

@4

ARUP

Arup's quarterly review of innovation, design and ideas **CITIES EDITION**



Welcome to the first issue of @4

@ = at Arup.

4 = quarterly focus on cities,
connectivity, resources and
healthy people and communities.

@4= innovation, design and ideas
from around the Arup world.



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How smart can our cities be?

Michelle Tabet is an urban strategist and designer at Arup in Sydney. She laughs when it's put to her that an Arup document expresses the view "city governance and operational tools remain rooted firmly in the 20th century".

"That's optimistic – some city governance models are distinctly more 18th century really," she says. "However we have the 21st century technology enabling us to sense many aspects of urban life – whether it's environmental conditions, movement, urban activities or noise."

"This, in turn, provides us with the capacity to know how different parts of the city – its infrastructure, building or public spaces – are performing in real time."

Governments can then adjust their operational models to govern their cities in real time, a transformational shift for most governments, both at local and state level.

"The advantage of deploying new technologies is that we are able to monitor and assess and act much more quickly – from a governance point of view, but this is only possible through data sharing amongst key players," says Tabet.

Michelle Tabet,
Urban Strategist and Designer,
Arup in Sydney



Why we want smart cities

In Arup's introduction to Smart Cities, transforming the 21st century city via the creative use of technology, the advantages of a smart city are strongly emphasised.

"Cities are real-time systems, but rarely run as such. In the past many have used Information and Communications Technology (ICT) to improve performance at a departmental level including mobility, utilities, community and e-government services. In these cities 'smart technologies' are creating more efficient systems and better informed citizens.

"Now leading cities have started to push this concept further. They are exploring how smart cities can add value within a strategic framework. This will mean moving from departmental solutions to a city wide approach, creating economies of scale and scope that will result in:

- Economic development and the creation of jobs
- Promoting resource efficiency and mitigating climate change
- Providing a greater place to live and work
- Running cities more efficiently, and
- Supporting communities."

The paper also contextualises new technology and its 'arrival' as an urban planning tool.

"With the Internet of Things (the networked connection between everyday objects) now including smart phones and tablets, social media, super fast broadband, and real-time instrumentation, we already have all the necessary tools to deliver smart cities." The only obstacles come from governance and data sharing requirements.

Smart cities framework at Arup

Until recently a city's operational and planning decisions have generally been based on snapshots and averages rather than the ongoing monitoring, insightful visualisations, and constant feedback loops that our contemporary information and communications technologies (ICT) enable.

At Arup, the Smart Cities Framework is a service for policy makers, city services departments, planners, designers and ICT professional to help reconstruct urban systems so that they are clearer, simpler, more responsive and citizen-focused.

The Smart Cities Framework describes how urban informatics can provide public interfaces for the city and its behaviour, while urban information architecture can address the organisational layers behind these interfaces.

In turn, these layers are fed with data from numerous sources, via 'instrumented' systems.

The primary layer of the smart city is this creation of an over-arching IT strategy. Arup sees this as the integration of procurement, design and operational models of ICT services and infrastructure through to the shape, profile and staffing of the city government itself.

Achieving the smart vision requires city administrations to adopt a top-down, strategic approach where resources are aimed at most or all activities in the city that could benefit from smart systems.

Placing ICT at the heart of city administration and planning can result in a significant reduction in the cost of service delivery. A study by Cap Gemini on the benefits of adopting a more strategic approach to information management in UK local authorities, put the value at £18 billion each year.

The advantage of deploying new technologies is that we are able to monitor and assess and act much more quickly.

Urban informatics can lead the way

The second layer of the smart city strategy is the development of informatics — which include web and mobile data services, urban scale displays and even installations within city architecture and infrastructure — that deliver important information to citizens and city managers.

Examples might include feedback loops on energy consumption or environmental quality, real time transport information or visualisation of traffic flows.

These can be engaging design-led installations that work at a neighbourhood or civic level, as part of awareness changing strategies, or functional web services that operate on mobile devices.

In Helsinki, Finland, GPS data from trams and buses is laid over Google Maps to show travellers where to locate their mode of transport. Provided with this kind of information, people feel they have more control of the transit network, and as a result, more likely to use public transportation.

The smart city strategy's third layer, instrumenting resource systems, is the enabler of smart city systems. It entails the design of sensor instrument networks and associated technologies that report on the activity and performance of the infrastructure.

