buildingsight

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Construction Rises to Plastics Challenge

Building a Sustainable Future

foreword

by **Richard Gurney**

Historically, the construction industry has been seen as one of the major industrial contributors to global greenhouse emissions.

As countries commit to more ambitious targets to reduce emissions, the construction industry is being challenged to play its part. And it is rising to meet this challenge.

We see smarter and more sustainable land use, and project design incorporating carbon footprint reduction. There is a greater focus on waste material repurposing, and reduction of waste generally as well as the identification of both economic and environmental benefits. Indeed, anticipated future project return is increasingly being measured against failure to mitigate the effects of climate change. Project bankability is now being determined through the lens of sustainable financial benefits.

If the construction industry is to successfully play its part in this effort, the insurance industry will need to be an active partner, adapting to new technologies and being an enabler to global innovation. The insurance market has always been crucial in managing emerging technology risk, and we view this support as equally important in ensuring projects are viable and compliant with carbon footprint reduction ambitions.

As we publish this edition of *Building Sight* the impact and ongoing effects of COVID-19 are at an early stage, but have the potential to be profound. While the construction industry has been considered an essential service by many governments, the welfare needs of the workforce are continually being weighed against the desire to keep the commercial environment moving and people employed. Our thoughts are with you, your families, and your businesses.

RICHARD GURNEY
Global specialty head, Construction, Marsh JLT Specialty

UPfront

NEW ROLES

Head of Global Contractor Development

Marsh JLT Specialty Construction has appointed **Kelly Outram**, currently regional director, construction practice and Hong Kong construction leader, as head of global contractor development. Kelly will assume her new role in May 2020. For the past 10 years Kelly has been based in Asia, and has worked on many major infrastructure project.

Kelly says, "Collaborating as a global team, our bench strength and global reach will allow us to compete in a space where we can, and will, outshine our competitors."

Head of Construction, Continental Europe

Philippe Onteniente, who joined Marsh JLT Specialty in March 2020, will lead the development and implementation of our construction business strategy across Continental Europe. He will also provide strategic insurance and risk management advice to clients across the region.

He has worked in the global construction industry for over 25 years, assisting major contractors and owners in developing and implementing risk and insurance solutions for large-scale construction and energy projects.

CLIENT EVENT

PPP and Project Finance Seminar

Marsh Panama hosted a breakfast seminar with support from the construction and credit specialties team. The seminar discussed the first PPP law to be introduced in Panama, and the implications of this.

Participants attended from across the construction and infrastructure sector, as well as the banking industry. João Búzio, LATAM regional construction leader, was one of the main presenters alongside Marsh's regional credit specialties leader, the secretary for PPP's at the Panamanian government and law firm AFRA.

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CLIENT RESOURCES

Coronavirus Resource Centre

COVID-19 continues to spread globally, presenting unprecedented risks to people, businesses, and economies. Organizations must prepare to respond to, and recover from, a range of impacts to their people, operations, and business as any delay could mean significant consequences later.

On marsh.com we have a regularly updated resource centre where businesses will find thought leadership, expert views, as well as solutions and strategies that you can apply as you navigate the challenges posed by COVID-19.

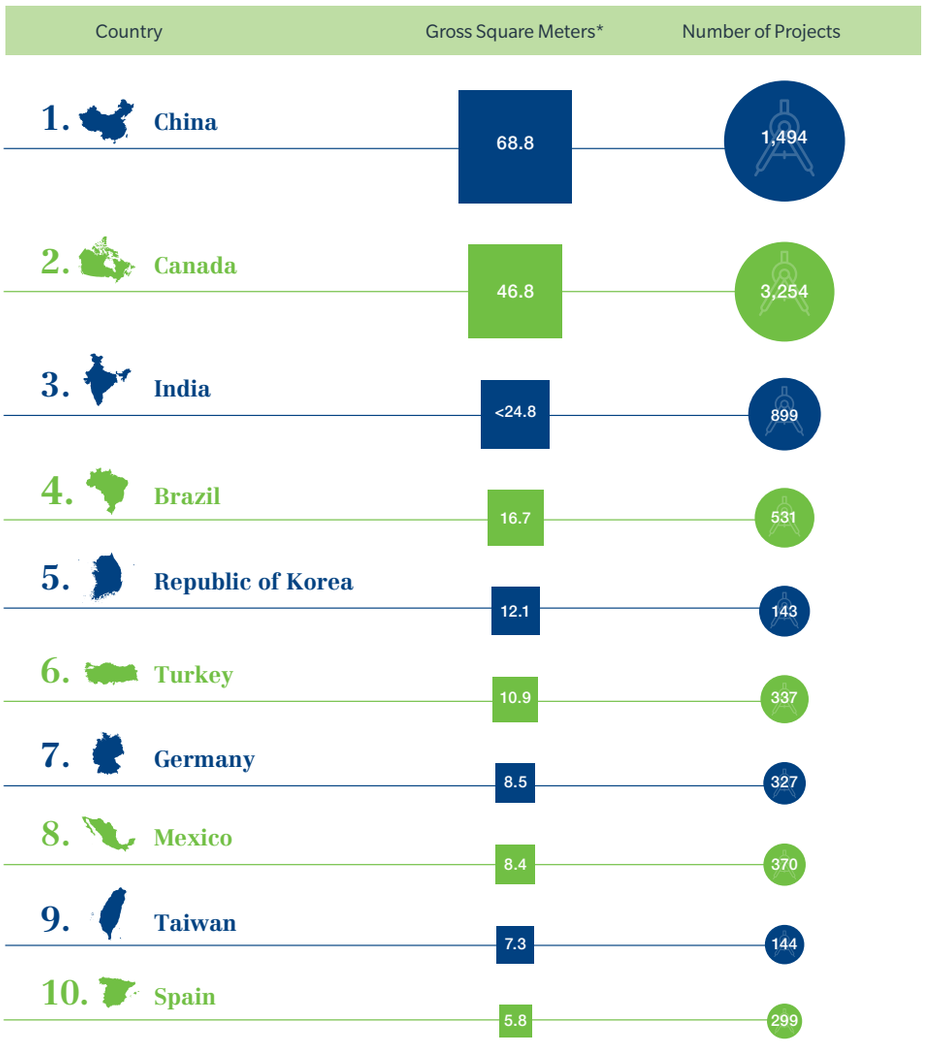
For more information visit www.marsh.com

