



City Dynamics

A London Special

Exploring the challenges facing major cities like London
Leadership | Funding | Connectivity
Transport | Energy | Preservation

ARUP

London by numbers

Percentage of heat generated by efficient community heating schemes



LONDON
3%

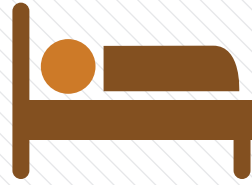
Source: London Energy Partnership; Danish Architecture Centre, 2008



STOCKHOLM
60%

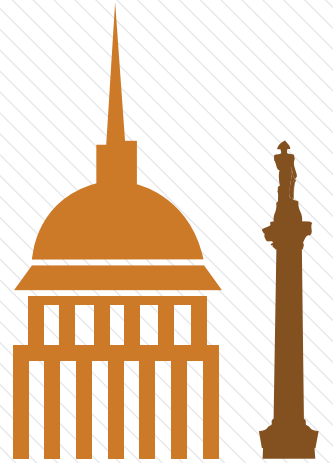


REYKJAVIK
95%



In 2011, London attracted
26.3 million
staying visits

Source: London & Partners, 2012



London has 40,000 listed buildings
and over 150 ancient monuments

Source: London.gov.uk, 2010

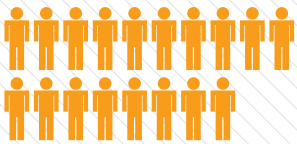
2012

London population



2030

London population



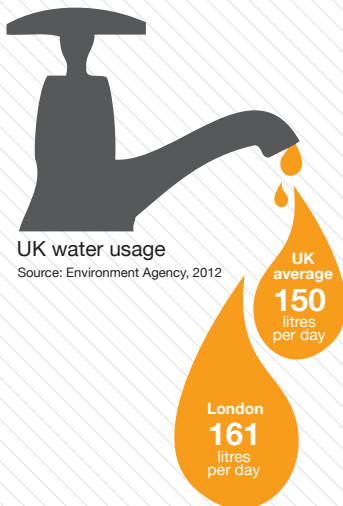
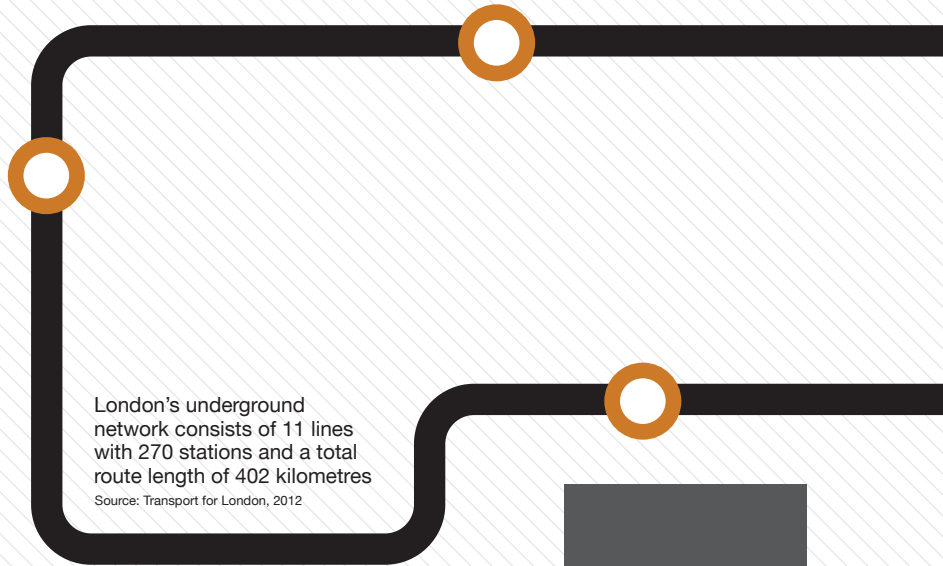
= 500,000 People

Source: Office for National Statistics, 2011



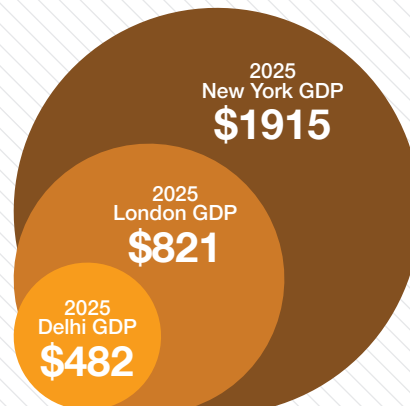
London is responsible for 8%
of the UK's CO₂ emissions

Source: London Energy Partnership, 2012

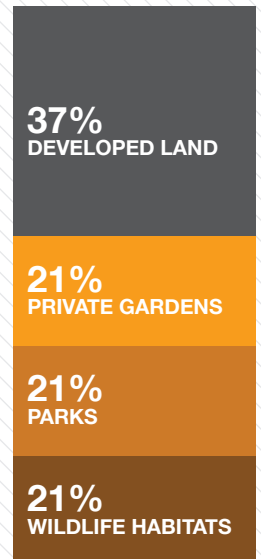


70% of floor space in
the Square Mile is offices

Source: City of London
Economic Assessment, 2010



Source: PricewaterhouseCoopers UK
Economic Outlook November, 2009

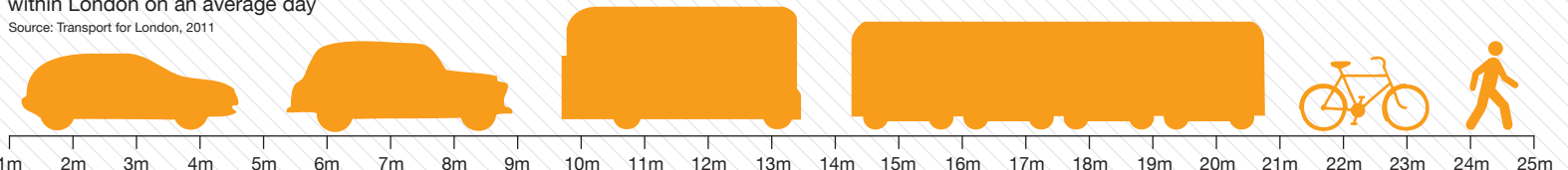


London's
160,000
hectares

Source: Environment Agency, 2010

24.8 million
trips or journeys are made to, from or
within London on an average day

Source: Transport for London, 2011



City Dynamics



London has been the focus of the international community this summer and so this edition of A² takes a fitting look at some of the challenges that major cities like London face and puts forward some smart solutions for addressing these.

Our cities are already home to more than half the world's population and by 2030 it's expected that nearly five billion people will live in metropolitan areas. We need to be thinking now about how we encourage connectivity in these population hubs – how do we make physical connections through transport and infrastructure, or virtual links through communications technologies?

How do we resource our communities through a sustainable approach to energy and resources? And how do we ensure a healthy population in cities that are calling out for urban regeneration at a time of economic uncertainty?

Using London as our benchmark, our contributors to this edition of A² put forward their views on how we can make our cities work for us. I hope you enjoy reading it and find the content valuable. And if you have any feedback, we'd love to hear from you at a2@arup.com.

Alan Belfield, Director, Arup

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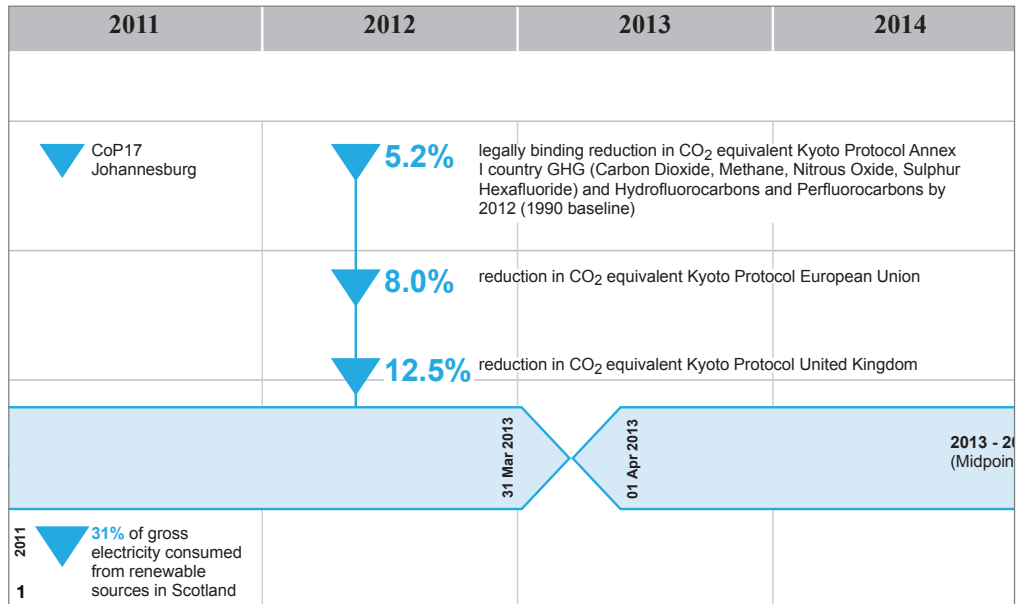
Is it possible to successfully conserve artworks whilst reducing energy consumption and costs?