Instrumentation and monitoring of a city's activities and operations means that the workings of operations are turned into data points and the system is made measurable.

Increasingly, reporting should be in real time, as efficient operations require immediate feedback, and will be built upon a platform of software services and wireless networks distributed across the city's man-made and natural infrastructure.

For example, we should consider how instrumentation, combined with urban information architecture and informatics can modify home energy consumption.

The impact of smart meters on home energy use is a very effective feedback loop. A meter monitors energy use on everyday appliances. This is analysed and displayed to the user. In trials, users have reduced energy use by up to 25 per cent as a result of the information.

The next frontier in this type of work is how real time information can lead to behaviour change within public spaces, to increase awareness but also impart responsibility of the future of our cities not only to its dwellers, but also its citizens.

Strategic design creates new possibilities for Adelaide super site

It was clear from the beginning of the Tonsley Park redevelopment in Adelaide that things were going to be differently handled – and better planned.

For starters it was pleasantly obvious the client – The SA Department of Trade and Economic Development (DTED) – understood the limitations of spatial design in solving this complex redevelopment challenge. DTED recognised the importance of running a strategic design process in parallel with the physical design effort to ensure a clear vision emerged for the site.

“Strategic design sits most effectively before spatial design in the overall design process,” Arup’s Andrew Wisdom explains.

“It involves thinking about what we are trying to achieve with a particular piece of the city and using that to frame the questions that need to be answered for the development effort to be successful.”

With the client’s emphasis on innovation and sustainable industries for the mixed used Tonsley site, the strategic design process was considered essential in ‘unpacking’ the kinds of business and industry that could successfully build on Adelaide’s competitive advantage.

Arup organised strategic design workshops where participants were encouraged to put aside any preconceptions of a ‘traditional’ planning process; and instead to consider more

creatively all the ways people in Tonsley Park could better live, work and play in the future.

This style of strategic design has provided a way for the client to take the Adelaide community on the whole ‘journey’ of the redevelopment of Tonsley Park, from the initial stages of design to the delivery of infrastructure and built form.

Tonsley Park will be a Climate Smart Precinct, meaning the layout of the site will be sustainable, particularly in relation to its infrastructure, energy, water and waste systems. Re-use of the main assembly plant (central to the site) is part of this plan.

When adapted for re-use, it will bring together education and industry in a way that encourages tenants to develop innovative and environmentally friendly technologies – and construction methods.



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Andrew Wisdom
Principal, Arup in Melbourne

Strategically designed and climate smart too

Andrew Wisdom says the participation of the Climate Group and the Climate Smart Precincts concept has been energising. “They do bring a slightly different perspective and world experience to projects but informed by similar sensibilities to ours – they’re also very keen on excellent outcomes. This scope of project works in very nicely with the Climate Smart Precinct agenda.”

Caroline Bayliss says the Tonsley Park site “has all the features to be a great showcase for a sustainable urban development and a Climate Smart Precinct. There will be a real quality of life for businesses and other residents.”

(The Climate Smart Precincts initiative is a coalition of leading businesses and governments working with select urban precincts to test policies, technologies and new business models to encourage low carbon, climate resilient urban development.)

“Those two key touchstones are crucial: to be low carbon and climate resilient – so there’s both adaptation and mitigation aspects to them,” Bayliss says.

The Climate Group has started the initiative in Australia along with partners Arup, Lend Lease, IBM, GE and Origin Energy/ Cogent, as well as the state governments of South Australia, Queensland and Victoria.

Arup is also involved in the development of a multi-faceted brand strategy that can be used not just as an identity, but as an investment tool for a whole variety of users and their interaction with the brand to help deliver viable commercial outcomes. This may well be achieved by redefining the wealth generation potential of the site as well as the adoption of innovative governance structures to deliver on the brand’s core pillars.

Adam Reid is the Project Director, for the SA Department of Trade and Development and is a strong advocate for the strategic design process underway at Tonsley Park.

“Arup’s work has opened our eyes to possibilities that had not previously been obvious,” Reid affirms. “This piece of work is adding substantially to the value of the masterplanning process and has provided us with a believable roadmap for transition of this part of Adelaide into a vibrant wealth generator for the city.”

More sustainable cities a necessity



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Cities occupy just two per cent of the earth's land mass, yet contain over 50% of its population. They use two-thirds of its energy and generate over 70% of its carbon emissions.