CONSTRUCTION SUSTAINABILITY INDICATOR

2019 Green Building Country Rankings

The US Green Building Council provides a listing of the top-10 countries and regions for Leadership in Energy and Environmental Design (LEED). This well-established and globally recognized green building rating system identifies where LEED is used to deliver developments that consume lower levels of energy, water, and carbon providing more sustainable and, it is hoped, healthier working and living environments for their inhabitants.

For 2018, China heads the list with over 68 million gross square meters of development, followed by Canada with over 46 million gross square meters and India with over 24 million. The rankings are in terms of cumulative LEED-certified gross square meters as of December 31, 2018, and includes 96,275 registered and certified projects in over 167 countries.



* Gross square meters are reported in millions. Data is reported as of December 2018.

** The US, where LEED originated, is not included on the list but remains the world's largest market for LEED.

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infocus

SPOTLIGHT

Low-Carbon Cement

Interest in low-carbon cement is ramping up, with established players and startups joining forces. But what are the risks?

Words by
Stephen Cousins

Portland cement is one of the most manufactured materials in the world. It is also the source of about 8% of the world's carbon dioxide (CO2) emissions, according to think tank Chatham House. If the cement industry were a country, it would be the third largest emitter in the world — behind only China and the US.

Although low-carbon cement alternatives have been under development for decades, increased concerns about global warming have ramped up interest over the past 12 months. Two deals in 2019 signal that mainstream construction sees the value in developing low-carbon technologies.

Bouygues Construction is partnering with Hoffmann Green Cement Technologies to develop Hoffmann's H-EVA cement, which uses alkaline-activated clay. Hoffmann says its cement has a carbon footprint 70-80% lower than traditional cement.

Meanwhile, global cement manufacturer LafargeHolcim has joined forces with startup company Solidia Technologies. Solidia cement hardens by adding CO2 instead of water — a so-called carbon-cured cement — which the company says reduces the overall carbon footprint by up to 70%.

It is already common to find concretes in which around a third of cement is substituted with industrial byproducts, such as ground-granulated blast-furnace slag or pulverized fuel ash, also known as fly ash. Waste from agricultural processes, such as rice husk ash, are also used in mixes. The substitutes are often used for technical rather than environmental reasons, but they do reduce carbon emissions.

> ***"Hoffmann says its cement has a carbon footprint 70%-80% lower than traditional cement."***

Novel binders, such as geopolymers or alkali-activated cement, are also used in specialist applications. Designed to partially or fully replace cement in concrete production, they can potentially make the binding element almost carbon-neutral.

To date these alternative concretes have rarely been as cost-effective as regular concrete and face market vagaries. For example, shortages in supplies of fly ash and slag have hit European cement companies. Since fly ash is a byproduct of coal-burning power stations, shortages are likely to increase as countries move to cleaner energy production.

Different concrete formulations can be difficult from a risk perspective, says Gaurav Kapoor, vice president and national project risk leader of the Construction and Surety Practice at Marsh JLT Specialty in Toronto. "If the process has not been formally tried and tested within a project, or multiple projects, the insurance market might be hesitant as the properties are still unknown."

In Canada, losses related to concrete and concrete forming has become more frequent, primarily due to issues including faulty workmanship, incorrect finishing, or ineffective or deficient concrete mixes.