UK Energy Legislation Timeline

Keeping on top of energy strategies, plans, programmes and schemes can be challenging. Arup has identified the key legislative and policy drivers to produce a user friendly timeline providing a clear picture for developing integrated energy, efficiency and emissions strategies.

The timeline provides an update as the Electricity Market Reform (EMR) proposals move to conclusion, along with a range of other energy policy mechanisms.

A copy can be downloaded from arup.com.



Stonewall Diversity Champions

Arup has joined Stonewall’s Diversity Champions Programme – Britain’s good practice employers’ forum on sexual orientation. Stonewall is the largest lesbian, gay, bisexual, and transgender (LGBT) equality organisation in the UK and Europe. The Diversity Champions programme brings together top employers from across the UK to promote diversity in the workplace, helping businesses and public services to develop inclusive workplace cultures and ensuring staff can perform to their full potential.

Joining the programme follows the hugely successful inaugural event of Arup’s Connect Out group – the firm’s LGBT network – which Lord Browne of Madingley recently addressed with an extraordinary and candid lecture describing his experience as a gay man in business.

Alan Belfield, Arup Group Board Director and Diversity Champion, commented: “Arup is firmly committed to providing a workplace that supports diversity. Our membership of Stonewall’s programme demonstrates our intentions to respect, welcome and support LGBT professionals in our business.”

Olympic Legacy Communities Scheme approved

The Olympic Delivery Authority Planning Committee recently granted outline planning permission for the Legacy Communities Scheme for the Olympic Park in London.

This development is seen as one of the most important regeneration projects in London’s history and will help stitch together the surrounding communities of the four host boroughs, providing around 6,800 new homes, schools, shops, parks, infrastructure and jobs.

The application was submitted by the London Legacy Development Corporation (LLDC) to fulfil the regeneration objectives of the London Olympic bid. Arup’s transport consulting team has provided planning advice and stakeholder consultation on strategic highway and rail operations, local highway modelling, and pedestrian movement studies for the project since 2005. These studies supported the Environmental Impact Assessments (EIAs) and planning applications for the Olympic Park in 2007, legacy transformation in 2010, and this latest major success for the Legacy Communities Scheme in 2012.



Siemens Urban Sustainability Centre

Two and a half years after announcing plans to develop a unique urban sustainability centre in East London, Siemens will officially open The Crystal to the public on September 19, 2012.

The Crystal seeks to be one of the most sustainable buildings in London. To optimise sustainable performance, Arup worked closely with Siemens to integrate sophisticated control and monitoring systems into the building’s design.

The Crystal incorporates several green features. As well as solar photovoltaic panels and ground source heat pumps, the building has a rainwater and foul water harvesting and treatment system, and is enabled for smart grid connection.

1 Detail of Arup’s UK Energy Legislation Timeline

2 The Crystal in East London



3

Brunel Lecture on tour



4

The frequency and impact of disasters is increasing, whether measured by loss of life or economic costs. This trend is set to continue as the risks associated with climate change are compounded by rapid urbanisation and environmental degradation.

In delivering her Brunel Lecture, the 9th in the series, Arup's Jo da Silva proposes that it is time for civil engineers to cease practising 'the art of directing the great sources of power in Nature for the use and convenience of mankind' and instead acknowledge the fundamental role engineers have to play in reducing the vulnerability of mankind.

The lecture will start touring globally later this year.

New approach to offshore wind turbine foundations

GRAVITAS Offshore Ltd has secured funding from DECC and the Technology Strategy Board's (TSB) offshore wind components technologies scheme to carry out research on the design and construction of concrete gravity foundations for large offshore wind turbines.

The company – wholly owned by the shareholders HOCHTIEF, Costain and Arup – will use the £556,250 grant to demonstrate the benefits of the foundation technique and also to develop standards for the solution type. Concrete gravity foundations using readily deployable UK labour resources and expertise are expected to play a key part in delivering Round Three offshore wind farm developments. GRAVITAS Offshore Ltd confirmed the ongoing work is designed to help demonstrate the cost-effectiveness of this approach against foundation technologies adopted hitherto for offshore wind systems in the UK.

3 Wind turbine with concrete gravity foundation

4 Arup's Jo da Silva

5 Arup's Naeem Hussain with HRH The Princess Royal



5

© Royal Academy of Engineering

Rewarding success

Naeem Hussain was recently awarded the prestigious Prince Philip Medal in the presence of HRH The Princess Royal. The medal is awarded biennially to an engineer of any nationality who has made an exceptional contribution to engineering as a whole through practice, management or education. As an Arup Fellow and Global Leader for Bridge Design, Naeem is a worthy recipient of the award.

Arup's Lee Franck and Stuart Ross have also recently been recognised for their contribution to the industry, both receiving a Rising Star Award for their achievements made in the early stages of their careers.

Lee's role in the design of the Timber Wave for the London Design Festival 2011 and her dedication as a mentor to university students contributed to her nomination. Stuart's involvement on projects including the Water of Leith Flood Prevention Scheme and the Early Careers Group at Arup won him recognition.

Best for business

London is working hard to keep attracting top business, says Baroness Jo Valentine, Chief Executive of business membership group London First.

Valentine has led London First, a not-for-profit group representing the capital's leading employers, through a decade of growth, the credit crunch and the current retrenchment.

For her, London's global outlook is vital to its success. "Britain is a small country and it's in our culture to have a global trading outlook," she says. "More than one in seven companies in London are foreign-owned and we welcome that. We're a hotel for the global business community."

"London attracts businesses from all over the world," Valentine continues. "Because we share a common language – or a version of a common language – we attract US companies. We've also got a longstanding relationship with India and the Middle East. And now lots of Chinese companies are using London as a toe-hold to explore Europe and the US."

Valentine points out that London is also attracting a healthy level of inward investment. "London seems to be a safe haven," she says. "There is less uncertainty in the UK than in the rest of Europe

to some extent because we are outside the Euro. There is a sense that the legal processes are robust and that politically, we welcome foreign capital and foreign investment."

"As a financial centre we are global because we trade currencies," she continues. "Only New York is in the same league as us. We now trade the Renminbi, the official currency of the People's Republic of China. And we have the supporting infrastructure - everything you need to put a deal together - within a few streets."

Valentine isn't complacent about London's position at the top: "International surveys often have us as number one. Our job is to make sure we stay there. With foreign direct investment into Europe we are the top destination for financial services. We must make sure we offer relevant financial services over the next 20 years."

To stay ahead, London First keeps in regular contact with its members about what they need for business – now and in the future. "We've gone to 70 people under 30 years old inside our membership and we're holding facilitated meetings

with them over six months so they can let us know what legacy they want current business leaders to leave," Valentine explains.

In the current economic climate, London First is working even harder to create a business-friendly environment. "We have a programme looking at New York, Singapore and Sydney over the next six months to see what the comparators are to understand what we should be learning," says Valentine.

She acknowledges that this summer has posed particular challenges for London as it hosted the Olympic and Paralympic Games: "Every day during the Games we had up to one million extra visitors in the city, making an additional three million journeys on the busiest days. This is over and above the regular 12 million journeys on public transport. Managing that at all our points of entry was a huge challenge, but the transport system coped well."

For Valentine, the challenge was worth it because of the legacy the Olympics will create. "My ambitions for an Olympic legacy are two-fold," she explains. "The



“There is less uncertainty in the UK than in the rest of Europe to some extent because we are outside the Euro. There is a sense that the legal processes are robust and that politically, we welcome foreign capital and foreign investment.”

first is that ‘brand London’ is enhanced for the foreseeable future, establishing the city’s place in the world. It’s great to see opportunities already opening up for London-based companies in Rio on the back of our exceptional preparations for the Games.

“My other ambition,” she continues, “is for the Games to have successfully acted as a catalyst for regenerating the East End of London. The challenge will be making sure that people have an opportunity to get jobs in the longer-term.”

“The Mayor of London has jobs and growth as a mission, as does the national government. It comes back to the business environment you create. The Mayor is keen on apprentices and I’m keen on apprentices. But businesses in London should also be more imaginative about how we bring in

the best available graduates. We need to think about who we employ and how we employ them.”

As it works to attract a strong workforce and keep London as a top city for business, London First has identified two competitiveness campaign priorities.

“Firstly, we need to have the air links to the rest of the world,” says Valentine. “We need to be doing more business with growing markets around the world, supporting our international competitiveness and growth, and for that we need to be able to get there.”

“Secondly, and closely aligned with that, is our immigration policy — making sure that we can attract the best and the brightest worldwide. Successful places attract the best people who want to work and study

there. We’ve got this new points system and we’re keen to make sure we have porous borders for highly talented people who can add value to London’s activities.”

“And we’re also looking at the long-term – where we wish to be in 20 years’ time so we can plot our way there,” continues Valentine. “We re-elected our Mayor in May this year, so we want to make sure that he is successful in his four-year term, ensuring we get strategic things sorted, such as the housing and commercial development that London needs to remain a vibrant city.”

Philip Dilley, Arup’s Global Chairman, is the Non-Executive Chairman of London First

London First

London First aims to influence national and local government policies and investment decisions to support the capital’s global competitiveness. It is a non-profit-making organisation and its agenda is independent of party political affiliations.
www.london-first.co.uk

Going places

How transport infrastructure can revitalise cities like London.