C40 Cities is the name of the network that develops greater understanding about sustainability and shares knowledge about the tools and technology that can help cities adapt to a low carbon future. Arup is playing a key part in developing these tools.

Mark Watts is a Director in Arup UK's newly formed energy consulting team, where he leads support to cities around

LISTEN

Mark Watts Director, Energy and Climate Change Consulting, Arup in UK



the world in developing strategies to tackle climate change, including managing Arup's strategic advisory role to the C40 group of cities.

Watts joined Arup in November 2008 as a Director, having been an adviser to former London Mayor, Ken Livingstone from 2000 to 2008. He led the development of London's groundbreaking Climate Change Action Plan and the associated program of projects to reduce London's carbon emissions by 60% by 2025.

He was also responsible for leading London's draft climate change adaptation strategy and, on behalf of the Mayor, for establishing the C40 group. Speaking from London recently, Watts said his experience with London and Ken Livingstone has considerably assisted his current work for C40 Cities.

This year the C40 Cities Leadership Group published two complementary reports to help them confront climate change.

The two reports enable C40 Cities to report greenhouse gas (GHG) emissions according to a common baseline, as well as helping them to understand the options they have for responding to the climate change challenge in the most efficient and cost-effective way.

The first report is Measurement for Management co-authored by the Carbon Disclosure Project and C40 Cities.

In this study, the C40 Cities publicly disclose their greenhouse gas emissions data according to harmonised GHG accounting methods.

(The Carbon Disclosure Project (CDP) is an independent, not-for-profit organisation that holds the largest database of primary corporate climate change information in the world.)

Arup report identifies how to take action

The second report co-authored by Arup and C40 Cities is Climate Action in Megacities: C40 Cities Baseline and Opportunities. This study details the powers that city legislators have taken, and the actions they are implementing, to manage climate mitigation and adaptation.

The report will help C40 Cities to learn from one another and identify opportunities to take action. The report also provides a tool to measure progress and share learning.

By identifying the opportunities to reduce emissions and aggregating results, the study provides decision makers with a tool to take the most effective action on climate change.

Arup's report shows that city authorities have the greatest potential to act on energy in building, transportation and waste management.

Overall, the two reports demonstrate the current impact of cities confronting global climate change and their potential to contribute toward a low carbon future.

"This report demonstrates that cities really matter when it comes to taking action on climate change," Watts said. "Mayors have real powers in the right places and our report documents how the world's 40 leading Mayors are using these levers to cut carbon emissions.

"There is a wealth of quantitative information here about what works, how it has been delivered, and the opportunities for extending successful action around the world to help us all move toward a low carbon future."

Innovation briefs



Existing buildings rating tool

How can you get the most value from your existing asset? A new online tool is here to help!

The online existing buildings survival strategy web tool is designed to help the owners of Australia's existing office buildings plan for the future of their buildings.

The recommendations produced are based on the Existing Buildings Survival Strategy Books developed from Arup's extensive research and global experience in existing building improvement.

See more at www.yourbuilding.org/ebss/

The invisible landscape

Ever thought about your favourite space or whether anyone else knows about it? What other special 'green' spots lie around your city? Is there somewhere with just the right amount of shade at lunch but no seats, or a place that could be your favourite if only there was some protection from the wind?

Launched during Melbourne's State of Design festival, the Invisible Landscape is an extension of the traditional community consultation process, and aims to uncover stories and ideas from the community around their favourite public spaces, through the use of online media tools and user-generated content.

The first iteration of the application focuses on the City of Melbourne, and allows the community to share thoughts, comments, information and images about the city's green landscape, discover other people's secret green gems, and reveal locations that could be improved to enhance liveability.

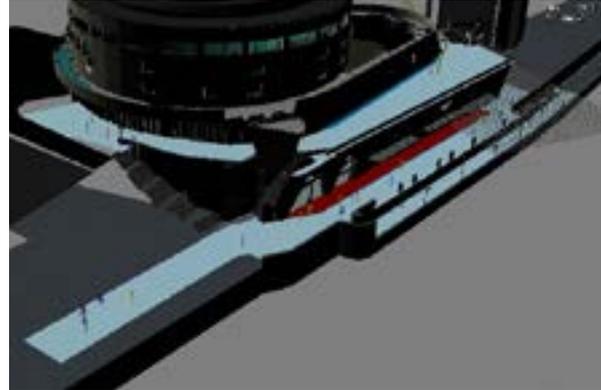
"People are encouraged to walk the city, identifying their favourite trees and green spaces, exploring the landscape and thinking about where they'd like to see change," said Andrew Maher, Leader of Arup's Digital Innovation team in Australasia.