As embodied carbon moves up the agenda for construction companies, more projects will be asked to consider lower-carbon mixes. As with any non-standard concrete mix, it is important to include a robust pre-construction testing regime, and allow sufficient time in the program to accommodate this. ■

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SPOTLIGHT

Alternative Materials

Using waste organic materials in construction can help cut embodied carbon emissions and divert waste away from landfill and incineration.

Words by
Stephen Cousins

A growing focus on the circular economy (where everything is engineered to be constantly reused or recycled), particularly in Europe, is driving the creation of a new generation of building products, based on waste from crops. Expanding the use of organic waste in construction could reduce reliance on raw materials and allow a new economy to flourish.

A kilogram of waste used as interior cladding, for example, would sell for between €5/kg and €6/kg, according to multinational professional services firm Arup. If incinerated for energy recovery, on the other hand, the same material's commercial price would be about €0.85/kg.

Over 100 companies around the world produce building products from agricultural or food waste — ranging from interior partitions and finishes to insulation materials, furniture, and cladding — according to Arup. Their report showcased 10 companies, 7 of which are based in Europe, producing products from 12 different crops.

While some products are certified for use in global markets, others require further R&D and investment. Hempcrete — a bio-composite material comprised from wooden refuse removed when processing hemp and lime — is already widely used around the world.

This is particularly true in France, where it is used to construct non-weight-bearing insulating infill walls, or to renovate old buildings made of stone or lime. UK startup Chip[s] Board has developed a sustainable alternative to medium-density fibreboard that can be biodegraded into fertilizer at the end of its life. It combines a non-toxic binding agent, made from potato peel, with fibers from waste potato skins, bamboo, beer hops, and recycled wood.

A more high-tech application, from Dutch firm Aectual, uses bioplastics made from renewable plant-based polymers to 3D print floors, façades, stairs, or even entire buildings.

Market acceptance of these new materials will hinge on factors such as reliable technical performance, standards, and regulations, says Joachim Fliege, senior engineering specialist at Marsh in Germany. "They will need to perform at least as well as traditional materials in terms of durability, fire resistance, safety, and health. And where standards don't yet exist for such products, independent testing and certification is a must.

"Even though these building materials are somewhat more expensive, a good CO2 balance makes them absolutely competitive compared to conventional materials." ■

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OCCUPATIONAL EXPOSURE

Streets Paved with Waste

Using waste materials such as plastics and discarded tyres to reinforce asphalt mixes for highways means less waste goes to landfill and longer-lasting surfaces.

Words by
Stephen Cousins

Worn-out tyres have long been used to reinforce asphalt mixes for roads, particularly in the US, China, and more recently Malaysia. Other waste materials are under trial including plastics, glass, and even toner from used printer cartridges.

As well as diverting waste from landfill, waste materials can improve pavements' durability and performance, modifying the bitumen in a mix in a similar way to a polymer additive.

India was an early pioneer in waste-plastic roads, with technology to blend waste plastics into hot-mix asphalt at asphalt plants developed at the turn of the century. Use has ramped up since 2015, when the Indian Government mandated that any urban area with over 500,000 inhabitants must construct roads using the technology.

UK-based MacRebur, whose waste-plastic pellets or flakes have been deployed in roads in Australia, the US, and the UK, claims that a one-kilometer stretch of road made with its binder product contains the equivalent of about 684,000 plastic bottles, or 1.8 million single-use plastic bags.

Melbourne, Australia, has also been home to trials involving the use of plastic bags and packaging, glass bottles, and printer toner in road surfacing. There are environmental concerns as well as benefits, however. Heating rubber or plastics to high temperatures can use extra energy and potentially release toxins into the environment. And plastic roads can potentially degrade, releasing microplastics that attract pollutants such as polychlorinated biphenyls.

Question marks also remain over how successfully roads comprised from these mixtures could be recycled at the end of their useful life.

Thomas Konstantis, a risk engineering consultant in Marsh JLT Specialty's Construction Practice, says: "It is essential that waste material trial characteristics, such as duration and testing conditions, are clarified prior to actual project application." Konstantis says such risks require a comprehensive asset life-cycle management plan, which addresses various challenges, such as health and environmental hazards (for example, toxic byproducts); supply of suitable plastics (including segregation between useable and non-useable plastics); and the project team's experience and training. ■

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> *"The main challenge in construction is around efforts to segregate, reuse, and recycle plastic waste at the end of its life."*

Allan Sandilands, principal consultant, Resource Futures

Construction *Rises to* Plastics Challenge

As the world wakes up to the environmental challenges posed by massive plastic consumption, the construction industry is reducing its reliance on single-use plastics and increasing use of recycled plastics.

Words by
Neil Gerrard

Plastic items can take up to 1,000 years to degrade in landfill, but the material's reputation has disintegrated a lot faster. Heightened awareness of its effects on the environment has prompted businesses and individuals to reassess their relationship with plastic.

As a major consumer of single-use plastic, the construction industry could help to drastically reduce waste by using less and re-using more in the form of recycled materials.