Some people have a deep affection for their transport infrastructure. “I know people who say they love even the smell of the Paris Metro,” says Eli Konvitz, an expert on urbanism working with Arup’s interchange design team.

Forecasts estimate that by 2031 there will be around 1.25 million more people and over 750,000 new jobs in London. So effective infrastructure is vital to securing London's position as a global business hub and attracting and sustaining the workforce that the city relies on.

For Konvitz, creating transport infrastructure that can transform the social and economic success of cities is about more than airports, rail lines and stations; it's about vision. He points to Arup's work on High Speed 1 (HS1) and the rail line's role in revitalising the Stratford area of east London as an example of what a vision can achieve.

Mark Bostock led the Arup team championing the right alignment for the Channel Tunnel Rail Link – the line that would become HS1. “We proposed a route that approached London from the east, with an intermediate station at Stratford, rather than from the south as British Rail wanted,” he explains. “This route offered a better

return for the UK because of the opportunity for regeneration in the Thames Gateway, its improved environmental impact and its connection with the existing rail network, enabling fast domestic stations on HS1.”

The £5.8bn HS1 has transformed travel between the UK and the rest of Europe. It's also helped to bring in over £10bn of regeneration investment, made the east of the city a more desirable place to live and given skilled workers from the south-east of England fast and easy access to the businesses of London.

Bostock points to the huge amount of work that went into creating the metropolitan hub of Stratford - home to the London 2012 Olympic and Paralympic Games. “Even before the Olympic bid was conceived, Stratford was the focus of one of the largest single planning applications the UK has ever seen. The work we did back then - the masterplanning, transport, environmental and infrastructure planning - has enabled Stratford to become an integral part of metropolitan London.”

Tim Williams, former UK government special advisor on housing, local government and urban regeneration, claims that having the right transport infrastructure was vital to London securing the Olympics and realising the benefits of hosting a major international event.

“For me, the rebranding of east London that's happening as a result of the Olympic Games is one of the most exciting things,” he says. “Perceptions are changing about where the area is – people now see it as part of central London because of the transport links that have been put in place.”

“This shows how capital programmes can create the context for a broader transformation,” Williams continues. “Local authorities need to ask: How can we use these capital programmes to transform areas? How can we use them to get people back into work? How can we use them to rebrand the district?”

Konvitz argues that projects such as HS1, the transformation of King's Cross Station and now Crossrail, show what happens when authorities are able to make a vision a reality.

“These projects illustrate the difference between aspiration and realisation,” he says. “There are lots of wonderful masterplans produced; the trick is realising the masterplan. Creating transport infrastructure that brings additional benefits for a city means thinking beyond the confines of that project – as Arup’s team did for HS1.”

Of course it’s not just about rail. Joined-up thinking is also vital when it comes to connecting domestic transport infrastructure with international air links. Heathrow Airport serves 29 of the top 30 world cities ranked by GDP, bringing business both in and out of the city. Access to the airport is a major focus for its management.

“Excellent surface access demands an integrated approach,” says BAA’s Surface Access Director, Allan Gregory. “Road, rail and aviation need to join together to develop strategies and create projects that will benefit passengers. If we’re really going to get more for less, then transport has to be integrated.”

Gregory points to the Heathrow Express as an example of excellent, integrated surface access. A rail line designed around aviation passengers, the Heathrow Express provides a direct link from Paddington Station to the airport, covering 15 miles in just 15 minutes.

Arup Director, Peter Gist, agrees with the need for this sort of approach. “If we want to maintain London’s position as a global business hub, we need to be thinking about an integrated transport policy for the UK as a whole,” he says.

“The Government has started the consultation process which will lead to a new aviation white paper for the UK. If this is going to deliver the right results, it must address airport and air services development as part of an integrated transport policy. Although the first consultation paper has not discussed the details of airport development yet, including the issue of hub airport development, there are encouraging signs that this approach is emerging.”

Konvitz argues that if future infrastructure for London is to spark successful urban demand, local authorities need to be empowered to make big decisions. “They need to create the plazas and spectacular entrances that we’ve come to cherish in many of London’s listed transport interchanges,” he says. “They need to be open to challenging the initial brief and they need to be supported to think in an integrated and holistic way.”

This is made difficult by the timescales

involved and the need to balance expenditure. “Crossrail has been something like 50 years in the making, and projects can typically take decades from conception to completion,” says Konvitz. “This makes it challenging because politicians tend to think in shorter electoral spans, so it’s hard to secure long-term financing, and it’s difficult to shape a project to serve the city of the future.”

“We try to model the costs and benefits of projects. But no model can predict the future, and it’s incredibly difficult to model a complex system like a city. We talk about evidence-based policy when in fact it’s often more a case of finding policy-based evidence to justify a decision. So in my view, using modelling for decision-making isn’t a replacement for a strong vision.”

Konvitz highlights the Paris Rive Gauche development as an example of where a strong vision has paid off. A neighbourhood on the left bank of the city’s 13th arrondissement, Paris Rive Gauche is an inner city, mixed-use, high-density development with a distinctly Parisian feel.

The brand new neighbourhood was built on top of old railway tracks, overcoming the problems of disconnection that they previously caused. Crucially, says Konvitz, transport infrastructure was built in from the beginning. The Metro and RER connections were essential to the success of the 130-hectare development which now houses 15,000 residents, 30,000 students, professors and researchers as well as creating 60,000 jobs.

It’s crucial that visions like this are given a chance to become reality in London, says Konvitz. “A strong vision can go a long way to overcoming the institutional inertia large projects face,” he says. “But we need to bring design into the planning process. Upfront investment in better design and planning is always worthwhile. Local and national authorities need the strength, capability and capacity to use projects to help them achieve broader and longer-term goals.”

And Allan Gregory agrees. “Economic growth and connectivity go together,” he says. “Our research shows that, after destinations available from an airport, the business community values surface access most highly. Like other passengers, they want a direct, seamless connection to their airport. With excellent surface access we can support London as a leading global city.”

¹ GLA Mayor’s Transport Strategy, 2010

² BAA Airports Ltd website: www.heathrowairport.com, 2012

³ Newham Council website: www.newham.gov.uk, 2012



© Daniel Chernits

Raising the bar

HS1 set the gold standard for transport infrastructure in the UK, and Arup’s work in developing the route for a link between London and the Channel Tunnel paved the way for the bid that won London the 2012 Olympic and Paralympic Games. Without it, the Olympic site at Stratford and its associated regeneration would not have occurred.

Arup’s involvement with HS1 dates back to 1989. The ‘Arup Alignment’ – approaching London from the east via Stratford – connected with the Europe-wide high-speed rail network and helped to regenerate areas of north Kent and east London. Against the odds, the UK Government adopted this private sector-initiated alignment for the Channel Tunnel Rail Link in October 1991.

Arup’s team, led by Mark Bostock, needed both vision and conviction to gather the political support required to realise their ambitious plans. “It was a huge political battle but also a huge policy battle,” says Sir Peter Hall, Bartlett Professor of Urban Regeneration and Planning, University College London. “And it was won on the basis of the evidence that this alternative line would deliver massive regeneration benefits.”

Lord Heseltine, who was Secretary of State for the Environment between 1990 and 1992 was an early supporter. “It seemed to me that Arup’s proposal had the great benefit of adding regeneration in the East End of London to the transportation connections with the Continent,” explains Heseltine. “I’ve no doubt that it played a part in opening up great opportunities.”

“The initiative that Arup took to secure the right line for HS1 demonstrates just how important integrated transport planning can be,” adds Bostock. “With the conclusion of the extraordinarily successful Olympic and Paralympic Games, London has resolutely moved east. A vision nearly a quarter of a century in the making has enabled a neglected area of east London to grow and thrive. Stratford is now firmly on the map.”

Smarter healthcare estates

Can your estate enable improved financial performance and optimal patient outcomes?