"An online interactive map and mobile app then allows them to plot their thoughts – upload a photo of their favourite tree, share a story about the city, or suggest where they'd like to see change."

"The City of Melbourne can then tap into this. They're trying to put value to what they call 'green infrastructure', but how do they value those things? Can they put a financial value to them? This is more about the social value."

Download the (free) Invisible Landscape app and share your favourite green urban spaces, or discover other people's secret gems [@fieldsofactivity.com/theinvisiblelandscape/](http://fieldsofactivity.com/theinvisiblelandscape/)

Follow the project on [Twitter @cityinvisible](#) and Facebook.



Innovating through time based animation

Move over spreadsheets, interactive animated reports are here to stay.

Arup undertook a large scale mode split survey at Clarkson, Murdoch, Joondalup and Stirling train stations in Perth. Data was collected at 15 minute intervals throughout the day's station operation at all points of arrival and departure, and classified into modes.

The data was collated into spreadsheets and graphs, and also translated to an interactive report, which allows the user to view a time based animation of the day's movements at the stations per mode, and interactively query the numbers and graphs.

"Representing data in this way offers significant advantages over traditional spreadsheet based reporting methods, and provides a holistic perspective of the data collected," comments Ben Cooper Woolley, Senior GIS Specialist based in Arup's Perth office.

Avatars and eye cones

City life is all about people. Our very presence along streets and in other public areas is the main indicator of a vibrant urban environment.

The way public space is arranged and how it relates to the surrounding environment has a significant bearing on how people use that public space. Planning for people movement is a key ingredient in the successful design of buildings, underground transport interchanges and the associated public spaces.

"Through the use of 3D software and by projecting visibility through people's field of vision, we can capture the intensity of what people can see in a 3D space and accordingly evaluate the best location for signage, advertising and retail," comments Paul Stanley, Senior Associate in Arup's Planning team.

Arup's pedestrian movement simulation software MassMotion - a 3D animation system inspired by gaming technology first made prominent by Lord of the Rings - enables the architects, wayfinding experts, developers or constructors to fully visualise a space and identify the impact of design on wayfinding through hotspots of visible intensity. This artificial intelligence allows the design team to plan for emergencies and to understand how various elements of the project will interact in real time.

Arup's Social Firefly @ Vivid



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Two teams from Arup were commissioned to produce new work for the Vivid Sydney light festival, centred around the key tourist areas of Circular Quay and The Rocks — their works were titled ‘Social Firefly’ and ‘[B]right on Time’

‘Social Firefly’ is a social network of friendly lights communicating through light and movement. Fifty robotic fireflies were suspended in one of Circular Quay’s majestic fig trees. The fireflies respond to light by pulsing their lights and moving their tails to spread light messages to their neighbours. Visitors were invited to use the torches provided to interact with the fireflies and get them dancing.

The artwork is a collaboration between Liam Ryan, Jason McDermott and Frank Maguire.

‘[B]right on Time’ was designed by the Sydney Lighting team (Tim Carr, Carter Leung, Tim Hunt and Jo Black) and with architect/urban designer Mark Gilder. It uses pulsating light to replicate the movement of trains in and out of Circular Quay station. Varying light intensity indicates the trains coming and going, with the light fading to black once each train has departed.

Spectators can stand under the rail bridge to enjoy an acoustic experience as the trains pass overhead (more on this project in an upcoming issue).

The inevitable ascent of BIM

Building information modelling

For the ‘unknowing’ among our readers, BIM stands for Building Information Modelling. In a recent feature in *Ecolibrium*, Sean McGowan posited that the simplicity of the acronym masks the strength and complexity of a tool that (McGowan says) is set to rewrite how the architectural, engineering and construction industries go about designing and building in the future.

“While BIM is often associated with 3D modelling and visualisation, its scope is substantially greater than that. It creates a virtual environment in which every possible fragment of information relating to a building’s design, visualisation, planning, construction and operation phases of its life can be held or referenced via hyperlinks,” McGowan wrote.

