priced higher than green cars, longer stays can be priced higher than short stays (or the other way round), and so on. The pricing scheme can be adopted upon changed conditions without changing technology. Instead of typical disincentives used in urban areas such as congestion charges which most people dislike, incentives that change driver behavior present an alternative to foster good practice like green car usage or P&R usage.

Kapsch TrafficCom offers with its Urban Zone Access Management a flexible system to reduce traffic congestion in a very selective way. It provides city authorities the possibility to define different tariffs for different users. Specific users may be identified as exempt or entitled to a discount from the charging scheme for specific reasons such as disabled, residents, buses, taxis or others. Also the ban access time could change during the day for the same user. ■

Website: www.kapsch.net

HYBRID BUSES IN LONDON



By **Sir Peter Hendy** CBE, Commissioner, Transport for London (TfL)

TfL has responsibility for implementing the Mayor's Transport Strategy (MTS). This strategy sets out the Mayor's goals and expected outcomes for London to 2031. It is multi-dimensional, covering spatial, policy and modal policies and proposals. The strategy sets out an integrated approach to improve the mode share for London's sustainable modes of travel.

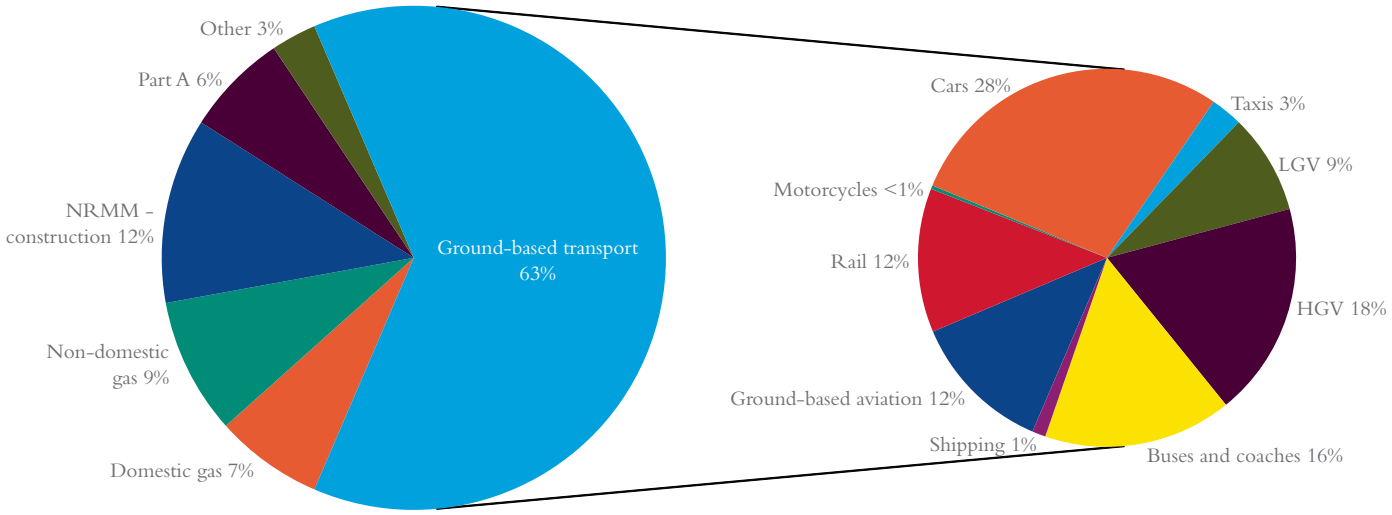
Whilst London's air quality has improved in recent years, it is the worst in the country and emissions of two local air quality pollutants continue to pose a challenge. Particulate matter (PM10) levels now generally meet EU limit values whereas those for Nitrogen Dioxide (NO2) remain too high. London's air exacerbates heart and lung conditions such as asthma, particularly in children, older people and those with poor health and so significant intervention is needed to reduce exposure and improve Londoners' health. Also, the Mayor of London Boris Johnson has a target to reduce London's CO_2 emissions by 60% by 2025, which is significantly more ambitious than the national targets set by Government.



