From stadium to street:

What could we learn from the staging of the Games?

February 2012



Experts

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Methodology

This report by Future Poll, the research division of The Future Laboratory, was commissioned by GE to investigate sustainability and the Olympics, now and in the future.

A combination of quantitative and qualitative research and analysis underpins this report, spanning extensive desk and visual research, and includes expert interviews on key themes as well as a consumer survey. This was conducted online in September 2011, polled 4,000 respondents aged 18+ living in Brazil and the UK.

Unless otherwise stated, statistics in this report refer to this survey, and should be credited thereafter as 'Future Poll for GE, 2012'.



Foreword

Welcome to this GE report, undertaken by Future Poll, entitled 'From stadium to street: What could we learn from the staging of the Games?'

As a sponsor and Sustainability Partner of London 2012 and a worldwide Olympic Partner through to 2020, GE is the exclusive provider of a wide range of innovative products and services that are integral to staging a successful Olympic and Paralympic Games. We work closely with host countries, cities and organizing committees to provide infrastructure solutions for Olympic Games venues including power, water treatment and transportation, and to supply hospitals with ultrasound and MRI equipment to help doctors treat athletes.

As part of this we are also very conscious of the longer term impact that the Games must leave behind in terms of a legacy for the host country. Indeed, as part of our commitment to each of the past three Olympic and Paralympic Games, we have provided a legacy gift to the local community. For London this has taken the form of £4.8 million of equipment to a new neonatal unit at Homerton University Hospital to address the local challenge of high infant mortality rates for years to come.

The purpose of this report is to examine a central hypothesis born out of our experience of helping to create the infrastructure of Games past and present: that the Games act as a useful test and learn environment which demonstrates the infrastructure, transportation, power and healthcare challenges we face in our future. Does the intense global focus on the Games help to create and highlight such challenges and help us focus on creating inventions of consequence that eventually find their way into our societies?

If so, this is the true 'legacy' of an Olympic Games and it is how we should judge success. The Games are a global showcase of how we power, move, build and cure our environments in terms of energy, transport, infrastructure and healthcare. The extent to which we learn from the challenges this presents and what we learn from the application of technology to address such challenges should extend beyond a simple sporting contest.

Our researchers, Future Poll, spoke to a number of leading experts in a variety of specialist fields and, combined with existing desk research and some original consumer research in the UK and Brazil, have produced a thought-provoking report which seeks to assess the true impact and legacy of an Olympic and Paralympic Games – beyond London 2012.

We hope you find it as interesting as we have.



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As you approach London 2012's Olympic Park your eye is drawn to one thing: the elegant new stadium that dominates the skyline, which will soon be the focus of the dreams and excitement of billions of eager spectators around the world.

Perhaps that is as it should be. The Games are, after all, about a group of elite athletes, straining every sinew to the maximum to prove they are the best in the world – and this is their stage.

Yet there is another, more self-effacing, structure at the west end of the park – the Olympic Park Energy Centre – which stands as a monument to another admirable element of the human spirit: our drive to tread more softly on our planet.

Of course, all the astonishing statistics surrounding the staging of the 2012 Olympic and Paralympic Games in London are at the forefront of everyone's minds. Hidden behind the infrastructure superlatives, however, is the Games' great green secret – their hugely important role as a global shop window for the emerging sustainable technologies that will shape all of our cities and lives over the next two decades.

As **Gareth Wynn**, Group Director of EDF's Olympic & Paralympic Programme, says: 'Apart from being an important part of reducing the carbon footprint of the Games, the use of these technologies will act as an important showcase for alternative energy, raising its profile among the population at large.'



It is a message that the public clearly still needs to hear. Six in 10 (61%) people in the UK – and 76% in Brazil – see the Olympics as a force for good, according to our survey of 4,000 people. In Brazil, 71% of people say they can already see clear and visible benefits from hosting the Games in 2016. Yet, despite this overwhelming optimism about the positive impact of the Olympics, the truth about their function as a sustainability role model is failing to hit home.

According to our research, 25% of Brazilians, and just 12% of people in the UK, believe that the Olympic Games will leave behind technologies for wider society to inherit.

Only 17% of people surveyed in Brazil – and only 5% in the UK – believe that the Olympics will improve their country's green credentials or reduce environmental damage. And 46% of people in the UK believe that the cutting-edge technologies on display at the Olympics are unlikely to trickle down into wider society once the Games are finished.

This is an information gap that London 2012 – and the Games that follow in its wake – will go a long way to plugging, according to leading sustainability experts.

As **Tom Gater**, of global sustainability consultants Futerra, says: 'The Games are an opportunity to leave a brain-print on billions of people about the way in which sustainable technology and thinking can be an authentic and integral part of their world and their life.'

The power of the link between elite sport and green technology cannot be overestimated. 'The Olympics are the pinnacle of human achievement and excellence,' says **Dr Gary Kendall**, Deputy Director of the Cambridge Programme for Sustainability Leadership in South Africa. 'A global audience will assume the same level of excellence for the sustainable technology associated with the Games, and will be that much more prepared to accept it into their everyday lives.'

This report reveals the full extent of the sustainable ethos that lies at the heart of London 2012. It assesses how green technology and thinking will not only evolve to shape future Olympic Games – but the cities, homes and communities in which we all live.

It examines the Games' influence, from stadium to street, in:

- The innovative building technologies used in the Olympic Park, which are creating a greener blueprint for future construction projects
- How the Games acts as a test bed for smarter, cleaner, and more efficient energy systems
- The transportation innovations that show how future cities will keep moving
- Leading-edge medical and fitness monitoring technologies used by Games athletes, and how we benefit from these in our daily lives
- How Olympic parks, as 'micro-cities', offer a glimpse of a system of future sustainable urban living
- The cutting edge technologies that will be at the heart of future Olympic Games.



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25% 12% in UK

believe the Games will leave behind technologies for the wider society to inherit

see the Olympics as a force for good

61%

76%

believe the Olympics will improve their country's green credentials

5%

17%

Brazil

•••••

UK

Build

N6

Sustainability for the Olympic and Paralympic Games in London has been designed from the ground up – in the way stadia and structures have been built, in the materials used and, perhaps most importantly, in the legacy planning that will ensure that buildings are fit for highly efficient low-impact use far into the future.