The most common plastics used in construction are polyvinyl chloride (PVC), high density polyethylene (HDPE), and expanded polystyrene (EPS). Plastic is used for various applications such as seals, windows and doors, pipes, cables, floor coverings, and insulation. The industry also traditionally uses plastic films for packaging. Where facilities exist and the systems to manage recycling are in place, packaging can be bundled up and incinerated in energy-from-waste plants.

Not all plastics are bad, and consumption within the industry looks set to increase, with plastic pipes, for example, already accounting for most new pipe installations. "Contrary to popular belief, it's important to acknowledge that plastics in construction are often a positive thing," says Allan Sandilands, principal consultant at the sustainability consultancy Resource Futures. "Many are highly durable, long lasting, and permanently installed, so they're unlikely to become marine litter," he says. Additionally, plastics are cost-effective, strong yet light, easily formable, and easy to maintain.

The main challenge in construction is around efforts to segregate, reuse, and recycle plastic waste at the end of its life, says Sandilands. "The benefit isn't always financially significant — it's more in terms of corporate social responsibility and commitment to best sustainable practice — so it can be a difficult sell.

> ***"The first step is to review key packages to see which will result in the most reduction, and focus on those."***
>
> *Isabel McAllister, director of responsible new business, Mace*

"From our experience there has not been a huge drive to tackle single-use plastics in the construction industry in the same way that we're seeing elsewhere, because it's insignificant in terms of tonnage compared with other waste streams and doesn't greatly affect contractors' bottom lines."

The need to protect the corporate environmental reputation is moving up the risk agenda within the construction industry, believes Robinson Zhang, acting infrastructure and mining leader for Marsh in China. "There have been high-profile cases where construction projects have caused damage to the environment, and we know these negatively affect the reputation of companies involved."

1,613 tons

of concrete and 136 tons in CO2 emissions was saved by using recycled plastic in the construction of a 13-storey residential tower.

Action Plans

Some companies are trying to make a difference, recognizing the reputational benefit of doing so. In 2019, German developer and builder Diringer & Scheidel Group used recycled plastic in the construction of a 13-storey residential tower to save 1,613 tons of concrete and 136 tons in CO2 emissions. The build used a patented void-former system made from recycled plastic from Heinze Cobiax Deutschland. Essentially, steel-reinforced air bubbles were used to replace up to 35% of reinforced concrete normally required in slabs.

In the UK, Mace is one of several firms to set itself targets for reducing plastics, through its "Time to Act" campaign. In conjunction with clients and the company's supply chain, Mace has measures on its sites to reduce single-use plastics, including using reusable shoe covers, a closed-loop system for protective plastic

Consumer Waste, Construction Resource

Waste plastic from consumers has the potential to become an important resource for construction. Some building products — such as pipes and UPVC doors and windows — already include a proportion of recycled material, but new applications in construction are emerging fast.

From an embodied carbon perspective, plastic is far less energy intensive to produce than traditional materials such as concrete and steel, especially when recycled. It also has engineering benefits such as its high strength-to-weight ratio, durability, and resistance to corrosion. Combine all those characteristics, and you have an environmentally attractive proposition.

Dutch firm KWS, part of the VolkerWessels group, had this in mind when it created PlasticRoad, a prefabricated road system made from 100% recycled plastic. It comes in hollow modules that are fitted together. Utilities run through the hollow section, with easy access for installation and repair.

KWS, working in partnership with oil firm Total and drainage product manufacturer Wavin, constructed a city bicycle lane in 2018 as a trial project According to KWS, PlasticRoad will last three times as long as an asphalt road surface and require less maintenance.

Recycled waste plastic is also being used to reinforce asphalt in road surfaces. UK company MacRebur, for instance, makes pellets from plastic waste that melt into the asphalt mix to create a stronger more crack-resistant road surface (see page 5).

Bridges are another contender for recycled plastics. The world's longest span recycled plastic bridge, at 30 meters, was installed across the River Tweed in Peeblesshire in Scotland, in 2011. There are several in the US too, where the system was pioneered.

The challenge in creating any product from recycled materials is ensuring the quality of the feedstock. That requires changes in technology and changes in attitude — to consider used plastic as a resource rather than waste. As economies around the world grapple with how to move to a new circular plastics economy, construction is well placed to become an important part of the circle. ■

sheeting, and a trial of reusable skip liners for concrete washouts.

Mace has also worked with its mechanical and electrical supply chain to change how it uses plastic — with one supplier of MEP modules and cables reducing single-use plastics in its products — as well as plastics in its packaging, to save the equivalent of 40 tons of plastic waste a year. Mace has also instituted a program of beach and river cleanups everywhere from North America, the UK and Ireland, to Dubai and Vietnam, and has collected an estimated two tons in plastic waste. It is now looking at how to increase its use of recycled materials.