London is world leading in achieving an unprecedented shift in mode shares for travel away from the private car towards public transport, walking and cycling. There was a 9 percentage point net shift in journey stage based mode share between 2000 and 2011 towards public transport, walking and cycling. The MTS aims to continue to build on this. It also aims to reduce the negative impact of London's transport system on London's environment – setting out how emissions from transport should be reduced.


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TIL5: NOx emissions in London, 2010.



Specifically it focuses on those emissions which are within the Mayor's direct control or influence, taking a lead by promoting a cleaner public service fleet, including buses, taxis and Greater London Authority (GLA) group vehicles.

London has long been the financial and political powerhouse of the UK with a reputation for innovation, invention and ingenuity. More recently, it has been turning its traditional red buses green including designing a unique hybrid double-deck vehicle for the capital to provide more sustainable public transport for the 21st century. The city currently has 8,700 buses operating across 700 routes, many of them 24 hours a day, delivering 6.5 million journeys a day, to reflect the demands of one of the most visited and multi-cultural capitals in the world. This number is made up of 440 hybrid buses that harness a combination of conventional diesel engines, electric motors and regenerative braking.

However, a step change is underway to raise the number of hybrid buses from the current number to 1,600 by 2016 – almost one in five buses in the fleet – with the help of mayoral policy and central Government support. The drive towards hybrid adoption comes from several compatible goals that have converged around the same time.

The Mayor made a commitment to return an iconic state-of-the-art 21st century successor to the famous Routemaster to the streets of London around the same time as the Government's Department of Transport announced financial support for measures that would reduce emissions generally in the city.

The hybrid option for buses offers a highly cost effective and practical means for CO_2 reduction and includes other benefits such as lower fuel consumption, noise and NOx emissions. Introduction of the first hybrids to London started with trials and evaluation in 2006 when a core of 56 vehicles from four different manufacturers were phased into service. Their satisfactory operational and environmental performance led to the hybrid fleet rising to 300 vehicles by 2012, then 430 by March this year, across more than 20 targeted routes.

"The city currently has 8,700 buses operating across 700 routes, many of them 24 hours a day, delivering 6.5 million journeys a day."

The pace of introduction has gathered momentum with the help of several grants, totalling £18m, from the Department for Transport's Green Bus Fund, and a mayoral commitment to return a 21st century Routemaster to the streets of London. TfL has just placed an order for 600 New Bus for London (NBfL) production vehicles from Wrightbus, of Ballymena, Northern Ireland, for introduction up to 2016 following trials of eight prototypes from 2012. The first batch of production buses are

currently being delivered to bus operator Metroline for conversion of route 24 which connects many popular tourist areas from Hampstead Heath to Camden, Trafalgar Square, Victoria and Pimlico. It will be the first route in the city to operate solely with this type of bus, 24 hours a day, from June this year. The Mayor is due to announce a second route conversion in autumn as part of the next stage of the roll out to central London areas where the vehicles' low emission and three-door boarding and alighting benefits will be of greatest benefit. The vehicle design is distinctive with a rounded back, open platform at the rear, two staircases and three doors.

The NBfL is easily the cleanest hybrid bus in the fleet and has been designed specifically with London in mind. When compared to an average diesel bus in the fleet, it emits around four times less NOx, almost half the CO_2 and four times less particulate matter under the London Buses' simulated route cycle. When all 600 vehicles are operating across the capital, the expected saving in CO_2 will be almost 20,000 tonnes a year. Both the NBfL and other types of hybrid procured by private bus operators from the open market are being deployed on routes within central London where pollution levels are known to be higher and can make a significant reduction in exhaust emissions.
In a separate initiative which seeks to achieve a 20 per cent cut in NOx from the bus fleet by 2016 compared to 2012 levels, TfL is retrofitting 900 Euro 3 buses from now to 2014 with selective catalytic reduction equipment which reduces exhaust NOx by up to 88% in real-world conditions. The £10 million cost is being funded equally by TfL and the Government's Department for Transport. A similar number of Euro 3 buses will also be phased out from 2014 and 2016 through the early renewal of route contracts. The new buses that replace them will have ultra-low emission Euro 6 engines which are anticipated to cut NOx by up to 95% compared to a Euro 3 counterpart.