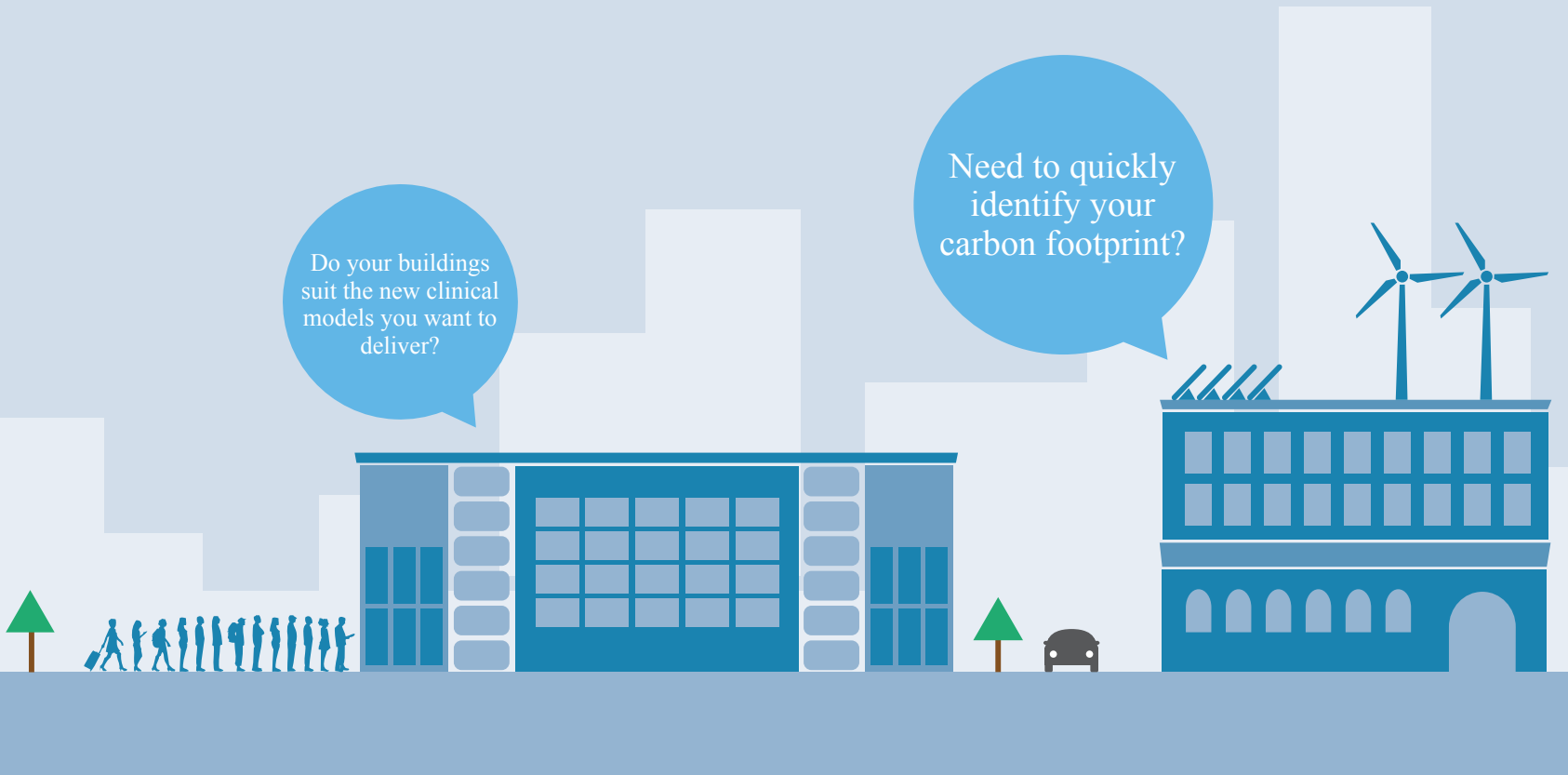
Today, healthcare providers in the UK are under increasing pressure to cut costs while meeting the changing needs of patients. In cities like London, many also face the problems that come with operating estates of tired buildings on constrained sites.

“The prognosis doesn’t have to be poor if providers get smart about their estates and think strategically,” says Arup’s Healthcare Business Leader, Stephen Pollard.



Do your buildings suit the new clinical models you want to deliver?

Need to quickly identify your carbon footprint?



“Through their estates strategy, healthcare service providers can create more suitable buildings, cut costs and reduce carbon emissions whilst mitigating risk.”

Pollard outlines the challenges now facing providers. “Service reforms mean healthcare providers need to deliver more services nearer to their patients as they treat the long-term conditions of the ageing population,” he explains.

“They need to do this with less money as the NHS faces an unprecedented flatlining of funds. So in response, large hospitals are getting larger and more specialist and smaller services are offering more generalised care to patients in the community.”

“The problem is that if you’re a chief executive of a healthcare provider, you might have inherited a mixed estate – maybe one PFI building, another from the 1980s, another from the 1960s and perhaps a Victorian building as well. That estate may not suit the services you now need to provide.”

This, says Pollard, is where the opportunity to think strategically lies. “If ever there was a time for an estates director who knows how to engage with senior leadership to understand the business plan and drive changes in the estate that support the plan, this is it,” he says.

Pollard argues that the role of the estates director has to change. “Historically, an estates director has been someone who kept things working and complied with standards and codes while dealing with an ever-dwindling budget and a maintenance backlog,” he says.

“Today, what’s needed is someone who can also help the executive team deliver capital programmes. These programmes can make a hospital more efficient, deliver care differently, make the organisation a great place to work and provide a welcoming environment for patients.”


“Some improvements to the estate might be relatively simple changes in response to new healthcare pathways,” Pollard explains. “For example, you might relocate

a reception area to improve the flow of patients or materials through a building. On a larger scale, it could mean rationalising an estate, selling buildings and using the capital to seed future reinvestment.”


“The challenge is combining a sound technical understanding of your existing estate and how much it might cost to change it, with a clear business model for your services. Do we need an outreach building in the local town centre as a priority or should we open the maternity wing we need on the main site? You’ve got to be able to answer questions like this.”

Answering these questions demands financial, clinical, programme management, property valuation, engineering and planning expertise – all in a short space of time. It’s this range of expertise that Pollard and his team at Arup bring to clients, and it’s this expertise that has helped University College London Hospital NHS Foundation Trust (UCLH) through the transformation of its estate.

“Trevor Payne, UCLH Estates Director,



Old, tired buildings causing difficulties for your estate strategy?



Unsure how to tackle your estate's inefficiencies?

has done a fantastic job rationalising their estate. From my desk I can see several buildings they've been able to sell-off to put the hospital into a new PFI building. The planning process needed to achieve this was very difficult but UCLH will now reap the benefits it brings."

Rationalising its estate has also enabled UCLH to build a brand new cancer centre. Opened in April 2012, the University College Hospital Macmillan Cancer Centre is a state-of-the-art building that puts patients' needs at its heart.

"Rationalising its estate paved the way for UCLH to build a centre that makes use of smarter design to create a fantastic environment for patients," says Pollard. "It considers every last detail. For example, by streamlining their processes, they ensure that patients spend less time waiting – and so the centre doesn't need many waiting rooms."

As well as transforming patient care, Pollard points out that smarter estates bring other benefits too. "Within the NHS there's a financial incentive for providers to reduce

carbon emissions and a more efficient estate can help with that," says Pollard.

"But sustainability is also about a smarter way of thinking. Looking at the resource efficiency in your estate enables you to see how you can improve processes so they're not only better for the environment but also better for patients and more cost-effective."

Pollard points to measures such as sharing Combined Heat and Power (CHP) networks or entering into a contract with an Energy Service Company (ESCO) to reduce the risk of supplying renewable energy. "These are the kind of solutions that healthcare providers are using but there's still scope to do more," he says.

So what will future smart healthcare estates look like? "You might see more vertical integration of services, or you might see a provider develop estates expertise and use this to host other providers within their campus," says Pollard.

"Taking on the role of a specialist property developer in this way isn't

something that every provider will be able to do. Providers that excel at it may use their expertise as an asset, generating income by hosting other providers."

"The possibilities are exciting but at a more basic level, I think a strategic approach to estates will give providers a genuine understanding of the value of their estate," Pollard continues. "They'll know how buildings contribute to financial performance, clinical outcomes, patient experience and sustainability."

How to create a smarter healthcare estate

1. Understand your existing estate – how are buildings performing?
2. Fix basic problems such as compliance with regulations
3. Plan capital projects that support your business plan
4. Design new buildings around the needs of your patients

Data for all

Smart cities: who is getting it right and where?

Large ICT firms often tell us that ‘smart cities’ are the future. By collecting information about our city systems – our energy grids and traffic networks – we will be able to manage them better and deliver a better service by making them more robust and energy efficient. But what does this mean for investment decision-makers and local business? And can smarter cities really have an impact on people’s everyday lives?

A ‘smart city’ is one that collects and leverages its data to meet its strategic objectives. Take Rio, for example. One of the most advanced city operations centres has just opened in the Brazilian city to help deal with the annual fatalities caused by flooding and landslides. The high tech situation room is designed to support the city in managing its services; combining better weather prediction with emergency service data to support its response to natural disasters.

This data is collected to deal with a specific issue, yet it’s becoming more and more apparent that such information may have a value beyond aiding operational efficiency to exploit – if it’s used in the right way. Rodrigo Rosa, Special Advisor

to the Mayor on Sustainability in Rio, explains: “Sometimes we don’t even know what it can do for us. We have people out there on the ground, working on their issue such as transport or security, but they aren’t used to looking at the data to do something different.”¹

Some cities are starting to make use of this available data by giving access to the public. The hope is that small companies and creative individuals will be able to utilise it to create innovative products and services for residents. The formation of the London Datastore, with an investment of under £15k, gave developers access to ready-to-use datasets that have been cleaned up and meta-tagged. The result has been the creation of many new apps for Londoners, including the Tube Deluxe, a guide to the London Underground transport system that has 50,000 active daily users and 350,000 downloads.²

New York has taken a similar approach, creating a ‘Big Apps’ competition that challenges its inhabitants to create value for the city by using data differently. One of the more innovative entries, 596 Acres, uses data about the city’s publicly-owned vacant lots to encourage people to turn them into usable public spaces. Through the app, a lot that had been vacant for two decades was transformed into a public garden that provides an open space for the community.³ Schemes like these



Smart information: Within two weeks of its launch in 2011, the London Bus Checker app went to the top of the UK travel app charts and has largely remained there. It covers journeys from all 20,000 bus stops in the capital. In June, we saw the launch of UK Bus Checker, providing real-time and scheduled bus information for nearly 300,000 bus stops around the UK. The app will be the first ever mobile app to include street-level bus route map information for the UK’s 17,851 bus routes. www.buschecker.com

¹ Arup, The Climate Group, Accenture and Horizon, University of Nottingham Information Marketplaces report, 2011

² Malcolm Barclay website, www.mbarclay.net, 2012

³ 596 Acres website: www.596acres.org, 2012

⁴ Technology Strategy Board press release, 2012

not only maximise local assets but support public ownership of the area.