Contractor Multiplex launched a plan in July 2019 with two key focus areas: Eliminating single-use plastics, and promoting circularity of existing plastic items. Called "7:5:3," the plan tackles 15 plastic categories by either banning single-use-plastic avoidable items, replacing plastic with alternatives, or finding a new use for the end of their life. For example, Multiplex's site canteens no longer sell single-use plastic bottles, while at its £200 million Principal Tower project in London it switched from plastic mastic tubes to foil mastic tubes, saving over 9,290 tubes of single-use plastic tubes and reducing the volume of packaging waste produced by 96%.

While the international construction sector has a long way to go, firms could be driven to take more care over plastic waste and materials generally as nations outline plans to target zero-carbon emissions by 2050 under the 2015 Paris Agreement. Construction firms can examine carbon material databases such as the Inventory of Carbon Emissions, or Trafikverket's Klimatkalkyl (see page 9), to gauge levels of embodied carbon in different forms of plastic as a starting point for determining how to reduce consumption in the most environmentally friendly manner.

The first step for any contractor committed to reducing plastic consumption is to create an action plan, advises Isabel McAllister, Mace's director for responsible business. "It's a long road, but the first step, is to review key packages to see which will result in the most reduction, and focus on those.

"Go after the 'easy wins' first," adds McAllister. "Switching from plastic catering products and packaging, using reusable cups and glasses, buying products in bulk for cleaning, and generally reviewing office deliveries and how items are packaged are all easy wins.

"On site, the solutions may be more niche, but we have created a resource of the options we have trialed, which is available to our sites to work with contractors to see which items are feasible for them." ■

> ***"The first step for any contractor committed to reducing plastic consumption is to create an action plan."***

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thinkingahead

Greening Our Cities

Planners are mandating more green areas in city centers to combat climate change and bring environmental benefits.

Joachim Fliege
Senior engineering specialist
Marsh Germany

New developments in London will have to provide an agreed amount of greenery if proposals in the draft London Plan go ahead. The plan is introducing an Urban Greening Factor (UGF) in a bid to improve the quality of the city environment and fight climate change impacts.

The UGF is a version of the green space factor that was pioneered in Berlin 25 years ago. In the last five-to-ten years, a handful of other cities — including Malmö, Seattle, Helsinki, Washington DC, and Southampton in the UK — have adopted similar schemes, as concerns over the environment mount.

Introducing more greenery into urbans spaces brings a raft of benefits. Green cover such as roofs or planted areas helps manage rainwater at source, reducing the risk of flooding. Greenery also reduces urban heat island effects, encourages biodiversity, improves air quality, and contributes positively to the well-being of people living and working in cities.

Owners and contractors must be diligent in selecting the right systems and suppliers, however. Green roofs or walls must be correctly specified and installed and — crucially — there must be a proper understanding of the maintenance requirements once a building is in use.

The green space factor is calculated by multiplying the proportion of a plot covered by greenery by a factor between one and ten, depending on the type of green cover, and adding those together to get an overall factor. Planners can use these to set different target factors, depending on the use of the site or its location. ■

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Carbon Counting Tenders

Some public sector clients are starting to look at carbon budgets alongside capital ones. Swedish transport authority Trafikverket has gone further.

Magnus Friberg
Construction practice leader
Marsh JLT Specialty, Nordic Region

In 2016, Trafikverket in Sweden launched its carbon reduction requirements for large transport infrastructure projects: Contractors bidding on contracts over €5 million, and due to start operation after 2020, must provide a carbon budget and details of how they plan to reduce the project's carbon footprint.

Between 2020 and 2024, design-and-build contracts will be targeted to achieve a 15% carbon reduction. From 2025 to 2029, the targeted reduction will rise to 30%. Projects that better their targets could receive a financial bonus. Carbon footprints for Trafikverket projects are calculated using a tool called Klimatkalkyl.

Sweden has set itself ambitious goals to reduce its carbon emissions and slow climate change. In 2018 the Swedish Government committed to becoming carbon neutral by 2045, five years sooner than its previous target date of 2050. Only Norway, Finland, and Iceland have more ambitious targets.

Public sector bodies in other countries are pursuing their own carbon accounting approaches for construction projects. Similar to Sweden, the Netherlands has its DuboCalc tool and takes carbon reduction commitments into account at tender. In other countries, such as the UK and Australia, individual organizations and projects are taking the lead but the goals and penalties for missing targets are less defined.

This process will keep improving. The important thing is that the construction industry is committed to reducing its carbon footprint and working together to find robust ways to do it. With the focus on carbon increasing, other authorities will look to learn from Trafikverket's experiences. ■

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Brownfield:

High Risk, High Reward

Brownfield sites are becoming more attractive in the US as development land becomes scarcer. But new players may face more risks than anticipated.

Words by
Kristina Smith

Brownfield used to be a dirty word in the US: plots of contaminated land, blighted by their industrial past, requiring significant investment to bring them back into use. Turning them around was left to specialists, who learned over decades about the associated risks and how best to deal with them.