TfL's longer term carbon reduction strategy includes demonstrating second-generation hydrogen fuel-cell buses and full-electric vehicles. Its current single-deck fuel-cell buses emit no tailpipe emissions and harness hybrid technology to increase fuel economy and range. There are currently five allocated to route RV1 from Covent Garden to Tower Gateway, and this number will rise to eight by summer 2013 when three new vehicles, supported by EU funding, join them and enable the entire route to be converted to hydrogen power. The two fully electric vehicles will join the London fleet in summer of this year and will be leased from BYD and operated by Go Ahead on the busy 507 and 521 routes through central London.

TfL is currently supporting pan-European initiatives to introduce and evaluate wireless induction charging for pure electric and range-extended diesel-electric hybrid buses under the umbrella of the UITP consortium and the Arup and C40 Cities Climate Leadership Group. The outcomes of both bids are expected to be known in 2013/14.

"The pace of introduction has gathered momentum with the help of several grants, totalling £18m."

TfL tests all the main bus types in the fleet over a simulated London route cycle at Millbrook Proving Ground to assess their emissions performance. The test recreates the conditions of a Route 159 bus travelling from Brixton to Baker Street with the usual number of gear changes, calls at bus stops, acceleration, braking and waiting time at traffic lights. By evaluating vehicles in this way, TfL has confidence that the expected environmental benefits of hybrid buses can be delivered in 'real world' operating conditions and that all vehicles are compared in a like-for-like way. Based on these test results, the average hybrid has demonstrated a 30% reduction in fuel consumption and CO_2, a 20% reduction in NOx and three decibel noise reduction in the EU legislated drive-by test.

So whilst London's air quality and carbon emissions remain a real challenge the innovative approach and financial commitment demonstrated through the hybrid bus programme is making a real difference in reducing emissions from the fleet TfL can directly influence. The Mayor and TfL will continue to build on this to support the update of low emission vehicles more generally and encourage behaviour changes to reduce vehicle emissions whilst introducing targeted local measures at poor air quality locations to reduce emissions and protect the health of Londoners.



Sir Peter Hendy *CBE was appointed Commissioner of Transport for London (TfL) in 2006, having previously served since 2001 as TfL's Managing Director of Surface Transport. He led, and played a key role in preparing for, the successful operation of London's transport for the 2012 Olympic and Paralympic Games. He was formerly Deputy Director UK Bus for FirstGroup and previously MD of CentreWest London Buses, managing it in London Transport (LT) ownership, leading it through a management and staff buyout with venture capital backing, and subsequent expansion. He started his transport career in 1975 as an LT Graduate Trainee. Sir Peter was President of the Chartered Institute of Logistics and Transport in 2011/12, and was also Chair of the Commission for Integrated Transport from 2005 to 2010. He was knighted in the 2013 New Year's Honours List, having been made CBE in 2006.*

TfL *is the integrated statutory body responsible for London's transport system. It came into existence in July 2000 as a result of the Greater London Authority Act 1999. It is a functional body of the Greater London Authority and reports to the Mayor of London. TfL's role is to implement the Mayor's Transport Strategy and to manage the transport operations for which the Mayor is responsible. The Act merged 14 predecessor entities into a single organisation able to take a holistic view of London's transport needs. London Underground became part of TfL in 2003. TfL manages London's buses, trams, Underground services, the Docklands Light Railway, London Overground suburban train services, river services, London's taxis, Barclays Cycle Hire Scheme, the Emirates Air Line cable car and we promote walking initiatives. We are also responsible for London's major highways, all of its traffic signals, the Congestion Charge and the Low Emission Zone.*

TEHRAN – SUSTAINABLE TRANSPORT AND GREENHOUSE GAS REDUCTION



By **Dr Mohammad Bagher Ghalibaf**, Mayor, City of Tehran

Tehran is adopting sustainable solutions to the problems of local air pollution and traffic emissions and a key example of this is the development of low carbon transport networks.