Back in the UK, the Technology Strategy Board (TSB) estimates that by 2030 there will be a £200bn global market for integrated city systems. They have set up the Future Cities Catapult, forming part of the TSB's £200m-plus programme to establish and oversee a network of technology and innovation centres in the UK. The investment will enable the UK to position itself as a world leader in 'smart city' solutions which can be marketed to the rest of the world.

"Both future cities and transport systems will be incredibly important areas of growth in the next 10-15 years," says Iain Gray, Chief Executive of the TSB. "The market opportunity for effective transport systems is already valued at over £190bn per year. The proposed Catapult centres in each of these areas will help UK businesses gain an important share of these markets through more rapid commercialisation of new ideas."⁴

But getting the most out of the data in our cities requires expertise far beyond the technical systems offered up by technology companies. It requires us to bring together an understanding of city planning, economic development, sociology and sustainability, as well as sound engineering practice. By combining this knowledge and

working closely with city leaders, we can start to devise strategic investment priority plans that can deliver real value to cities in the short and longer term.

Tom Steinberg, Director of MySociety, a social enterprise that specialises in civic technologies claims: "The leaderships of cities need to understand that the process of becoming digital is not something that can be an outsourced task. It's about managing city systems in our own self-image."

Cities face tremendous challenges in the coming years: climate change, population growth, demographic change, urbanisation and resource depletion. While financial constraints continue to dictate city strategies, collaboration and cross-sector engagement is key.

"No single party holds the full set of tools to make informed, appropriate and innovative decisions that can address our contemporary local and global issues," says Volker Buscher, Director at Arup. "But if we encourage sensitive and informed dialogue between city leaders, smart city experts and the local community which translates into action, I see a great opportunity for cities to transform into thriving, healthy and happy places that are globally competitive."

And Tom Steinberg agrees: "Cities need to realise that they don't just have websites – they ARE websites."



Smart mobility: Business travellers can now use on-demand Personal Rapid Transit (PRT) 'pods' at Heathrow Terminal 5. The futuristic-looking vehicles travel on their own guideway, removing the need for queuing and buses. Pod system developer, Ultra Global PRT, and its promoter, BAA, are hoping others will adopt the system. "It is now up to the creativity of designers to find applications," says Austin Smith, Associate Director at Arup. "In the right context, PRT could provide significant personal, environmental and commercial benefits over other more conventional forms of transit. PRT could open up a whole raft of new opportunities, enabling fresh approaches to land-use planning and personal mobility." www.ultraglobalprt.com

mysociety.org

Smart democracy: Social enterprise, mySociety, builds open source websites which benefit the civic and community aspects of people's lives. For example, 'TheyWorkForYou.com' allows the public to easily view what their MP has been doing in Parliament, whilst 'WriteToThem.com' allows people to contact their local representative. "We live at a moment where many of the most important politicians in our country and others overseas are actually eager to stand up and say that open data is an important priority for them, and for their nations," says Tom Steinberg, Director of mySociety. www.mysociety.org

Self-funding the future

London is largely dependent on national budgets to fund developments to its infrastructure but all that could change – and should, argue Arup’s Alexander Jan and Ben Berman.



Over the last few years, London's economy has taken a number of blows. With its high dependence on financial services, the city has had a torrid time. But look closely at the latest statistics – and at the city's skyline – and you will see signs of life. London may be turning a corner.

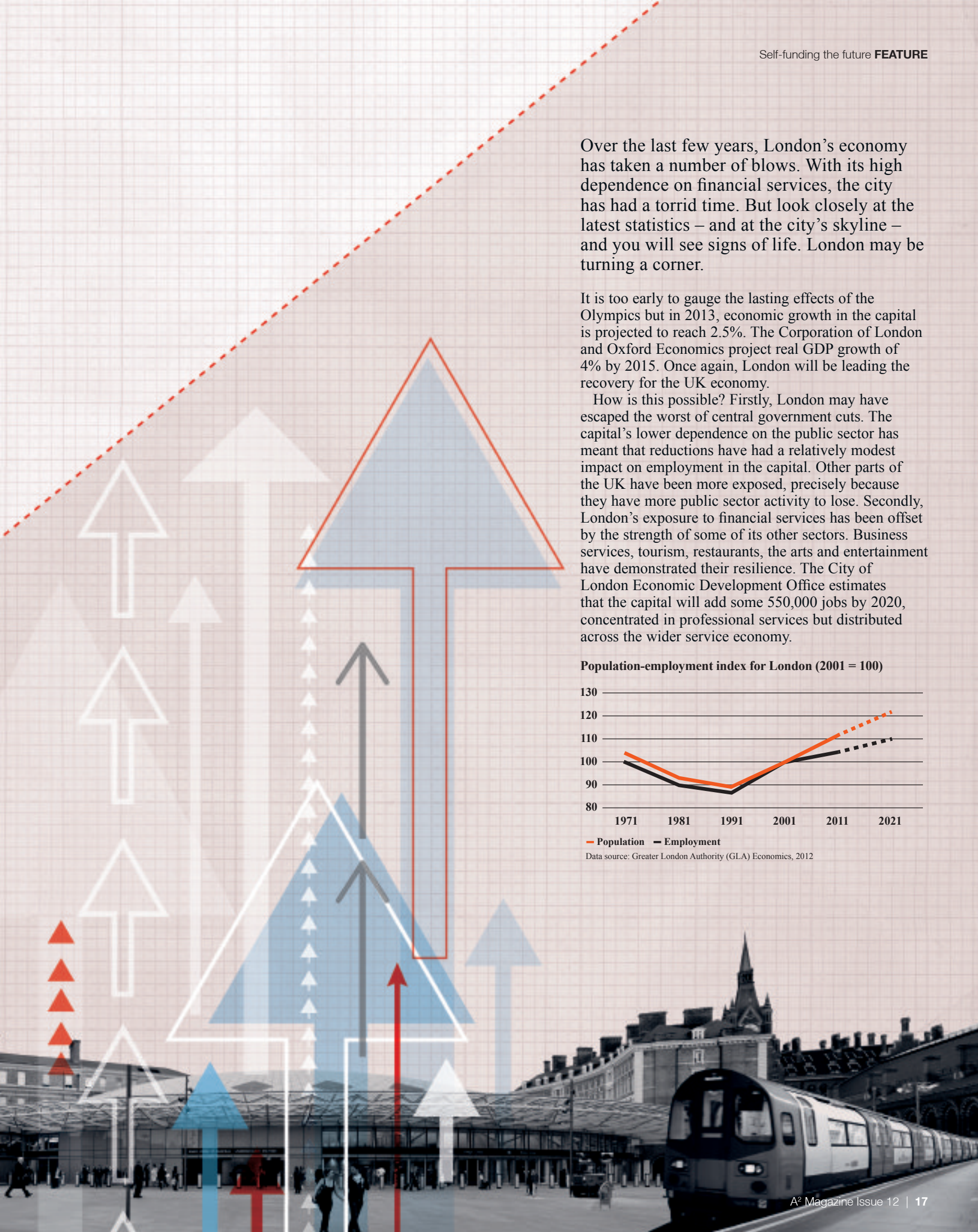
It is too early to gauge the lasting effects of the Olympics but in 2013, economic growth in the capital is projected to reach 2.5%. The Corporation of London and Oxford Economics project real GDP growth of 4% by 2015. Once again, London will be leading the recovery for the UK economy.

How is this possible? Firstly, London may have escaped the worst of central government cuts. The capital's lower dependence on the public sector has meant that reductions have had a relatively modest impact on employment in the capital. Other parts of the UK have been more exposed, precisely because they have more public sector activity to lose. Secondly, London's exposure to financial services has been offset by the strength of some of its other sectors. Business services, tourism, restaurants, the arts and entertainment have demonstrated their resilience. The City of London Economic Development Office estimates that the capital will add some 550,000 jobs by 2020, concentrated in professional services but distributed across the wider service economy.