“In essence, BIM documents the manmade DNA of a building.”

Hyperbole from an over enthusiastic author? As a world leader in implementing BIM how does Arup approach this new resource with the catchy name – but the not-so-simple definition?

“BIM can mean so many different things, so we must be clear what it is you collectively want to achieve,” says John Hainsworth, Associate at Arup in Sydney. “In simple terms, asking why you need to use BIM will have you soon figuring out when, and how, it is to be best applied for gain.”

Hainsworth says, for instance, BIM might well be used as the coming together of a 3D model that has been assembled by lots of different kinds of software.

“Or BIM can host a virtual construction meeting, on a big wall screen so clients and designers can all interact with it in a 3D way.

“At Arup,” Hainsworth estimates, “there are 29 different things BIM might offer, and the client might only want one or two of them, so we choose the software appropriate to the task.”

Hainsworth says all traditional 2D drawing using BIM-enabled software is now quicker, more accurate for delivering synchronised documentation.

More a process than software

In a recent paper Peter Scuderi, Senior Associate, at Arup in Brisbane, advises users “to allow the current best of breed software to be used, but don’t paint yourself into a corner by stipulating proprietary formats – if necessary, establish a workflow that permits different software to work together.”

Scuderi and John Hainsworth agree that the more accurate description of BIM is as a process. Scuderi said in his recent paper: “BIM is a process that uses technology to revolutionise the creation of geometrically coordinated 3-dimensional objects that are similar to ‘virtual models’ of what the final construction (whether it is a building, a road, a bridge et cetera) will look like throughout its lifecycle.

“BIM enables the provision of more accurate information earlier in the delivery process of the project – resulting in a lowering of risk for all stakeholders. It visualises all the design and construction in real time, as well as identifying potential operational problems to allow for whole of lifecycle management.

“In practical terms, when changes are made to the model, the wider impact can also be seen. For example if a sink is relocated, it also indicates that plumbing needs to be re-routed.”

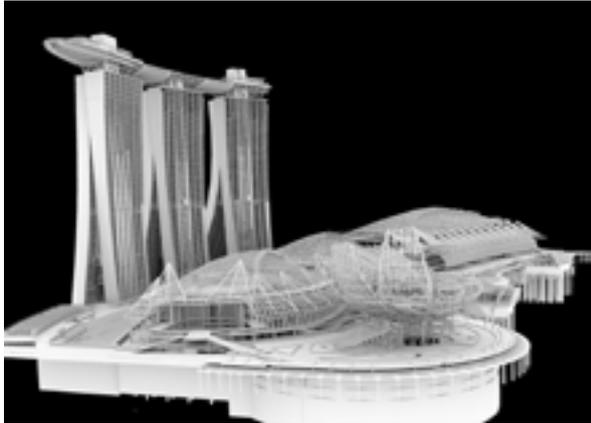
John Hainsworth says Australia is at a tipping point for implementing BIM*.

“There is a compelling economic case for encouraging greater use of BIM in Australia. Organisations that are aware of this, and already engaging with BIM, will have a distinct advantage,” he insists.

The Australian Federal Government, through the Built Environment Industry and Innovation Council, commissioned a report that does put forward a compelling economic case for the widespread adoption of BIM in the Australian construction sector.

The study concludes “BIM has macroeconomic significance, (and) that its accelerated widespread adoption would make a significant difference to national economic performance.”

**BIM is currently being applied in numerous Arup projects including 33 Bligh St Sydney, Monash Law School Melbourne, 8 Chifley Square Sydney, Hobart Hospital, Hong Kong International airport, Town Hall Redevelopment Sydney, Brisbane Domestic Terminal Extension, St Pancras International Station, Kinghorn Cancer Research Centre Sydney, Australian Steel Institute Costing Study, One Shelley Street Sydney.*



BIM instrumental in award winning Marina Bay Sands

In Singapore, the government is applying a strong mandate for BIM, offering financial incentives to those willing to be the early pathfinders, with the goal of increased industry adoption, and ultimately full BIM submissions, by 2015.

Already in Singapore, the BIM process greatly increased the capacity of Arup's Marina Bay Sands team to transfer data efficiently and effectively, from design to documentation, and geometry control through parametric to design.

Arup and the already famous Marina Bay Sands project has recently emerged as the winner in the Innovation in Structural Engineering category of the recent Bentley Systems Be Inspired Awards.