Before taking office as Mayor in 2006, one of my biggest concerns, in addition to urban air pollution and traffic congestion, was the role of Tehran as a major contributor to greenhouse gases (GHG). The data indicated to me, as the mayor of the city, that without comprehensive, scientifically sound and long-term plans, it would be impossible to find solutions to these problems. As a result, the Municipality of Tehran was set to move towards sustainable transport as one of its priorities. Research, planning and development stages were outlined and serious work started from the first day.

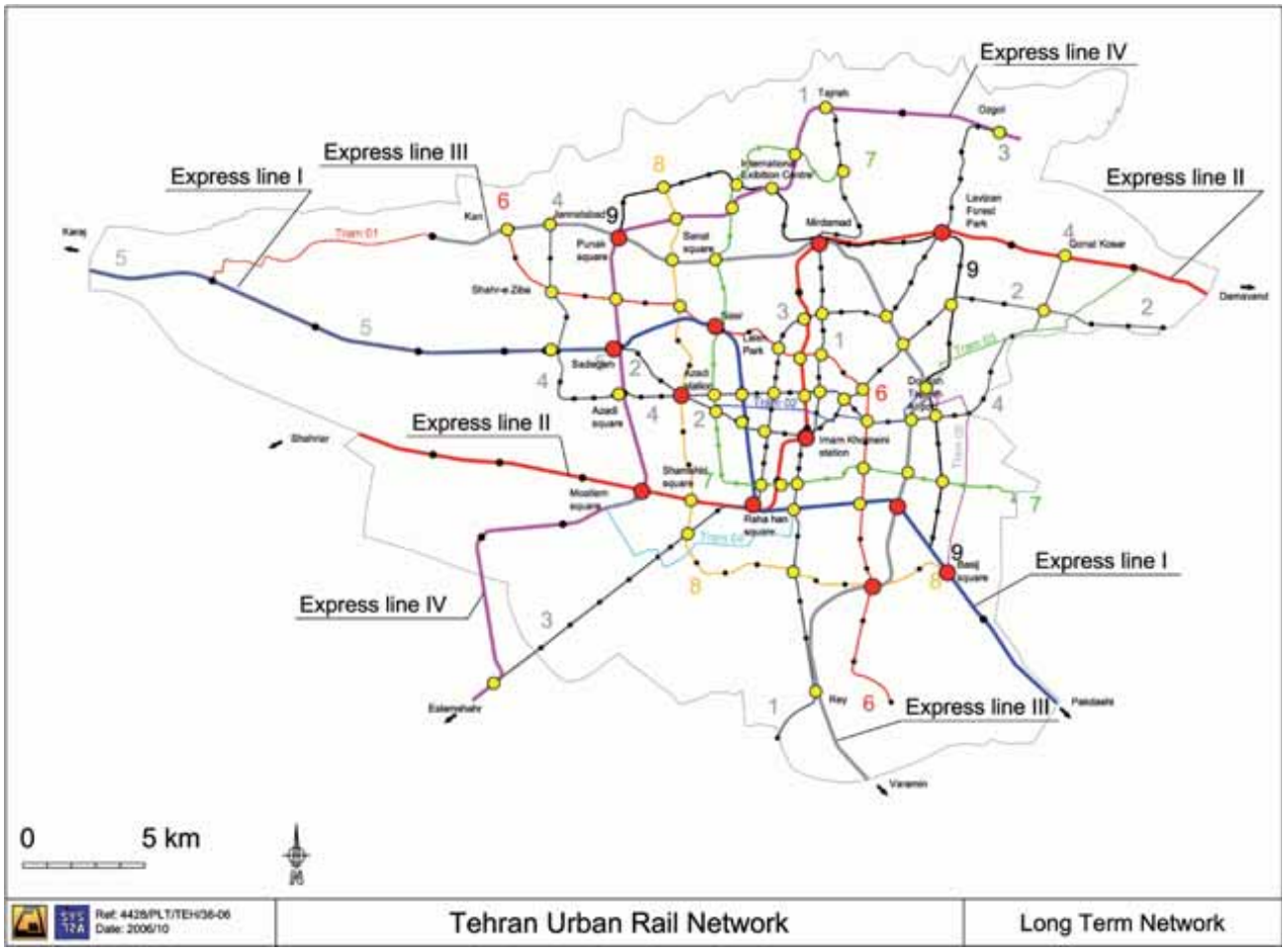
Tehran, the capital city of Iran, with an area of about 780 sq km, has been growing rapidly over the past few decades. Its population increased from less than 700,000 in 1941 to more than 7 million in 2005. In 2012, according to the latest census data, Tehran had more than 12 million residents in the form of more than 3.7 million families. The number of passenger cars in Tehran is estimated to be more than 3 million.