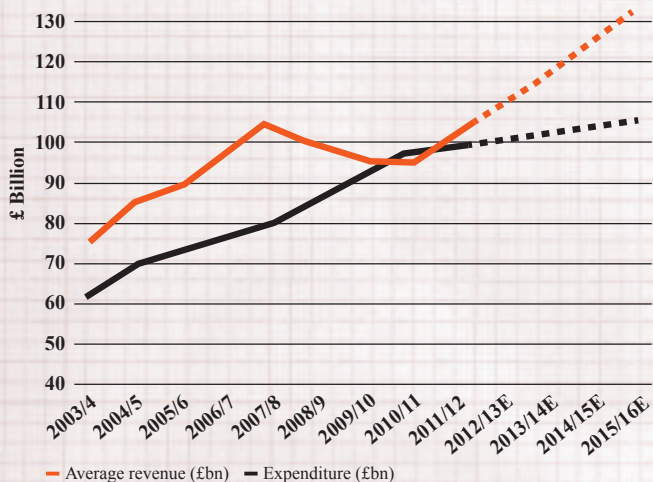
Population-employment index for London (2001 = 100)



Data source: Greater London Authority (GLA) Economics, 2012



London's contribution to UK public finances (nominal)



Source: City of London Economic Development Office; Oxford Economics, 2012

The economy is not the only thing that's growing. Recent estimates from Greater London Authority (GLA) Economics signal that the population will continue to increase. In the 1990s, when many UK cities shrank, London grew by nearly 5%, with the growth driven by a high birth rate and migration. In the latest census for 2011, London's population increased to 8.17 million. It could exceed nine million by 2020. That would be the city's largest population for over 200 years and more than 19% up on 2001.

For decision-makers, population increase on this scale raises big challenges. There will be increased pressure on transport, housing, education and other public services. Infrastructure is subject to increasing strain. Concentrations of economic under-performance and deprivation generally persist, regardless of growth. London could become a less attractive and competitive city. Evidence from the 1970s and '80s suggests that without investment to replace and enhance its fabric and to better connect its inhabitants, London will struggle. That in turn may undermine economic growth and the economic position of the UK economy as a whole. A case for investment is evident. But who should pay for improvements?

Left to its own devices, London could pay its own way. According to research for the Corporation of London, between 2003/04 and 2010/11, the capital made a net cumulative contribution of around £80bn to public finances. London's tax payments are projected to increase by some £38bn per annum in the coming years, whilst public expenditure is set to increase by only £8bn. By 2015/16, London's net contribution is forecast to return to a record

£27bn per annum.

At present, financial self-sufficiency is not politically realistic. The taxes and charges that Londoners and businesses pay are largely taken by central government. VAT, fuel duty, air passenger duty, income tax, corporation tax, the lion's share of business rates (for now) - all these drop into general taxation. Some 50% of the GLA's budget comes from government grants, compared to just nine percent in New York. When it comes to taxes, England remains one of the most centralised countries in the western hemisphere.

However, changes are afoot. The Coalition is progressing reforms to allow local authorities to retain income associated with, for example, new developments. A reform of business rates is on its way that could dramatically reconnect councils with businesses located in their areas. Transport for London, the body that is responsible for all public transport in the capital, has been allowed to engage in "prudential" borrowing against future farebox income.

But are these changes sufficient? Take the Underground. Next year will be its 150th birthday. It has been carrying over 1.1 billion passengers annually and is only perhaps half-way through a rebuild and expansion. Crossrail's opening in 2018/19 will add some 10% capacity to the London rail network. Thameslink is in delivery but these increases could be largely used up by 2030. Much of the suburban railway operates at peak time capacity, with little further opportunity for expansion. With big portions of London's growth anticipated to be in the suburbs, pressure on the road network will rise.

Significant projects in the Mayor's Transport Strategy, including "Crossrail 2" (previously the Chelsea-Hackney Line)

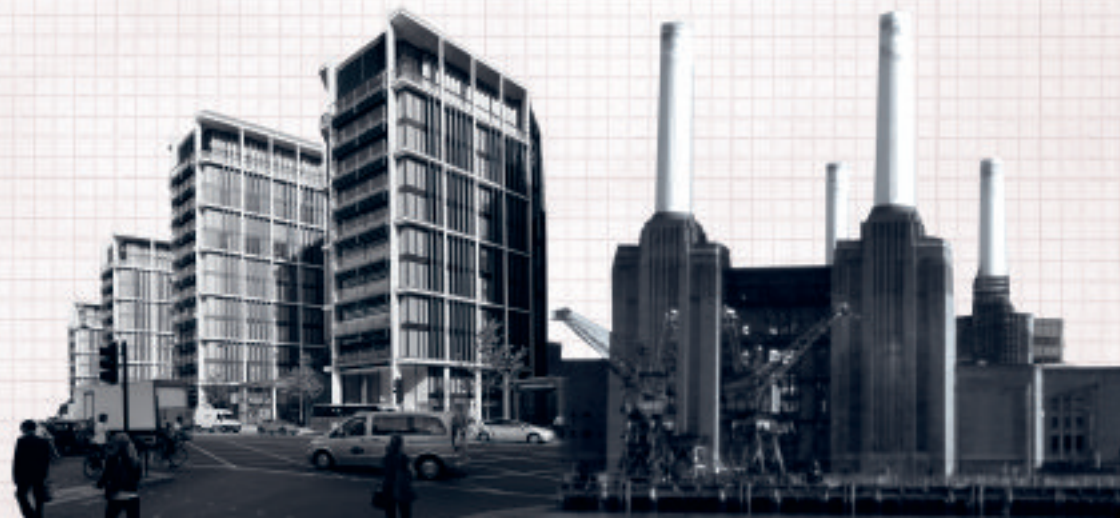
and Northern Line extension to Nine Elms, a major development site just south of the river, wait in the wings unfunded. High Speed Two will also require scarce public resources. As growth returns to London and the South East, roads, railways and the Tube risk being ever more congested, struggling to play their part in supporting employment.

An 'alphabet soup' of funding policies is on offer to help to fund capacity expansion. The Government has already announced that local authorities should have borrowing powers linked to future growth, introducing the Community Infrastructure Levy (CIL) and Tax Increment Financing (TIF) policies in the past two years. Then there are the 'City Deals'.

Existing legislation stipulates that local authorities may only borrow within "prudential" rules. Historically, local authorities have been unable to retain business rates and cannot borrow against them. TIF and other such policies open the system, permitting additional leverage for local infrastructure based on the anticipated increase in business rate tax receipts incurred as a result of development. Such funding mechanisms are likely to contribute a reasonable share to major projects' development costs.

London's major development projects already rely on local funding. Arup analysis shows that London is contributing some 60% of the £15bn total project cost for Crossrail. Non-domestic occupants are paying a levy of 2% per annum on properties with a rateable value in excess of £55,000. Fare yields are being used to back borrowing. Alternative taxation policies (in England) such as 'New Development Deals' and 'Earn Back' retain the local focus of funding and permit authorities to capitalise directly on incremental business growth.

TIF could work especially well as a means of financing transport infrastructure in London. Take the proposed Northern Line Extension as an example. The project, adding a branch to a line of the London



Underground system in its southern reach, will help regenerate a significant portion of London and generate 'windfall' gains for Battersea. Wandsworth, the local authority in which much of Battersea is located, contributed some £86m of non-domestic tax receipts to the national pool in 2010/11. Other changes could permit the authority to retain much of this and borrow against it going forward. How much might growth in Battersea's business rate receipts provide?

Other councils and areas under development provide some indication of tax potential. The Shard, a gleaming mixed-use tower in Southwark which is the European Union's tallest building, could generate as much as £15m per annum in business rates. Further to the west in Battersea, higher densities will grow the area's tax base.

Central London's councils provide some indication of growth potential. Westminster contributed some £1.2bn in business rates in 2010/11. Camden, which has a smaller share of the city centre, provided a more modest £359m, reflecting the fact that it covers less of central London. If Wandsworth, which is more suburban, were to generate even a third of Camden's

London's major development projects already rely on local funding. Arup analysis shows that London is contributing some 60% of the £15bn total project cost for Crossrail.

contribution, the annual increment in tax receipts would be some £34m.

Back-of-the-envelope calculations show that TIF could help to fund a good portion of a Northern Line extension. Analysis by Arup and the London School of Economics suggests that future business rate receipts could increase by £30m annually. The GLA and others have estimated that the Nine Elms extension could cost some £500m to £700m. Assuming 5% capital costs over 20 years, the total amount payable would translate to annual payments of between £40m and £60m. Extending the payment period to 30 years would reduce annual payments by 20 percent to between £32m and £48m. Growth in future receipts from Wandsworth alone might provide more than 60% of the annual development costs for the line.

All these changes are pulling in the right direction. But lasting, radical reform needs to be pursued. There needs to be a further handing back of power from Whitehall to city halls. This should include making local government much more dependent on its own tax base for infrastructure development. There is a pressing case for lasting, stable investment vehicles. Sources of funds for councils could include a share of sales, payroll, aviation and vehicle taxes. A virtuous circle would be created of authorities being financially incentivised to nurture private sector economic and employment growth whilst improving accountability to voters and business.

Private finance would become easier to tap. New infrastructure such as the extension of the Underground to Nine Elms and Crossrail 2 could be accelerated.

Inevitably there will be risks and challenges to this process. Important questions over the impact on the rest of the country will need to be addressed, not least the North-South divide. But if the economic crisis has taught us anything, it is that policy makers should maximise opportunities for sustainable economic growth, from wherever they come. London would be more capable of accommodating a burgeoning population and employment. It would be in a strong position to help meet the UK's economic challenges.

The Government has offered 'devo-max' to Scotland, a way of giving it a great deal of autonomy without full independence. Why not treat London in the same way?

Alexander Jan and Ben Berman are both in Arup's transaction advice team. Alex is Head of Transport and Ben is a senior consultant.