The award recognises projects that have demonstrated excellence in planning, modelling, analysing, designing, or delivering structures. Selected from a pool of 20 other entries, Marina Bay Sands and Arup were anointed for their use of technical innovation to deliver the extraordinary structure that stands in the heart of the new Singapore downtown.

Arup has had to overcome a number of structural challenges in the project which is characterised by three cascading hotel towers topped with a 1.2hectares Sands SkyPark, two crystal pavilions and a lotus-inspired museum. Notably, the most challenging aspect of the project was the SkyPark cantilever, the longest of its kind in the world.

Arup designed the structure to withstand strong winds and vibration caused by people movement; and to provide optimal comfort for guests.

The design was formulated to allow for safe and easy construction at 200 metres above ground — the height of the SkyPark — and in the deep marine clays at basement level was needed.

Arup achieved this successfully with a combination of innovative engineering approaches. It also adopted innovative 3D modelling technologies, which were especially beneficial in the engineering of the project's complex structural steelwork in a short timeframe.

How to succeed with BIM

Peter Scuderi, John Hainsworth and colleagues at Arup have drafted the following advice for potential BIM users.

Strategy

Key to the overarching success of BIM on a project is the alignment with organisational objectives, whole of life of the project, collaboration across the project team and the cost benefit and risk analyses.

In order to be most effective, BIM needs to align with organisational objectives and with stakeholder needs. In today's challenging financial world, companies more than ever need to add value to projects through close collaboration with all stakeholders.

Open standards

In order to achieve maximum benefits, the BIM software needs to be integrated and interoperable across the project team. All involved need access and understanding of its workings, and in particular, the client needs access to the building information over its whole lifecycle.

Establishing clear protocols that serve as the foundation for BIM use on a project should provide a robust structure for BIM implementation. These should be agreed to by the project team at the outset, and may include specific and individual requirements for components of the project. Ideally protocols will be developed by the client prior to going to tender so that there are clear expectations of what is required.

Process

Ideally each project using BIM will develop a framework to specify the processes and workflows prescribed. The process will align with stakeholder requirement and outline the software that will be needed throughout the project.

Essential to the success of the implementation of BIM is appropriate training for the users and clear communication between the stakeholders.

Implementation

Real success of BIM is only known once the project is fully implemented. However the ability of BIM to provide clash detection between the different disciplines and performance testing of environmental, fire and acoustic factors tends to lead into a more straightforward construction.

By using a computer model that shows building parts as objects, construction information and scheduling can be improved, performance auditing is simplified, and asset management once the building is in operation is easier to undertake.

In the next edition

Healthy people and communities

Healthy city design in an ecological age

A paper by Australasian head of Planning, Andrew Wisdom, draws a link between the health challenges of affluent industrialised cities and the challenge of creating resilient cities suitable for the post-industrial era we are entering. It makes the case for considering these two sets of challenges as two sides of the same coin and provides a framework for determining how we tackle them.

Building the education revolution creating healthy communities

A key strategy for Arup is delivering projects that promote the growth of 'healthy communities' and the education sector is a key component of this. Over the past two and a half years Arup has been involved in wide range of Building the Education Revolution (BER) projects across Australia to stimulate the economy and provide new educational facilities for the wider benefit of society.

It has been a challenging, controversial and complex programme for all involved and clearly there is an imperative to determine what benefits have accrued for society from this investment. In Victoria, Arup in association with our partner Indec Consulting, is working with the Department of Education and Early Childhood Development to uncover both the sustainable benefits that have been realised by the BER as well as incorporating the lessons learnt into new standards and methodologies for the delivery of future education facilities.

In our next issue we will present details of this project and how Arup's Benefit Management capability is being applied to uncover both the tangible and intangible benefits of this generational investment in education facilities.

Consumers produce nearly 60% of food carbon emissions

A study conducted by sustainable food distribution company Food Connect and Arup has revealed that as much carbon was contributed by consumers after food purchase than during the production and distribution stages. The study showed consumer refrigeration and cooking accounted for a sizeable 46% of emissions, while only 3% resulted from farm production. The use of plastic and recycled cardboard packaging created a greater carbon footprint than produce transportation and storage. In the next edition we will talk to Arup's Matt Kluck, Sustainability Consultant in more detail about the study.



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