Tehran Municipality's management has developed a strategic perspective for sustainable transport and GHG reduction. Without a carbon-neutral city, the future of the inhabitants would be bleak. To avoid this, all plans and operations should be geared toward establishing greener, less carbon-intensive procedures. This includes city-wide construction projects, operations as diverse as transport, waste management and city services, as well as energy consumption. Iran is an oil-rich country with no energy crisis likely for the foreseeable future, but this has not stopped us from exploring other sources of energy, such as nuclear and hydro at the national level, or implementing fossil fuel efficiency strategies in the city.

SUSTAINABLE TRANSPORT DEVELOPMENT

Tehran is a vibrant and dynamic city. The capital of Islamic Republic of Iran is the home of all major political and public institutions. Tehran Bazaar is the centre of large-scale business operations in Iran. The central bank, private banks,

Figure 1. The Tehran subway system map to be completed by 2030; the plan includes 430 km in 12 lines and construction of 276 stations. So far, 120 km of lines have been completed.



Tehran stock market and the largest universities of Iran are located in this city. When Tehran breathes, tonnes of air contaminants and CO_2 emissions are released into the atmosphere. In such a large metropolitan area, only sustainable and green transport can ensure that we are moving towards creating and maintaining a responsible, world-class city. We have had it planned.

The first priority in our move to the realisation of sustainable green transport has been developing public transport and removing private cars from the streets. Tehran subway (underground railway) lines have been constructed and expanded systematically. The plan is to have 430 km of subway rail lines and 276 stations by 2030, making 10 million trips a day possible. By 2012 more than 120 km of the total lines planned had been constructed and are now operational: in 2009 there were 500 million trips made through the subway system.

A related key decision has been the introduction of the bus rapid transit (BRT) system, in spite of hurdles such as narrow streets and already congested highways. A comprehensive study of the public transport system started in 2006; finally a network of 10 BRT lines was designed based on an in-depth analysis of major transit corridors. Other dedicated as well as normal, regional and local lines play a feeder role for the subway and BRT systems in this design.

"Tehran includes a central zone that on normal working days is closed to unauthorised passenger cars."

Currently, six out of ten BRT lines are operational, benefiting from buses with a highly efficient diesel engine design. The newly

developed BRT system accounts for 300 million trips per year. It is estimated that these developments have reduced CO_2 emissions by one million tonnes per year – certainly not enough, but a move in the right direction. The plan for Tehran sustainable transport by 2030 has allocated more than 45 per cent of the total journey share to city buses, BRT and the subway system; 5 per cent is accounted for by cycling, and passenger car use will be limited to only 32 per cent.