According to the US Department of Energy, buildings use 39% of the energy and 74% of the electricity produced each year in the US. A University of Michigan study has shown that 91% of a building's emissions come from its use and just 9% from its construction.

O TECHNOLOGIES

CARBON COUNTERS

Meticulous and innovative pre-planning was carried out before a single brick had been laid, in order to cut carbon emissions from the operation of the Olympic Park by 50% by 2013.

'Ordinarily, carbon measures are done retrospectively,' says **David Stubbs**, Head of Environment and Sustainable Development on the London Organising Committee for the Olympic Games (LOCOG). 'What we did, uniquely, in London, was to create a carbon count for the entire event beforehand. This allowed us to make carbon-reduction strategies integral to the entire Olympic plan.'

The impact of this strategy can be seen in the fact that 60,000 heavy vehicle movements were simply eliminated by the early decision to locate a concrete plant on the construction site.

CONCRETE ACHIEVEMENTS

A building material with a decidedly shaky sustainability record was turned into an unlikely green construction ally.

'The concrete used in buildings such as the Aquatics Centre had 40% less embodied carbon than standard concrete,' says **Dan Epstein**, Director of Sustainability at Useful Simple Trust and former Head of Sustainability for the 2012 Olympics.

'It's not an entirely new material, but it has been used here on a massive scale. We proved that it can be used to an extremely high standard – as both a structural, load-bearing material and a fair-faced finish, to great aesthetic effect.'



The concrete used in buildings like the Aquatics Centre had 40% less embodied carbon than standard concrete **Carbon than Standard Concrete Carbon than Standard Concrete**

9/%

building materials recycled by the London Olympic organisers on site



LIGHTWEIGHT SHOWPIECES

The main stadium, designed by architects Populous, is the lightest Olympic stadium built to date, minimising the use of steel and, consequently, reducing its carbon footprint. As an extra sustainable touch, unwanted gas pipelines form the roof truss, and recycled granite from London's King George V docks was used for the stadium's river banks.

An ultra-lightweight design means that the Handball Arena has a low carbon footprint. Strategically placed roof lights reduce the need for artificial light, the arena is almost 100% naturally ventilated, and resource-saving technology has been employed to reduce water consumption by more than 70%.

Recycled plastic kerbs are being used in the new road system on the Olympic site, because they are much lighter and cheaper to use and transport. 'These Olympics set a great example by deploying existing sustainable materials that have not yet been used widely,' says Epstein.

FUTURE PROOFING

Creating legacy stadia that meet the demands and desires of future generations is a key component of the 2012 green game plan. 'Sustainability is not just about aiming for carbon reduction in building projects,' says **Michael Beaven**, Head of Building Services and Environmental Engineering at Arup Associates. 'It's about creating environments that last, because people want them to be there, generation after generation.'

Future-proofing of buildings has been central to this sustainable design strategy. The 80,000-seater Olympic stadium in Stratford has been designed so that it can be significantly reduced in size and capacity after the Games, to provide a low-impact legacy sports arena.

The demountable stadium has 25,000 permanent seats in the lower tier. But the lightweight steel-and-concrete upper tier, which can hold a further 55,000 spectators, can be completely dismantled, to provide flexibility of use in years to come.

Variations of this adaptable approach to future use are on display throughout the London 2012 Olympic Park. The Velodrome will become a cycling centre for the Eastway Cycling Club. A road-cycle circuit, a mountain-bike course and a BMX circuit will combine to create the Lee Valley VeloPark, with cycling facilities across all disciplines in one cycling hub.

The basketball arena has been built as a flat pack, with a 12,000-seat capacity stadium that can be easily dismantled. Current plans will see it taken apart and sold to Brazil for use in the 2016 Games in Rio de Janeiro.

HYPER-RECYCLING

Reduction of waste was another important piece of the sustainable construction puzzle, and has produced a success story that promises even better recycling results for future Games – and for society at large.

'The London Olympics organisers managed to recycle 97% of the materials used on-site,' says **Darryl Newport**, Director of the Sustainability Research Institute, University of East London. 'But we also carried out some innovative work on using the remaining 3% of waste material as a form of lightweight aggregate building material.'

Time constraints meant that the team could not perfect a reliable manufacturing process in time for use at the 2012 Games. But, Newport says: 'It was a valuable research project which will find use in future developments'.

70% reduction in water consumption and almost 100% naturally ventilated Ultra-lightweight Handball Arena, London 2012

12,000 seat flat-pack Basketball Arena to be taken apart and sold to Brazil for use in the 2016 Games in Rio

GREEN CITY BLUEPRINT

Past Olympic cities demonstrate effectively how the Games' sustainable agenda can affect green transformations and provide inspiration to a wider audience.

Vancouver, home of the 2010 Winter Olympics, re-invented its 80-acre Olympic and Paralympic village – an area that has been described as 'the greenest neighbourhood in the world'.

The site features solar-powered waste compactors, rainwaterharvesting roofs that divert water into underground cisterns for use in irrigation and toilet flushing, and a neighbourhood energy utility that recovers heat from sewer lines.

A neat innovation that attracted global interest was the use of Alcoa's smog-absorbing aluminium on many buildings. Its titanium dioxide coating ingests smog-producing nitrogen oxide, which is then washed away by the next rain shower. About 10,000 square feet of this cladding offsets the pollution from four cars a day – equivalent to the air-cleaning effects of 80 trees.



DOMINO EFFECT CITIES

Proof of the way in which Olympic sustainable thinking and technology can spill out across an entire city and start to reshape its construction priorities can already be seen in the plans for Rio's 2016 Games and Pyeongchang's 2018 Winter Olympics.

Facing a hotel-building boom to accommodate Olympic crowds, the Brazilian government has decided to ensure that Rio's hospitality industry bolsters the sustainable aspirations of their Games.

BRL\$1bn of government money has been allocated to hotel projects that can demonstrate strong environmental credentials. Highly attractive financing conditions are being offered to projects that feature efficient use of water resources and sustainable waste management.

'By putting sustainability at the heart of a major sports event such as the Olympics, organisers can start a domino effect that spreads sustainable development and thinking throughout a city, or even a country,' says **Gary Kendall** of the Cambridge Programme for Sustainability Leadership in South Africa.