Today, the narrative is different. "We have been in economic expansion for a long time. There has been a lot of redevelopment, so we are running out of clean sites to develop," explains Chris Smy, global leader of Marsh's Environmental Practice. "A lot of real estate companies are getting involved in properties they would not have touched five or ten years ago."

There are plenty of sites to go after. The US Environmental Protection Agency (EPA) estimates there are over 450,000 brownfield sites. In some regions, such as the East Coast, there's demand for commercial and light-industrial sites as the reshoring agenda gains pace, says Jim Vetter, senior environmental risk advisor at Marsh. Elsewhere — California, for instance — land for housing is scarce.

And there is a strong linkage between reuse and sustainability. "There's a huge spectrum of reuse," says Randall Jostes, CEO of Environmental Liability Transfer (ELT), an environmental liability assumption company that has been redeveloping brownfield sites since 2004, though Jostes' experience stretches back further. "We've redeveloped brownfield sites into everything from industrial to recreational, commercial, retail, even high-rise residential." ELT's Brayton Point development sees a traditional power generation site transformed into one for renewable energy (see box).

In parallel with rising demand for sites comes another challenge: Many of the "easy" brownfield sites have already been redeveloped. According to ELT, 60% of redevelopments have been "low-hanging fruit" sites, although such sites only account for 15% of the 450,000 brownfield sites in the US.

Turning around brownfield real estate successfully requires a broad range of skills: risk management, risk transfer, technology expertise, and real estate know-how.

"Average developers who are looking for land in a constrained market will think they can take on these sites," says Eric Zitek, Western regional development manager at Viridian, a brownfield developer with a track record of almost 20 years. "However, once they get into the details, they find it's too difficult and then fall out of contract."

However, not everyone can make these sites work. For instance, in 2013 Viridian took on the ePort Logistic Center in Perth Amboy, New Jersey (see box), after another major developer had grappled with it for several years before admitting defeat.

Cleanup Funds

The US started to tackle its bank of contaminated sites back in 1980, when Congress established the Comprehensive Environmental Response, Compensation and Liability Act. Known as Superfund, it forces those responsible for polluting a site to clean up or provide funds for the EPA to do so.

The challenge for any developer considering one of the 1,600 Superfund sites is that the process to determine the remediation required, fund, and deliver them is very complicated. "It has been arduous and slow, although the EPA is examining the process to see if they can simplify it to deliver quicker and more cost-efficient cleanups," says Jostes.

There are around 20 different EPA funding programs that aim to encourage brownfield development, the latest being Qualified Opportunity Zones, which offer tax breaks to brownfield plots in low-income and rural communities.

Sites that require government funding or tax breaks to make them viable may not be the best bet, says Viridian CEO Bill Lynott. "We think our projects need to stand on their own two legs. If the real estate does not work, if you cannot integrate it with environmental cleanup costs, we know our investors would not be interested."

New Vision

Regulators' attitudes to brownfield-site repurposing have matured over the years. Today they are far more willing to look at a fit-for-purpose approach. For example, areas of contaminated soil can be capped off, or contained within one part of the site. Controls, such as monitoring ground water and gases, and preventing change of use, ensure safety in the future.

Risk mitigation has matured too. Brownfield insurance has developed into a niche, but significant, part of the market, says Vetter. "With brownfield, you have to go about things more collaboratively, and have more technical discussions around the site and what you intend to do."

Viridian's approach to insurance has changed over the years, says Lynott. The company used to take out stop-loss or remediation cost cap insurance that covered known pollutants. Given the changes that occurred within the market as the product developed, Viridian now works with proven cleanup contractors with strong balance sheets who can guarantee cleanup outcomes.

Changes to pollution legal liability (PLL) insurance, which covers unknown pollutants, have been positive for the market, says Jostes. "We now have excess of indemnity as a rider to PLL insurance to guarantee the brownfield developer's performance. The seller can make sure a PLL is put in place with an excessive indemnity insurance should the developers fail. That's really opened the door to a lot of new competition."

One of the biggest challenges faced by brownfield developers is the variation in approaches between states. "The biggest lesson I have learned is to be very aware of regulations, particularly those subject to change. That really is the wild card," says Jostes. "To understand regulations is to be successful."

Slow processing times threaten successful delivery in some jurisdictions, says Lynott. "The challenge is getting deals done properly, as quickly as possible. Time is the enemy of financial deals." Some states are now alert to this issue, he says. New Jersey, for instance, has allocated experienced senior project managers who can tackle technical and commercial issues alongside developers.

Given the variety of risks beyond those in the ground, even highly seasoned players such as ELT and Viridian cannot guarantee that every development will deliver huge returns. "We have found that we are successful in nine out of ten projects, but the nine are successful enough to weather the storm of the tenth," says Jostes, candidly. "There are always risks. But where there are greater risks, there's generally greater reward." ■

Category of Contaminated Sites

CATEGORY 1 — Real Estate Value Exceeds Environmental Liability

60% Contaminated Site Development.

15% Contaminated Sites.