“The time for trials and experiments is over – we are putting in place large scale programmes that can deliver significant CO₂ reductions and billions of pounds of energy savings.”

Boris Johnson, Mayor of London¹

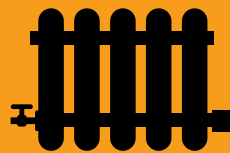


CASE STUDY: London Borough of Brent

One of the boroughs that has already benefited from the Decentralised Energy for London programme is the London Borough of Brent.

Its South Kilburn regeneration area is an attractive site for decentralised energy because it is intended for a mix of uses including 2,400 homes which will be built over the next 11 years. This means that the heat demand will be spread throughout the day. For example, houses and flats have the highest demand in the mornings and evenings, whereas offices and schools have their peak demand in the middle of the day.

Joyce Ip, Regeneration Project Manager for the London Borough of Brent states: “The technical and commercial support we received has been invaluable. The team advised us on tender documentation, procurement routes, and undertook technical and financial modelling to assess the viability of our project. The Decentralised Energy for London programme has helped us to realise our decentralised energy potential and has assisted us in bringing this project to market.”



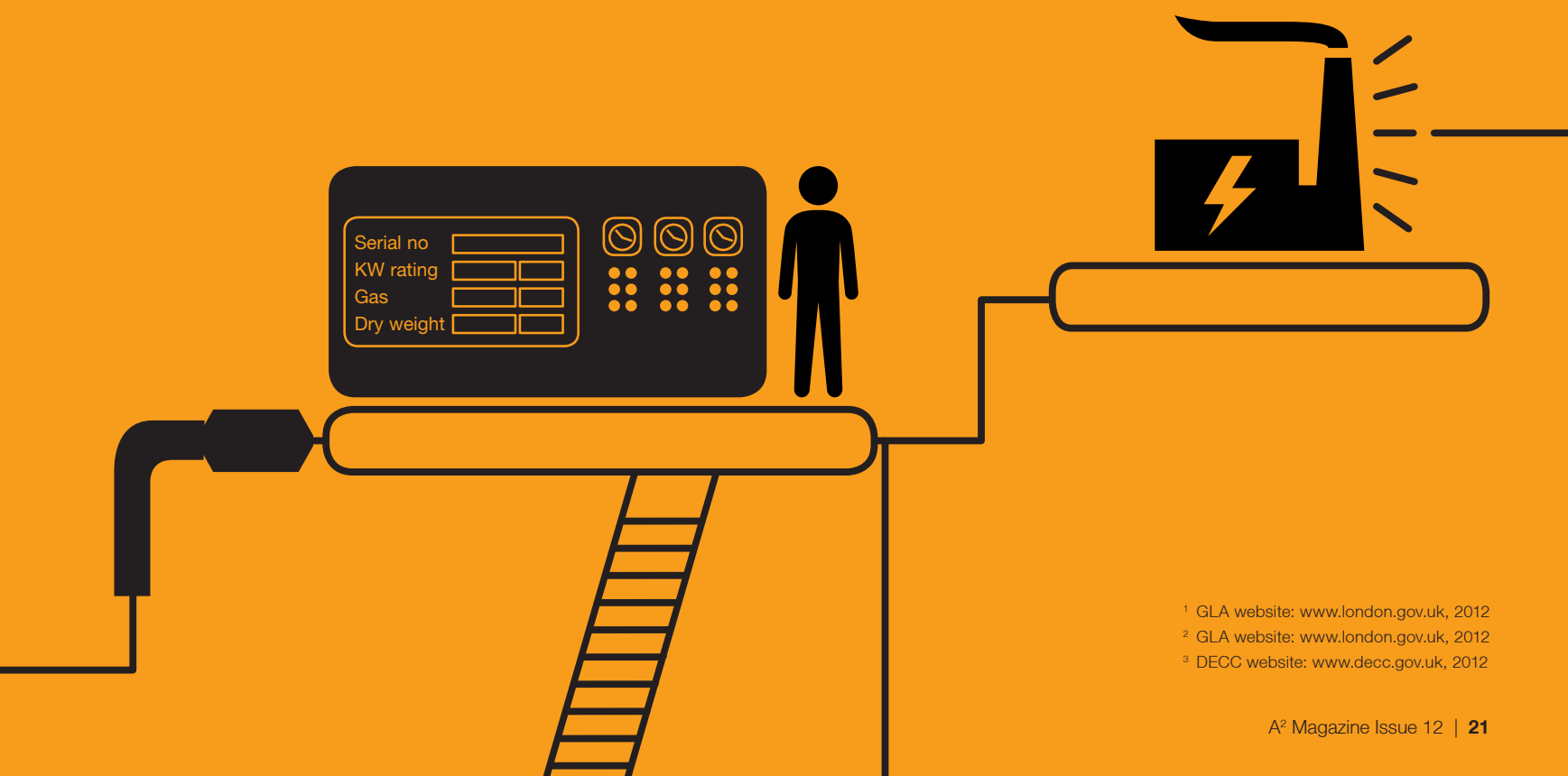
De-carbonising London's energy supply

London has a target to deliver 25% of its energy through decentralised energy sources by 2025 but what is it doing to get there and is it on track?

The Mayor of London, Boris Johnson, has an ambition for the capital to become a low carbon economy and has outlined a number of commitments designed to achieve major reductions in London's carbon emissions.¹ One of the most ambitious commitments focuses on London's use of decentralised energy: the generation of energy or heat close to the point of use which is regarded as a sustainable, secure and cost-effective approach to generating low to zero carbon energy.²

At a national level, the Department of Energy and Climate Change (DECC) has recently renewed its focus on lower carbon heat, stating that: "Heat is the single biggest reason we use energy in our society. We use more energy for heating than for transport or the generation of electricity. This year the UK will spend around £33 billion on heat across our economy."³

Somewhat surprisingly given this recent surge of interest, decentralised energy is not new according to Paula Kirk, an associate in Arup's energy strategy team: "There are a number of district heating networks dating back to the 1950s, including the use of waste heat from Battersea Power Station to supply housing estates across the Thames in Pimlico. In addition, Scandinavian cities have been reliant on district heating systems since the 1970s."



¹ GLA website: www.london.gov.uk, 2012

² GLA website: www.london.gov.uk, 2012

³ DECC website: www.decc.gov.uk, 2012



“The great thing about DENet is that it’s quick, simple to use and allows local authorities to take direct control of the assessment process” says Kirk



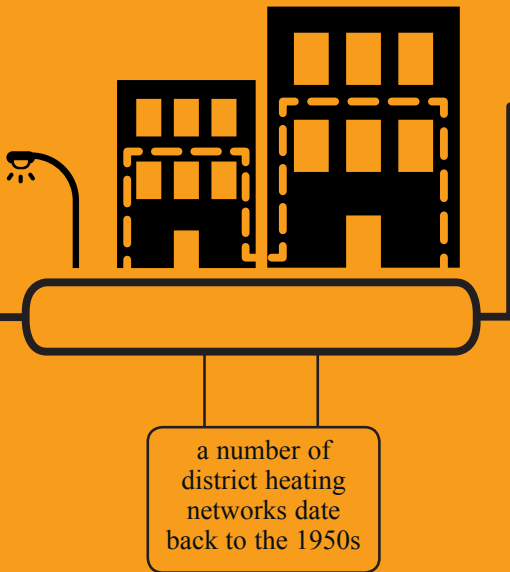
This is all good news but is the capital likely to meet its decentralised energy target by 2025? Judging by how far it has come in a relatively short space of time, Kirk believes that it will. “London has been on a long journey over the past six years: from identifying the potential for decentralised energy using heat maps; to capacity building through providing training, support and advice to local authorities; to delivery and actually putting pipes in the ground. We’re really beginning to get some traction and see real results.”

This hasn’t happened by accident. It has been orchestrated by the Greater London Authority (GLA) which has set the decentralised energy agenda for the capital and put in place appropriate funding and support mechanisms for the 33 London boroughs. What is particularly encouraging is that the decentralised energy targets have survived a change of political leadership – having been set by Ken Livingstone but then reaffirmed by Boris Johnson.

Planning for decentralised energy infrastructure in London began in earnest with the London Climate Change Action Plan, published in early 2007. The Decentralised Energy Master Planning (DEMaP) programme which ran from 2008 to 2010, with significant consultancy support from Arup, turned targets into a delivery roadmap. This produced significant enabling research, such as the London Heat Map, which is still being used today.⁵

The Heat Map outlines supply and demand to identify where Combined Heat and Power (CHP) and district heating schemes may be feasible. Once decentralised energy opportunities have been identified, more detailed technical and financial feasibility studies can be carried out. “In London, having a common map has helped to join everything together across local boundaries so that a large heat demand in one borough can easily be linked to a source in a neighbouring area,” explains Kirk.

A number of boroughs were quick to embrace this new tool and move it on to the next level. For example, having worked with the London Borough of Haringey right from the beginning of DEMaP, Arup was quickly commissioned by them, with funding from DECC’s Local Carbon Frameworks programme, to produce a pre-feasibility tool. Named the Decentralised Energy Network Assessment Toolkit (DENet), the tool was designed to help local authorities and other stakeholders determine which decentralised energy opportunity areas offer the greatest potential to curb emissions and help local residents and businesses reduce their energy costs.