'The sustainability perspective – social, economic and environmental – has become an important legacy aspect to be taken into consideration in the planning process,' adds Professor **Lamartine DaCosta** of the Olympic Studies Group at Gama Filho University, Rio de Janeiro.

Pyeongchang will be a template for a green building revolution throughout South Korea, having been designated a Low-Carbon Green Growth Model City by the government ahead of the 2018 Winter Olympics. An injection of \$86m-worth (£56m, €68m) of government funds into building energy-efficient homes – which incorporate solar energy, solar thermal heat, geothermal heat, fuel cells and small-size wind-power generators – across the country is predicted to fuel an \$8.4bn (£5.5bn, €6.6bn) house-construction boom.

'While the Olympic Games is a sporting event – even more importantly, it is regenerative for a whole area,' says Darryl Newport.



10,000 sq ft of smog-absorbing aluminium offsets pollution - the equivalent of 4 cars per day Vancouver Winter Olympic Games, 2010

Building a better future

from stadium to street

CHALLENGES 🕍

Looking to the future we are going to face a number of issues and challenges on a national and global scale as we create the built environment:

> European Commission target of reducing domestic emissions by **80**% (compared to 1990) by 2050

The buildings sector accounts for **40%** of the EU's energy usage and offers the largest single potential for energy efficiency (source: Carbon Trust)

Globally, the built environment accounts for **40–50**% of natural resource use, **20**% of water use, **30–40**% of energy use and around **a third** of CO₂ emissions (source: ukgbc.org)

The UK government has committed that from 2016 new homes will be built to a **Zero Carbon standard**

Renovating existing buildings could lead to a decrease in energy demand of **41**% by **2050** (source: EU)

OLYMPIC TECH

Technologies and innovations piloted at the Olympics that could help to address some of these challenges include:



Innovative and world leading carbon-measurement systems from London 2012 will set a new benchmark for construction



The use of recycled and low-carbon materials in construction and greener building techniques will make future construction projects more sustainable



Architects and engineers will use what they have learned from the design of Olympic venues to create lightweight, portable and adaptable buildings such as schools and hospitals **N**12

Concern about energy is the sombre 'mood music' of our times. The global population will hit 9.1bn by 2050, pushing demand for energy ever higher, according to the United Nations Population Division. At the same time, the Intergovernmental Panel on Climate Change is demanding an 80–95% cut in carbon emissions by 2050 in order to limit increases in global temperatures to below a climatically crucial 2°C.

There is no quick technological fix to our energy conundrum. Instead, says the International Energy Agency's 2011 World Energy Outlook, we will need a portfolio of low-carbon technologies to halve CO_2 emissions by 2050: 'No one technology or small group of technologies can deliver the magnitude of change required'.

London 2012 is a stringent, demanding test bed for the wider adoption of intelligent, sustainable energy systems that will ultimately deliver this wide palette of technologies.

Even before the Games have begun, external construction and property companies are beginning to take notice and adapt their plans to the Olympic template. As leading property specialist Jones Lang LaSalle notes in its 2011 report Winning Gold for Green: The Influence of International Sporting Events on Sustainability, Regeneration and Property: 'Sustainable regeneration activity in East London has and will serve as a potent demonstrator of possibilities at other UK and international regeneration schemes, and we have already witnessed UK commercial developers and occupiers adapting to Olympic standards.'

GAS GIANT

Two natural gas-fuelled Energy Centres being built at the Olympic Park and Stratford City developments sketch out the shape of things to come in terms of city-scale power generation over the coming decade.

The centres house three J620 Jenbacher gas power plants, which will power, heat and cool the Olympic Park and become the sustainable energy heart of the many thousands of homes that will take its place after the Games have ended.

The use of cogeneration technology developed by GE is 'probably the most energy-efficient system that could possibly have been used', according to **Tony Gale**, General Manager London 2012 at GE.

The project is an important moment for society as a whole. 'It acts as a launchpad', says Gale. 'It is demonstrating to other cities that it is possible to use these systems on a huge scale.'

The 10-megawatt generation scheme is a cornerstone of London 2012's mission to prove the viability of sustainable technology to the public at large.

'For every unit of energy used for the Olympic Games, we have committed to generating an equal amount of energy from renewable sources,' says Gareth Wynn of EDF. \searrow

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10_{MW}

Manager and Man

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SMART ENERGY

A major step towards a future in which all homes have smart energy systems able to take efficient advantage of the ebbs and flows of renewable energy sources is being showcased at the Athletes' Village for London 2012.

The athletes' homes in the London 2012 Olympic Park will each be fitted with smart meters,' says Wynn. 'It's a first step towards more widespread adoption of this technology across the UK, allowing people to monitor and reduce their own energy use. The implementation of smart meters is an important stepping stone towards creating a Smart Grid for the entire country.'

After the Games, the Village will be converted 2,850 mixed-occupancy homes, ready and waiting to make use of future Smart Grid developments. 'Each apartment is installed with the necessary communications hub, to switch between different energy supplies and tariffs and find the most cost-effective and efficient,' says Tony Gale.

In the future, homeowners might be able to make use of fluctuating wasteheat supplies from the nearby Barking and Dagenham power station to keep their houses warm and their water hot. 'This heat supply is inconsistent, so the smart energy system would enable homes to switch to other back-up supplies when it is unavailable,' says Darryl Newport, director of Sustainability Research Institute, University of East London.

'Such systems will be vital to enable us to introduce wide-scale use of renewable energy sources such as wind and solar, which fluctuate according to climatic and seasonal conditions.'

EAST WIND

A national push to make South Korea's 2018 Winter Olympics 100% energy efficient will add momentum to a countrywide sustainability drive.

The host for the 2018 Winter Olympics aims to reduce national energy consumption by 3% and national electricity consumption by 6% by 2030, through the implementation of a national smart grid. In addition, it hopes to reduce national greenhouse gas emissions by 4.6%. The Winter Olympics will represent a key focal point for these efforts, bringing world attention to these commitments.

'Existing renewable energy facilities in the region can already provide 73.4% of the electric energy demand for a Winter Games,' says **Byung-Nam Lee**, Pyeongchang 2018 Director General of Evaluation Preparation.