CATEGORY 2 — Environmental Liability Exceed Real Estate Value (Polluter Pays)

20% Contaminated Site Development.

25% Contaminated Sites.

CATEGORY 3 — Environmental Liability Exceed Real Estate Value (No Polluter to Pay)

20% Contaminated Site Development.

60% Contaminated Sites.

ePort Logistic Center, Perth Amboy, New Jersey

Viridian repurposed this former industrial area — used to produce metals, paint, and chemicals — into a Class A warehouse distribution site. One of the challenges of the 102-acre site was that many parties had responsibility for the remediation, which meant that Viridian had to ensure that liability resolution worked for all those parties as well as the new owners.

Brayton Point Commerce Center, Massachusetts

ELT acquired the Brayton Point Power Station in 2018, less than a year after it was decommissioned. A 1,200-megawatt high-voltage direct current converter, to serve a burgeoning offshore wind generation, will be at the heart of the redevelopment. Alongside the converter, a marine commerce terminal will exploit the deep-water port, which was once used to import coal, to move bulk cargo and materials for the offshore wind sector. ■

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Infrastructure for Good

New infrastructure can deliver environmental as well as economic gains. Here are three such projects from around the world.

Words by
Neil Gerrard

Multilateral development banks and infrastructure investors are starting to prioritize sustainable and resilient infrastructure that helps to slow climate change and protect communities from natural disasters. It's not just about doing the right thing: Switching to a more sustainable development model could be worth at least US$26 trillion by 2030 compared to business as usual, found a 2018 report by New Climate Economy.

"We are moving towards a new climate economy," says Ken Chee, vice president in the Marsh JLT Specialty Construction Practice in Kuala Lumpur. "Moving forward, we need robust ways to evaluate new infrastructure projects within these emerging models."

SMART Tunnel, Malaysia

Malaysia's SMART (Stormwater Management and Road Tunnel) tunnel in Kuala Lumpur truly deserves its name. The 11.5 kilometers-long, 13.2 meter-diameter structure is the world's first and longest dual-purpose traffic and storm water storage tunnel. It was constructed after conventional flood alleviation measures, such as channel widening and deepening, were no longer effective in a city that suffers regular flash floods.

As well as helping to divert floodwater away from the confluence of two rivers, a three-kilometer section of the tunnel doubles as a two-deck motorway at the main southern entrance to the city, cutting journey times into the center from 20 to 8 minutes. When rainfall is low, water doesn't need to be diverted into the tunnel, but in moderate storms, water flows into a bypass tunnel in the lower section of the motorway tunnel, which remains open to traffic.

In heavy storms, the road tunnel section is closed completely and, as part of the larger Kuala Lumpur flood mitigation system, the tunnel directs huge volumes of water to a storage system that can hold up to 3 million cubic meters of water. Before the watertight gates are opened in the tunnel during a severe storm, a system of 200 CCTV cameras linked to a central control room ensures no vehicles are left inside. After flood events, the motorway is cleaned with high-pressure water jets and can reopen within 48 hours.

Completed in 2007, SMART cost US$515 million to build but, over the 30-year concession period, it is expected to generate savings of US$1.58 billion by preventing possible flood damage, and another US$1.26 billion in savings from traffic congestion. The tunnel diverts around 30,000 cars a day from the city center.

> *"SMART is expected to generate combined savings of US$2.84 billion over 30 years."*

Mi Teleférico, Bolivia

At more than 3,650 meters above sea level, La Paz in Bolivia is one of the highest cities in the world. Its suburb El Alto sits even higher, at 4,000 meters. Their altitude, combined with the congested, winding roads linking El Alto and La Paz presented a particular transport challenge: despite their centers sitting only 19 kilometers apart, road journeys can take hours.

To combat this problem, the Bolivian government announced the creation of the Mi Teleférico project, the world's highest cable-car system, launched in 2014. It currently consists of 23 kilometers of lines with 20 stations along six routes, and will eventually be expanded to at least 34 kilometers of cable with five more lines and a total of 30 stations. Capable of transporting 230,000 passengers a year, the network is open 17 hours a day with cars departing every 12 seconds.

Aside from offering a far more efficient, quicker means of transport, the new lines are also sustainable. They have helped to alleviate pressure on the public transport system in La Paz-El Alto, which is dominated by buses, taxis, and minibus services negotiating narrow streets, creating high levels of noise and air pollution. By contrast, the cable car system uses electrical power for its main drive and has won praise from the Bartlett Development Planning Unit, part of University College London, not just for its speed and relatively low cost of construction, but the fact that it emits low levels of particulate emissions.

Mi Teleférico has also proved a benefit for people with impaired mobility, who find the accessible system easier to use than more traditional forms of transport such as the bus network, which lacks dedicated stops. Built by Austrian-Swiss company Doppelmayr Garaventa Group, the project has been funded by the Bolivian government and runs without the need for a grant or government subsidy. In 2018, it reported an operating surplus of US$5.8 million.