However, London’s renewed commitment to this form of energy generation and the progress it has made in recent years mean that it is considered to be leading the way in the UK and there is increasing momentum nationally. “DECC is looking to London and the work that has already been carried out to help shape policies around the National Heat Strategy,” explains Kirk. Launched in March 2012, the strategy describes how the heat distribution system will need to develop over time with stakeholder consultation expected in the next 12 months to determine specific policies.⁴

⁴ DECC website: www.decc.gov.uk, 2012

⁵ London Heat Map website: www.londonheatmap.org.uk, 2012

⁶ EIB website: www.eib.org, 2012

⁷ GLA website: www.london.gov.uk, 2012



25%

By 2025, London aims to deliver 25% of its energy through decentralised energy sources

Although the London Heat Map and DENet were and are incredibly useful and have expedited a number of decentralised energy projects, the GLA was keenly aware that technical know-how and access to funding were two major hurdles to quick implementation. As a consequence, it took the next logical step and initiated a programme to provide London boroughs and other project sponsors with technical, financial and commercial assistance to develop and bring decentralised energy projects to market. Decentralised Energy for London was set up in 2011 with €3.3m funding, 90% of which was secured from the European Investment Bank's ELENA facility.⁶ It has already supported 29 decentralised energy projects and aims to facilitate over £95m of projects before summer 2014.

Following a number of similar queries from boroughs regarding the technical design of district networks, the Decentralised Energy for London team is now seeking to establish standardised guidance for the delivery of projects and for their operational phase.⁷ This will take the form of a London District Energy Manual for developers, network designers and energy producers and "is designed to improve the efficient delivery of decentralised energy schemes through a London-wide network," according to Kirk.

Although this framework and the support being put in place to deliver it are still developing, it seems that the future for decentralised energy in London looks bright. There are now four dedicated decentralised energy officers in London (two in Islington and one each in Haringey and Croydon) and the boroughs are beginning to really drive implementation on the ground.

"If the decentralised energy community can raise awareness of London's success to date, both within the capital and beyond, we should be able to meet the 2025 target and make a significant contribution to achieving Britain's national carbon reduction targets."
says Kirk.

Climate control: preserving the world's heritage



As the world's largest museum of decorative arts, the V&A is leading the way in conserving priceless artefacts with a passive control strategy that could provide up to 30% energy savings compared with traditional approaches.

London has a rich heritage of over 240 museums. Of paramount importance to these bodies is the way in which they conserve the treasures they hold. This is not only vital for their permanent collections but also their temporary exhibitions which generate a significant amount of revenue and are often made-up of artworks on loan from galleries and owners across the world.

Unless a museum can guarantee adherence to international regulations about maintaining the right temperature (70°F or 21°C) and 'relative humidity' (50%), it is not seen as suitable to borrow great art and artefacts.¹ However, over the years this 'one size fits all' requirement has resulted in spiraling energy consumption and costs. Consequently, there have been calls to take a more tailored, less energy-intensive approach.

In 2009, the National Museum Directors' Conference (NMDC), which represents leaders of the UK's national collections and major regional museums, developed a set of guidelines for reducing the carbon footprint while ensuring that standards of conservation are maintained. Their guiding principles state: "NMDC recognises that museums need to approach long-term collections care in a way that does not require excessive use of energy, whilst recognising their duty of care to collections. There is general agreement within the international museums community that it is time to shift policies for environmental control, loan conditions and the guidance given to architects and engineers, from the prescription of close control of ambient conditions throughout buildings and exhibition galleries to a more mutual understanding of the real conservation needs

of different categories of object, which have widely different requirements and may have been exposed to very different environmental conditions in the past."²

As the world's largest museum of decorative arts, the V&A is leading the way in adopting these policies. In 2001, it launched its FuturePlan to transform the Museum through new galleries and beautiful redisplays of its collections.³ The first 10 year phase of FuturePlan cost £120 million and saw around 70% of the Museum's gallery space redisplayed.

Phase 1 was completed with the opening of the acclaimed Medieval & Renaissance Galleries which use a passive control strategy that could provide up to 30% energy savings compared with traditional approaches. By allowing the galleries to operate within wider humidity and temperature ranges than standard, conditions are controlled without the need for cooling or humidification. The operating ranges were set from an understanding of the needs of the collection; individual objects with more particular requirements are displayed in cases that provide a buffer against the environmental fluctuations. The system is fully automated and last summer conditions were within the desired control bands for 99.5% of the time. Light is also controlled to differing degrees for different objects, again based on the particular needs of the collection.

Andrew Lerpiniere, Associate Director at Arup, led the team working with the Museum and states that: "The challenges addressed here are an industry-wide issue so the Medieval & Renaissance Galleries project is an important test-bed for museums and their movement towards reduced energy use and greater sustainability."

Since Summer 2011, the V&A has been concentrating on the Europe 1600-1800 Galleries but as Steve Hyde, Head of Estates at the V&A, outlines: "We are committed to a long-term sustainability solution not just for the objects here but for those in storage as well."

The importance of humidity

The Museum's pioneering approach for the Medieval & Renaissance Galleries is based on recognising that what affects most objects in a detrimental manner is not temperature but humidity, and in particular changes in relative humidity. Rapid changes

have the worst effect. Humidity and temperature are closely linked.

Lerpiniere explains that: "The system works to maintain stable relative humidity levels in the range of 30% to 70% using ventilation and heating only. Ventilation is controlled on moisture content so that it only operates when it is helping the internal conditions. For example, if the gallery is dry but the external air is dryer, then the system won't run."

Further energy savings are made as the system operates for a reduced amount of time compared to a traditional system. This is balanced against requirements for maintaining indoor air quality. It was found that the system purges enough air when it is operating that air quality is maintained during the periods when it doesn't run.

Curators are rightly concerned that their precious objects should not suffer stress or damage. "Modelling using thermal analysis software played a big part in persuading the Museum that we should do this," says Lerpiniere. "One of the things that was really difficult to model and predict was how quickly the humidity would change – the fluctuations over a 24-hour period." He anticipated that the building would behave better than the theoretical calculations showed and this has proved to be correct. "The fabric of the buildings has a dampening effect," he says.

Further adoption

This new approach to conservation has been so successful that the Museum is adopting a similar approach for the new Europe Galleries, on which Arup is also working, with ZMMA as the architect. In addition, according to Hyde: "A lot of other museums are talking about having similar strategies."

The approach may be applicable to museums that have comparable climatic conditions but more extreme climates are likely to require a greater degree of intervention. For example, Arup is working on the Kolkata Museum of Modern Art in India and also on the Orientalist Museum in Doha, Qatar. Both have far more challenging climates than London does. Referring to Kolkata, Lerpiniere says: "We will never manage without cooling."

¹ Vanessa Thorpe, The Observer, 13th November 2011

² National Museum Directors' Council website: www.nationalmuseums.org.uk, 2012

³ V&A website: www.vam.ac.uk, 2012

Caring for objects at the V&A

Every object in a gallery is different and conservators have to ensure that they are kept in the best possible conditions. Here we look at a selection of objects in the V&A; at their requirements and at how those requirements are satisfied.



Boar and bear hunt tapestry

This woollen tapestry was made in Arras or Tournai in France and dates from 1425-30. At 11m long, it was a challenge to find a suitable space to display it. The tapestry is sensitive to changes in humidity but it is also very prone to light damage – some dyes are typically even more light-sensitive than the pigments used in paints. The tapestry is therefore kept in a part of the Medieval and Renaissance Galleries that is at a light level of 50 Lux. “One of the things the galleries have done well is to create light levels that are low without making the space feel gloomy,” says Charlotte Hubbard, Head Sculpture Conservator at the V&A. “Although the aim is to rotate light sensitive objects, it’s not the case with this one as we don’t have a replacement.”



Tuscan cross

This figure of Christ was made out of poplar wood in about 1250. It was originally painted and there is also some decoration with tin leaf. It has been repainted several times over its life. Hubbard explains: “Any wooden object will respond to moisture levels in the atmosphere. It will both absorb and give up moisture. We want it in an environment that is as stable as possible.”

The cross sits in the Medieval & Renaissance Galleries. “With the Arup system we are aiming to get as little fluctuation as possible,” says Hubbard. The object has been on open display ever since it came to the museum, and will continue to be. The conservators have determined that the light levels should be below 250 Lux – a comfortable but not bright level of light. This was worked out on the basis that displaying the object at this level for 25 years would not cause any damage to the painted surface.



Ardabil carpet

Made in Iran in about 1539, this magnificent – and enormous at 10.51 by 5.34m – silk and wool carpet is unique in its size and splendour. It forms the centerpiece of the Jameel gallery and, because it is so special, needs to be on display all the time. There are no ‘alternatives’ with which it can be rotated on display. Instead, the museum has taken an approach which limits the amount of light that strikes it, by illuminating it at 50 Lux for 10 minutes out of every 30 during opening hours, and keeping it in near-dark the rest of the time. It sits on the floor in a huge glass box which helps protect it from changes in relative humidity, with a polyester felt below it that won’t restrict the movement of fibres if any changes do occur. The case, which is of non-reflective glass, also helps to protect the carpet from dust.

What are your thoughts on the issues facing us all in creating a better world?

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