'A new wind energy plant will be constructed to make the Winter Games selfsufficient, with renewable energy, in 2018. The environment is a priority for the South Korean government: our aim is to achieve 100% energy efficiency through renewable energy, and to use a smart grid system to secure renewable energy at all venues.'

The sustainability effort surrounding the Games gives momentum to South Korea's wider drive towards increased energy independence.

Jeju Island, 50 miles (80km) off the country's southwest coast, is home to a prototype Smart Grid that the government plans to roll out nationwide. The project, launched by a £36m (\$55m, €43m) government investment that will quadruple by the end of 2013, is testing real-time grid monitoring, digital power transmission and digitally operated power distribution systems. The Korean Advanced Institute of Science and Technology is also leading research into the potential of algal biofuels – using algae as an alternative to conventional biofuel sources from land plants. Success would mean the realisation of a cherished sustainability dream: a renewable, biodegradable fuel resource that doesn't compete for land space with existing food crops, and which provides 100 times more oil than existing alternative fuel crops.



The athletes' homes in the London 2012 Olympic Park will each be fitted with smart meters... allowing people to monitor and reduce their own energy use Gareth Wynn, EDF

A new wind energy plant will be constructed to make the Winter Games self-sufficient, with renewable energy, in 2018... our aim is to achieve 100% energy efficiency through renewable energy

Byung-Nam Lee, Pyeongchang 2018 Director General of Evaluation Preparation

TORCH FIRE BREAKTHROUGH

An innovative search for a new and sustainable way to power the 2012 Olympic torch and flame neatly encapsulates the way in which green technology initiatives can have unexpected benefits for a consumer audience.

Researchers at EDF developed a carbon-neutral fuel using briquettes made from elephant grass. Originally, the intention was to provide a low-emission fuel for the Olympic torch and flame on its 70-day relay across the UK. But the research team was unable to complete its work by the fixed deadline.

But initial disappointment soon faded when the EDF innovators realised that they had invented a briquette that was as reliable and luminous as conventional gas-fuelled torches.

'We realised that we had produced an entirely new bespoke low-carbon fuel, which has been patented and can be used in domestic fires and garden torches,' says Wynn.

TOWER OF THE SUN

The energy to power Rio's 2016 Games will be provided by a stunning sustainability masterpiece, designed to inspire wider use of Brazil's underexploited renewable power potential.

The Solar City Tower, a landmark structure studded with solar panels, will provide green energy night and day. During daylight hours, sunlight will generate electricity directly. Excess energy gathered by the solar panels will pump seawater high into the tower, to power turbines that will keep energy flowing to the Games at night.

Brazil has a very different energy mix from that of previous Olympic host nations. More than 90% of the country's energy demands are satisfied by renewable sources, with hydroelectricity making up 70% of the total, according to the Energy Research Company, Empresa de Pesquisa Energética (EPE). And yet, about 70% of Brazil's overall hydroelectricity potential is unexploited, according to government research.

This puts the country in an ideal position to take advantage of the opportunity embodied by the Solar City Tower, according to Tony Gale of GE. 'The unstable energy system in Rio offers a great opportunity to upgrade the entire system,' he says. 'It is probably easier to do this in a place where there is not a very solid, stable, embedded system already in place.'

'We're very interested in the new ability to have almost instantaneous feedback and data on energy usage', says **Bill Hanway** from AECOM, chief architects of the Rio 2016 Masterplan. 'Rather than waiting months to make adjustments, we now have the ability to adjust energy levels instantly to meet lighting and broadcasting requirements, using smart technology. This technology is available now: it will be even more cost-effective by the time we deliver the Rio Games.'





Brazil's Energy Mix

Renewable energy sources



Powering the future

from stadium to street

CHALLENGES ذ

Looking to the future we are going to face a number of challenges on a national and global a scale as we look to power our lives:

- European Commission says that carbon emissions in Europe should be cut by **20**% (from 1990 level) by 2020 (source: EU)
- The government's 2009 Renewable Energy Directive sets a target for the UK to achieve **15**% of its energy consumption from renewable sources by 2020 (source: decc.gov.org)
 - Scottish government pledged to get **100**% of its electricity from renewables by 2020 (source: www.scotland.gov.uk)
- Global energy consumption will rise by **49**% by 2035, with the largest increases in demand from non-OECD economies (source: International Energy Agency)
 - **95**% of global energy demand could be met by renewables by 2050 (source: WWF / Ecofys)
 - In London, Boris Johnson has committed to supplying
 - a **quarter** of London's energy from decentralised sources by 2025 (source: London.gov.uk)
 - This will achieve an annual CO₂ reduction of **3.5 million tonnes** but requires £5-7 billion of investment in partnerships between local authorities and companies

OLYMPIC TECH

The technologies powering the Games that might enter our daily lives include:



Efficient energy cogeneration technologies, which have been tested at scale, that will enable sustainable energy systems to sit at the heart of new city developments





Carbon-neutral fuel supplies that will spur the creation of new, efficient domestic heating and lighting

Wind, solar power and biofuel technologies developed for showcase Games projects that will help countries around the world find the right renewable energy mix to meet their individual needs

Power

Move

Transport infrastructure is, perhaps, the area in which London 2012 - and the Games that follow - have the greatest opportunity to create an optimistic, aspirational vision of what a sustainable low-carbon future might look like. To achieve the European Commission's Transport 2050 strategy targets of a 60% cut in carbon emissions by 2050 will require an end to the use of conventionally fuelled cars for urban transport, a 40% use of low-carbon fuels in aviation and a 50% shift in medium-distance freight and passenger traffic away from roads onto rail and water transport.

Market analysis suggests that plug-in electric vehicles will represent 40% of the global car market by 2050. The International Energy Agency (IEA) suggests that global sales targets of electric vehicles will be 7m in 2020, 30m in 2030 and 100m by 2050.

To move towards this Brave New World, people need successful examples to inspire them. London 2012's integrated system of alternative-fuel automobiles, modern public transport and dependable rail networks, combined with state-of-the-art walking and cycling networks, offers a reassuring glimpse of a bright future that the man on the street can look forward to, rather than dread.

HYDROGEN TAXI

The first Fuel Cell Black Cabs – developed by a consortium led by Intelligent Energy – have already taken to the streets of London in preparation for the Games.

The vehicles use a hydrogen fuel cell to produce electricity, powering their onboard electric motors. Fuel cells in vehicles create electricity to power a motor by using hydrogen and oxygen from the air.