"A small-scale feasibility study for the use of hybrid electric buses is being carried out to investigate their technical and economic aspects."

ACTION TO DISCOURAGE PRIVATE CAR USE

Limiting private car use in Tehran is being done through a number of measures ranging from expanding public transit services to enforcing dedicated green zone central regions. Tehran includes a central zone that on normal working days is closed to unauthorised passenger cars. Only taxis, city and BRT buses are allowed entry into this green zone. The zone is monitored and law is enforced by several traffic cameras on all its 140 entrances. The introduction of Tehran central green zone has decreased private car use in the area and has encouraged citizens to use public modes of transport. A larger perimeter around the central green zone has been marked for entrance only by private cars with odd/even license plate numbers that match the odd/even days of the working week.

Educational programmes matched by several incentives are being offered widely to citizens to discourage use of private vehicles and encourage use of cycling for short distances. In several places in the city, free bicycle rides are being offered. Dedicated bicycle routes have been created along several important streets and highways. Safe use and operation of bicycles is being encouraged by training and advertisements.

CITY GREEN SPACE

Dedicated pedestrian streets are being constructed in the central zone of Tehran, resulting in the removal of cars from a few of the capital's historic paths, and creating tourist attractions along with safe places for families to walk.

Trees and plants have an important role in making the future of the city. We have been able to increase the amount of urban green space in Tehran from 9 sq metres per person in 2006 to 14 sq metres per person in 2012. This has been achieved by increasing the number of city parks from 1,200 to 1,900 in 2012. In addition, Tehran's green belt has been continuously developed from 24,000 acres in 2006 to 38,000 acres in 2012.

FUEL AND OTHER MEASURES

The City of Tehran provides a significantly higher quality of diesel fuel than regularly available for its fleet. The low sulphur fuel ensures better economy and less damaging gas emissions. Several feasibility studies are under way for the introduction to the city fleet of closed carbon cycle fuels such as dimethyl ether (DME), produced from organic sources. A small-scale feasibility study for the use of hybrid electric buses is being carried out to investigate their technical and economic aspects. The City of Tehran is also looking into the possibility of using electric bikes instead of gasoline powered ones in the central green zone.

"Several large-scale construction projects have been completed to smooth the flow of traffic"

The City of Tehran has moved toward the use of electronic services to eliminate redundant city trips. Most of the city services are currently offered on the web, providing remote access for citizens. Since traffic congestion on Tehran's highways is a major cause of raised fuel consumption, several large-scale construction projects have been completed to smooth the flow of traffic. These projects include the Tohid traffic tunnel, the Niayesh traffic tunnel, the Sadr bridge (the first double-deck highway in Iran, more than seven km long), and the construction of the Tehran ring highway.



Tehran municipality is eager to move forward in its implementation of more carbon reducing programmes in both the transport and service sectors. Every year, millions of dollars are spent in projects which directly or indirectly move the city towards a lower level of emissions. This is not enough, of course. While we have the ambition and desire for a less carbon-intensive environment, the smooth operation of the city with more than 12 million citizens is always the first priority.

Giving the magnitude of the Tehran metropolis, there are many opportunities for programmes that are highly effective in reducing CO_2 emissions. Carbon trading with developed countries can potentially be one of the solutions. The City of Tehran will seriously consider and study any proposal that is aimed at CO_2 emissions reduction, as well as CO_2 capture and sequestration, and is ready to become actively involved in carbon trading programmes. ■

Dr Mohammad Bagher Ghalibaf *is a veteran of the Iran-Iraq war, serving as a senior commander in the eight-year conflict. He was later appointed as the Commander of the Police Force, and in 2006 was elected Mayor by Tehran's City Council. Dr Ghalibaf has a Ph.D in political geography and is an Associate Professor at Tehran University, where he teaches and supervises post-graduate students. He has published many articles in peer-reviewed journals and presented papers in important national and international conferences; he is also the author of five books. Dr Ghalibaf is a commercially qualified Airbus A320 pilot.*

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