The London project to deliver a fleet of the zero-emission taxis to the streets of the city in time for the Games is on schedule, and the first Fuel Cell Black Cabs have covered a combined total of more than 8,000 miles (12,900 km) in both road and test-track testing conditions. \searrow







£10m invested in eight walk and cycle routes

charging posts around city for hybrid vehicles



electric-hybrid vehicles for the Games

43%

100m

of people surveyed in Brazil say they see the Games as an opportunity to jump-start a sustainable transport future

82% of cars sold in August 2011 are flex models running on gasoline or sugarcane

of people are concerned about the quality of transport in Rio

50m

50%

100m

130m

Rio 2016





S TECHNOLOGIES

HYBRID CARS AND BUSES

A fleet of 5,000 electric-hybrid vehicles will ferry athletes, officials and other members of the Olympic Family around the city. An entire new infrastructure has been created to keep them on the road, providing a sustainable transport legacy for London to build on in the future.

'We have been working with EDF, Transport for London and LOCOG to deliver 120 charging posts in various locations in London,' says Tony Gale. 'These will form part of the Olympic infrastructure, and will service the fleet of 200 hybrid BMW vehicles. They will also be left behind as a technological legacy for the city.'

Public transport will also get a high-tech makeover. All new London buses will be hybrid from 2012, creating a quieter and cleaner transport system for the entire city. Their conventional engines are combined with electric motors that are recharged every time the driver applies the brakes. With continuous charging of the batteries, the vehicles get more miles to the gallon than conventional diesel buses.

£10M WALKABOUT

More than £10m has been invested in improvements to a network of eight walking and cycling routes, which link different parts of London to the Olympic Park and other venues.

These routes are known collectively as the 2012 Games Walking and Cycling Routes, and will be the main spectator routes used by people walking and cycling to the Olympic Park and River Zone venues during the Games. A wayfinding programme, due to be completed by March 2012, is being developed alongside the route improvements, to enable users to navigate easily.

Ω CASE STUDIES

OLYMPIC JUMP START

Sochi

Millions of Brazilians are hoping that the Rio 2016 Games will revolutionise their vast country's creaking transport infrastructure. More than four in 10 (43%) Brazilians, in a Future Poll survey for GE, said that they saw the Games as a huge opportunity to jump-start a sustainable transport future.

At the moment, 50% of people surveyed in Brazil are concerned about the quality of transport in their country. But there are clear signs that their government is addressing their concerns as the country gears up for the Games in four years' time.

Electric cars do not yet play a significant part in the world's fourthlargest car market. More than 8 in 10 (82%) cars sold in August 2011 are flex models, which can run on either petrol or sugar cane alcohol, according to leading trade publication EV Update.

To move to a more sustainable transport model, Brazil's government development bank BNDES has financed BRL\$7m (£2.5m, \$3.9m, €3m) of a BRL\$12m (£4.4m, \$6.7m, €5.3m) investment into electric propulsion solutions. A new generation of super-efficient batteries is the key target of the research programme, which plans to take advantage of the country's huge and renewable hydroelectric production capacity.

The project runs alongside a state-sponsored scheme to switch to an electric public transport system. The first 32 Eletra hybrid buses – running on a combination of ethanol-powered generators and electric battery motors – were launched in Rio in 2009. Their São Paulo manufacturer is using the same engine technology to produce a hybrid trolleybus and two electric truck models.

€**300**bn

ROLLING STOCK REVOLUTION

Russia's 2014 Sochi Winter Olympics will give the country a further push away from roads towards more sustainable rail travel.

Already one of the world's biggest railway equipment markets, the Russian government has announced plans to invest a further €300bn (£249bn, \$382bn) in new rolling stock and infrastructure over the next 30 years.

At Sochi, a new 48km railway will be in operation by 2014, parallel to a new highway and running at a capacity of 8,500 passengers per hour. Another 2.7km railway line will connect Sochi Airport and the town of Adler. In a 24-hour period, up to 64,000 people will be able to travel in one direction alone.

invested in new rolling stock and infrastructure over next 30 years

2014 8,500/hr number of passengers that can travel on the new 48km Sochi railroad by 2014

Moving ahead

from stadium to street

CHALLENGES 🕍

Looking to the future we are going to face a number of challenges on a national and global scale as we look to address our transportation needs:

The European Commission's Transport 2050 roadmap plans to phase out conventionally-fuelled vehicles from city centres completely by 2050. CO₂ emissions from aviation also need to be cut by **30**%

- The EU transport sector is **98**% dependent on oil for its energy supplies
 - European greenhouse gas emissions from transport rose by **26**% between 1990 and 2007 (source: European Parliament)
- UK government is committed to sourcing **10** per cent of the energy used in UK road and rail transport from renewable sources by 2020
- The UK will need **1.7 million** electric vehicles by 2020 and **6.4 million** by 2030 to meet target of **80** per cent reduction in carbon emissions by 2050 (source: WWF)
 - Mayor Boris Johnson has pledged to have **1,300** charging points in London by 2013 (source: www.parliament.uk)

→ OLYMPIC TECH

Technologies and innovations piloted at the Olympics that could help to address these challenges include:

The rapid acceleration in the uptake of electric vehicles in London. Mayor Boris Johnson has pledged to have 1,300 charging points in the capital by 2013, and aims to ensure that 'no Londoner is more than a mile from a charge point'



Fuel-cell cars, and next-generation hybrid cars and buses with super-efficient batteries, will become common



Safe, useable walking and cycling routes, with intuitive navigation systems, will be integrated into city and town developments



High-speed trains will re-emerge to overtake the car in mass-transit projects, particularly in emerging economies

N 22

-**A**Cure

At the Games elite athletes must perform to their peak potential. This demands the latest technology to help maintain their fitness, enhance performance and protect their wellbeing. At the top of their game physically, athletes are generally amongst the first people to use technologies that ultimately have the potential to help make all of us healthier in the future.

'Athletes are early adopters of high tech innovations, such as new composite materials for equipment,' says Peter Baum of the Institute for Prospective Technology Studies, Spain. 'Training efforts rely more and more on the research results of sports medicine and exercise physiology, increasingly integrating the newest technologies."

Zara Hyde Peters, CEO of the British Triathlon Federation, says the Olympics, in particular, encourage innovation: 'The Games promote a no-stone-unturned approach to performance. There are fractions-of-a-per-cent of difference between athletes. Technology helps ensure that an athlete's preparation is as close to ideal as possible.

TECHNOLOGIES

FIT FOR THE FUTURE

Addressing the issue of public health is as necessary a challenge for society as is sustainability.

According to the World Health Organisation, nearly 43m children under the age of five globally were overweight in 2010. Obesity in childhood increases the risk of developing cardiovascular disease or diabetes, related social and mental health problems, and can inhibit learning and development.

'It's among the children watching London 2012 that we'll see the biggest increase in sports participation after the Games', says **Professor Ian Henry**, Director of the Centre for Olympic Studies and Research, Loughborough University, 'The impact won't be on the current adult population, but on youngsters. And we know that participation in sport at a young age is more likely to be associated with participation later in life."



^{ff} It's among the children watching London 2012 that we'll see the biggest increase in sports participation after the Games... we know that participation in sport at a young age is more likely to be associated with participation later in life

Professor Ian Henry, Director of the Centre for Olympic Studies and Research, Loughborough University

1in3

adults under 35 in the UK already use websites or apps to track their health



EMPOWERING PEOPLE

This monitoring technology, developed for sportspeople, will be the key to helping everyone manage their health better, say experts.

'Exercise is becoming increasingly individualised,' says Professor Henry, 'People are going to gyms more than joining sports clubs. Games consoles such as the Wii, which facilitates physical activity, are a significant part of this, moving exercise into the home.'

Cutting-edge sports technologies will also filter into our daily lives. Smartphones, IT-enabled clothing and GPS tracking devices will enable people to keep track of their exercise – tracking technologies such as Nike+ are only the beginning.

In the UK, Future Poll research has found that one in five adults already use websites or apps to track their health. Among the under 35s, this rises to more than one in three. New products, such as adidas's intelligent attachment for soccer boots, or Canadian company 4iiii Innovations' sunglasses with built-in performance tracking displays, will help ordinary people take advantage of the kind of kit traditionally the preserve of world champions and record breakers.

'It is not just the preserve of the elite any more,' says **Zara Hyde Peters.** 'Being able to watch your own fitness develop and see how you react to exercise helps get people interested in exercise and maintains their involvement.'

A HEALTHCARE LEGACY FOR LONDON

London 2012 will also leave behind a clear medical legacy for London in the form of a state-of-the-art Polyclinic.

Built to provide advanced healthcare facilities for athletes, it will remain as a first-class primary care unit. The four-storey, 5,000 sq m building will house, among other facilities, multiple GP surgeries, outpatient activity; physiotherapy services; a children's clinic as well as diagnostic facilities including X-ray and ultrasound.

The Games are also bringing leading-edge medical equipment to east London. 'This area of the city had one of highest infant mortality rates in Western Europe,' says **Bettina Fitt**, General Manager, UK & Ireland, GE Healthcare. 'The team at the local Homerton Hospital have worked with GE to bring in world-class facilities, including an MR scanner, ventilators, incubators and other specialist equipment. In a short space of time they have had a significant impact upon mothers and babies in the Hackney area. That could be the 2012 Olympics' most important legacy.'

AWESOME ADAPTATIONS

For athletes with disabilities, major advances in equipment are being made. There are prosthetic limbs which now, by some measures, outperform human capability; and increasingly streamlined, lightweight and manoeuvrable mobility devices and wheelchairs.

'There's no doubt that the technology associated with prosthetics and Paralympics adaptations are awesome.' says **Dr Richard Budgett**, Chief Medical Officer, LOCOG. 'The development is driven by performance and that can feed back into enhanced ability in normal life, and increase quality of life tremendously.'

And it's not just Paralympians who can take advantage of the expertise honed for major sports events such as the Olympics. The Games are a crucible for medical knowledge, and London 2012 will bring together an unprecedented, world-class team of doctors and healthcare professionals.

'Most of the doctors involved in the Olympics don't just deal with elite sports people,' says Dr Richard Budgett.

'At the Games, professionals come together who are going to have a big influence on medical practice over the next four years. It's quite an opportunity.' \searrow

state-of-the-art Polyclinic, and leading-edge medical equipment Olympic legacy for East London

5,000m²

There's no doubt that the technology associated with prosthetics and Paralympics adaptations are awesome... The development is driven by performance and that can feed back into enhanced ability in normal life

Dr Richard Budgett, Chief Medical Officer, London Organising Committee for the Olympic Games (LOCOG)

PREVENTION BEFORE CURE

Healthcare for athletes is also undergoing radical change. No longer simply about treating injuries, now fitness levels are continually monitored and potential health problems are identified at the earliest possible opportunity.

'Technology has evolved,' says Bettina Fitt. 'The definition we can now obtain in modern scanning equipment means we can identify miniscule tears in ligaments or tendons, and provide very early treatment.'

PRACTICAL, PORTABLE HEALTHCARE TECHNOLOGIES

Thanks to the demands of the Games, medical equipment is becoming increasingly portable, affordable and accessible', says Bettina Fitt. 'GE's Vscan, for example, is a pocket-sized ultrasound. Its development was really accelerated for the Vancouver Winter Olympics.'

'The aim is to make medical devices more accessible while maintaining or increasing their quality. If a person can be scanned in their GP's practice, that is much more convenient and affordable than having to go to a hospital to use a large piece of equipment.'

Widespread use of ultrasound is becoming vital. Dr Richard Budgett says it makes diagnosis and treatment quicker and more effective. 'Ultrasound-guided injections, particularly those that are more difficult such as in the spine, can now be done on-site. London 2012 will be the first time this has happened.'



ACure

Ultrasound-guided injections, particularly the more difficult ones such as in the spine, can now be done on-site.
London 2012 will be the first time this has really happened
Dr Richard Budgett, Chief Medical Officer, LOCOG

21st century health

from stadium to street

CHALLENGES ذ

Looking to the future we are going to face a number of issues and challenges on a national and global scale as we look to address our healthcare needs:

- A quarter of all Europeans will be over **60** by 2030. The number of centenarians is set to rise from **11,000 to 80,000** by 2033 (source: Independent)
 - The rise of 'lifestyle diseases' such as obesity will place pressure on healthcare (source: The Lancet)
 - 50% of UK men and 40% of UK women will be obese by 2030 (source: The Lancet)
 - **65 million** American adults could suffer from clinical obesity by 2030 (source: World Future Society)
 - Crop yields in central Asia could decrease by up to **30**% by 2050, leading to a worsening of malnutrition among the rural poor (source: WHO)
 - There could be an increase in excess of **60**% in obesity related diseases between 2005 and 2030 (source: WHO)
- Public expenditure on healthcare in the EU could jump from **8**% of GDP in 2000 to **14**% in 2030 (source: World Bank figures)
- Healthcare represented **9**% of GDP for all OECD countries on average in 2008

---- OLYMPIC TECH

Technologies and innovations piloted at the Olympics that could help to address these challenges include:

🝆 27 🗹



Portable medical devices for monitoring heart rate, bone density and body mass composition developed for elite athletes will become a part of day-to-day healthcare, improving the efficiency of health services

Ordinary people will use microchip-controlled, internet connected devices to measure, track and share their fitness performance



Materials and devices developed for Paralympic performance will enable a wider range of assistive technologies for the 10% of the world's population who live with a disability **N** 28

The growth of megacities will define our lives in the 21st century. The population of Delhi, for example, will increase from 21m today to 28m by 2030, according to UN figures.

Sustainable infrastructure and homes will spell the difference between a vibrant metropolis and a polluted, disease-ridden slum, say sustainability experts. Olympic cities offer a practical, high-profile template for achieving the former rather than the latter.

'Major cities are becoming more important than nation states in driving the change towards a sustainable future,' says Dr Gary Kendall, of the Cambridge Programme for Sustainability Leadership in South Africa. They are where most of us live and they compete to become the greenest and most environmentally sound. Look at how Paris and London are competing to be the most sustainable with their bike and electric car hire schemes.

'The Olympics are like the World Fairs of the 20th century - a chance for a city to show off its technological wares and to challenge other cities to match or better them.'

Tom Gater of Futerra agrees. 'London 2012 has effectively built a micro-city, the Olympic Park [to be renamed the Queen Elizabeth Olympic Park], which will become an ultra-sustainable neighbourhood for a mixed demographic after the Games,' he says. 'It's a practical demonstration of what can be done, and other cities will be watching and following."

The way in which the sustainability trends woven into the fabric of the Olympics will play out in our day-to-day existence over the next decade and beyond can be seen in some of the consumer technology that is beginning to emerge.

TECHNOLOGIES

SMART HOMES

Digital technology will prove key to blending sustainability into our daily lives as seamlessly and unobtrusively as light switches and dishwashers. 'At the domestic level, the technology is already available,' says Tony Gale of GE. 'But the issue is managing the data and making it available to the consumer – or letting the intelligent technology make energy-efficiency decisions for vou.'

US-based innovator EnergyHub has adopted the latter approach. The start-up's new system uses the almost limitless computing power of cloud technology to monitor and control home heating and energy systems through bespoke, real-time monitoring and control.

The system sifts through vast amounts of online data in the cloud. comparing competing energy tariffs and sources and variables such as local weather conditions to make minute-by-minute energy-efficiency decisions on a homeowner's behalf.

The Nest, an intelligent home communications hub developed by US software specialists Tony Fadell and Matt Rogers, takes the smart home concept a stage further. The system uses six sensors placed around the house to monitor temperature, ambient light, humidity and motion. Day by day, it builds up its own understanding of the homeowner's behaviour patterns and preferences, and then begins making sustainable power and energy adjustments accordingly. \searrow

The Olympics are like the World Fairs of the 20th century - a chance for a city to show off its technological wares and to challenge other cities to match or better them

Dr Gary Kendall, Cambridge Programme for Sustainability Leadership in South Africa

London 2012 has effectively built a microcity, the Queen Elizabeth Park, which will become an ultra-sustainable neighbourhood for a mixed demographic after the Games

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Amount that could be saved on fuel bills in the UK by replacing kitchen appliances with the most efficient models



ORGANIC KITCHENS

Our kitchens offer the greatest opportunity for future domestic sustainability gains. In the US, kitchen appliances account for more than 25% of electricity use in an average household, according to the US Department of Energy.

The Energy Saving Trust says if every household in the UK replaced just their fridge-freezer, washing machine and dishwasher with the most efficient models, it would collectively save £585m in fuel bills, and prevent two million tonnes of CO_2 – enough to fill Wembley Stadium 257 times – from entering the atmosphere.

Innovators are harnessing organic processes to cut down on kitchen energy use. Celcius, created by Argentinian designer Marcela Vanesa Céspedes, is a kitchen waste disposal and recycling appliance that uses enzymes to break down organic waste. The unit produces excess energy that can be used to heat small appliances in the home.

SMART TRASH

Rubbish bins that automatically scan waste for recycleable, or even resaleable, items will be standard in our homes by the end of the decade.

The Smart Trash system, developed by Professor Valerie Thomas, an industrial engineering and public policy specialist at Georgia Institute of Technology, US, indicates how this sustainability trend will develop.

A rubbish bin fitted with scanner reads a UPC barcode or radiofrequency ID (RFID) tag on each piece of waste. It logs the make, model or component part and transmits the data to a waste company's website, and to auction sites such as eBay. A reply tells the system whether the item can be recycled or has any second-hand value.

SUGAR PLANES

Sustainability will be an integral part of our travel plans as airlines make extensive use of novel new biofuels to comply with a 2009 international industry-wide agreement to cut carbon emissions to 50% below 2005 levels by 2050.

With the world's eyes turning to Brazil in 2016, Boeing, Embraer and the Inter-American Development Bank (IDB) are jointly funding a project to analyse the sustainability of producing renewable jet fuel sourced from Brazilian sugar cane. The study will be led by ICONE, a research think tank in Brazil with extensive experience in agriculture and biofuels analysis, and reviewed by WWF.





cut in 2005's carbon emissions in the aviation industry by 2050



SOLAR CARS

By the 2020 Olympics global auto manufacturers will be looking beyond hybrids and moving towards fully electric vehicles (EV). The German government is allocating €2bn (£1.7bn, \$2.5bn) to EV research and development and hopes to have one million electric cars on the country's roads by 2020. Nissan, manufacturer of the all-electric Leaf, aims to sell 1.5 million electric cars by the end of 2016, although it will face competition from models such as the Audi e-tron, the Chevy Volt and the Tesla Model S.

One step further is a pioneering project from renewable energy innovator SolarCity, which is offering solar EV car chargers to customers in 11 US states and Washington DC, allowing them to drive on pure sunshine. The company, which received a \$280m investment from Google, makes it easy for people to embrace solar power by leasing them complete photovoltaic packages.

GENERATOR TRAINS

Train travel will become not just a way of saving energy, but of producing more. The T-Box, developed by designers Ale Leonetti Luparinia and Qian Jiang, captures wind energy from passing trains to generate electricity.

It is designed to fit into the spaces between existing rail tracks, so about 150 T-Boxes could hypothetically be installed over 1km of track. A passing train travelling at 200 kmph would produce a wind speed equivalent to 15m/sec. The T-Box would be able to catch this wind and produce about 3,500W of power. This energy could then be used to power remote areas that don't have electricity or rail sub-systems.

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WHAT IS SMART ENERGY?

Alternative technologies such as solar and wind energy are plentiful and renewable, but inherently variable, depending on climatic conditions and local environments. Turning these into a reliable source of power demands that we develop smarter energy grids that can respond to changes in demand and supply over time – both seasonally and hourby-hour – as well as varying requirements across regions in a network.

Such grids could incorporate alternative supplies as well as efficiently align power supply and demand.

By 2050 our domestic and industrial energy landscape will be transformed. It will be a two-way power infrastructure in which embedded intelligence enables real-time coordination and dynamic decision-making.

Not only will this mean a more robust and resilient infrastructure that suffers fewer outages and features the necessary flexibility to accommodate renewable generation sources, electric vehicles and other low-carbon technologies.

As customers, we will also be able to make more informed decisions about our energy use and its associated costs. Successful deployment of the Smart Grid could save €52bn a year in the EU alone, both by reducing losses from electricity distribution and by enabling greater energy efficiency.



Amount of money that could be saved per year in the EU by use of Smart Grid technology, making more efficient use of variable renewable energy supplies, such as those planned for Pyeongchang 2018



New city living

from stadium to street

CHALLENGES ذ

Looking to the future we are going to face a number of challenges on a national and global scale as we evolve the way we live:

2012 global population = **7 billion+** (source: World Food Programme)

Over **50**% of the global population live in urban areas, and the United Nations Population Division predicts By 2030 this will rise to **60**% (source: United Nations Population Division)

More than **\$40 trillion** could be spent worldwide on infrastructure projects before 2030 to provide the power, water and transportation services these new city-dwellers will demand (source: OECD)

In 2010, **884 million** people in the world did not have access to the kind of water supply likely to provide safe water (source: UNICEF and the WHO)

Waste is on the rise - By 2009 there were already **2.37 million tons** (2.15 million tonnes) of electronic products ready for

end-of-life management in the US. Only around **25**% of those products were properly recycled (source: US Environmental Protection Agency (source: EPA 2011)

In 2010, **884 million** people in the world did not have access to safe water (source: United Nations)

✿ OLYMPIC TECH

Technologies and innovations piloted at the Olympics that could help to address these challenges include:

> 33 🗸



Intelligent technologies built into home appliances to maximise efficiency and minimise waste



Smarter buildings and a grid that responds to our energy requirements helping us to manage micro-energy generation



Transport technologies that have evolved to make better use of renewable resources will be the foundation on which new city infrastructures are designed

Conclusion

Later this year the world's eyes will turn to London to witness the efforts of athletes from more than 200 nations as they attempt to win medals at the London 2012 Olympic & Paralympic Games. But apart from entertaining and inspiring the millions of spectators, what can we really draw from this unique sporting event in terms of wider benefits? As the last medals are presented and the final triumphant athletes go home, what is the real 'legacy' that it will leave for us all?

Put simply, an Olympic Games focuses our attention on the issues we will face in the future and how we can tackle them. By providing a highly concentrated, artificial environment – a microcosm of our cities and communities – it allows us to experiment with new and innovative ways to address everyday problems.

Through every single day of this globally broadcasted event a vast population of spectators and athletes will be 'moved' around the host city, in and out of the Olympic Park, and up and down the country to other arenas. They will see their heroes in stadia that are 'built' in a sustainable way and 'powered' by low carbon technologies, which are designed to endure. They will cared for by cutting edge healthcare technology, ensuring peak performance is achieved. In other words it gives us a fresh perspective on how we might tackle some of the future challenges that we will face on a much larger scale.

Think of the tough targets imposed by Governments in areas such as the environment; how we generate our power; the need to reduce carbon emission targets; how we accommodate growing numbers of vehicles on our roads and growing populations; and the way we treat, diagnose and look after our citizens. The Olympics will show us the difficulties and challenges of doing this on a relatively tiny scale – but we will face it everyday with billions on a global scale. The Olympics allows us to test and learn. Of course like all test environments, there are probably many innovative concepts that never make their way into the mainstream. But others will be developed and refined to create lasting solutions to meet the needs of different countries around the globe...

Because the Games are such a public event, they also play an important role in embedding new concepts in the consumer psyche and changing behaviours which help to fuel evolution. Yet the consumer research undertaken as part of this study serves to highlight the extent to which it is also a 'hearts and minds' exercise to ensure consumers are truly engaged.

The fact that many consumers are not aware of or do not believe that the cutting edge technologies on display at the Games matter, indicates that we must do more to explain the challenges of our global future and the benefits of tackling them through technology.

The modern Olympics have continually redefined global achievement – whether through individuals pushing themselves beyond the limits of their physical abilities or as the only global event to bring more than 200 nations together. In the future, the Games' motto of "Faster, Higher, Stronger" should represent both the spirit of sporting achievement and inspire solutions to the growing challenges of our age, as host nations concentrate on making the greatest show on earth the greenest show on earth.

200+

nations of the world take part in the Olympics: the only event to bring them together in both competition and mutual benefit







Note: Whilst every effort has been made in the preparation of this report to ensure accuracy of the statistical and other contents, the publishers and data suppliers cannot accept liability in respect of errors or omissions or for any losses or consequential losses arising from such errors or omissions.

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