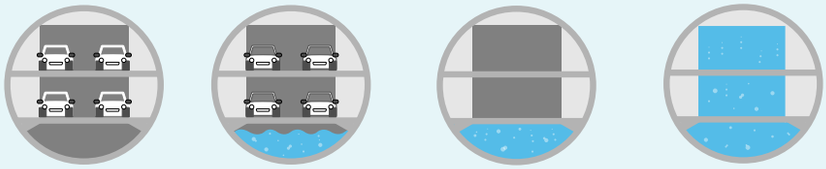
DC Water, US

Washington D.C. has embarked on a huge US$2.6 billion infrastructure program to rid its rivers of raw sewage. The city's waterways were suffering as a result of its antiquated "combined sewer systems" that collects rainfall and sewage in the same pipes. During heavy rainfall, the systems become overwhelmed and combined sewer outflows (CSOs) found their way into the local Potomac and Anacostia rivers, adversely affecting water quality. Around 1.3 billion gallons of diluted sewage was estimated to flow into the Anacostia River in an average year.

The solution was to start constructing four huge underground tunnels used to store the CSOs until they can safely be treated at wastewater treatment plants. The project is due for completion in 2025; the Anacostia river tunnel, funded by US$1.4 billion from rate payers and government funds, has already been completed.

The CSO discharge rate is expected to fall in volume by around 80% in an average year of rainfall. That will rise to 98% with the completion in 2023 of the US$580 million Northeast Boundary Tunnel segment, which will connect to the Anacostia River Tunnel. Once the final two tunnels — designed to protect the Potomac and Rock Creek — are finished, average-year discharges into the Washington D.C. waterways are expected to drop by 96% overall. ■

SMART TUNNEL, MALAYSIA



Normal conditions
3 kilometer section of tunnel doubles as a two-deck motorway.

Moderate storms
Water flows into a bypass tunnel under the motorway.

Heavy storms
Motorway tunnel section closed to traffic.

Severe storm/flood
Tunnel can be completely filled with water.

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New Renewables *for* Net-Zero Cities

Net-zero-carbon buildings and developments must tap into novel sources of heat and power, such as sewer networks, metros, or even coal mines filled with water.

Words by
Stephen Cousins

A new model for net zero is emerging. Energy-intensive buildings or developments in urban areas need to step outside the traditional site boundary and find new sources of local renewable energy.

"Ensuring sustainable, reliable energy sources is one of the biggest challenges our cities face, particularly as we look to incorporate more smart technology," says Blair Chalmers, director, Marsh & McLennan Insights. "Local, renewable energy will become a very important piece in that jigsaw."

Over 60 global entities, including 6 states and regions, 26 cities, and 31 businesses, have signed up to the World Green Building Council's, Net Zero Buildings Commitment, promising to cut operating emissions in all buildings under their direct control to net zero by 2030, and to advocate that all buildings become net zero by 2050. The voluntary standard aims to maximize the chances of limiting global warming to below 2 degrees, and ideally below 1.5 degrees, in line with the Paris Agreement.

Harnessing Waste Heat

Reliance on natural gas for heating is a major source of CO2 emissions. Global fossil CO2 emissions were projected to rise by 0.6% in 2019, according to the Global Carbon Project, despite falls in coal use because natural gas and oil consumption are growing. This could be cut significantly by exploiting abundant natural sources of heat in rivers and lakes, or from metro tunnels or commercial and industrial facilities that discharge warm water.

"There's a need to take a more holistic view of infrastructure, particularly on large mixed-use sites," says Duncan Price, director of sustainability at engineering consultancy Buro Happold. "In terms of heating, it means moving away from high temperature gas combined heat and power systems [that have become staple on projects in Europe over the past decade], to lower temperature heat networks with secondary heat sources, such as waste heat from metros or sewage systems."

Developments that harness waste heat this way already exist. The recently completed Museum of Bavarian History in Regensburg, Germany, incorporates a structure that can extract up to 70 liters of sewage per second from a main sewage collector. Coarse solids are removed and the clarified water is pumped to two heat exchangers; these operate in combination with a heat pump to each produce 280 kilowatt for heating, or 500 kilowatt for cooling in the summer.

> ***"There's a need to take a more holistic view of infrastructure, particularly on large mixed-use sites."***
>
> *Duncan Price, director of sustainability, Buro Happold*

The London Borough of Islington is upgrading its district heating network at Bunhill, which serves heat to seven local sites, to recover energy from the London Underground via a heat pump. Underground metros produce hot air when trains brake or accelerate; this can be harnessed to heat buildings when combined with other warm air in the tunnel and heat radiating from the ground.

Until recently, engineers have struggled to accurately calculate how much heat can be transferred from metros, but researchers at Switzerland's Ecole Polytechnique Fédérale de Lausanne (EPFL), found a way in 2019 of doing just that. Modeling Lausanne's planned M3 metro line, engineers at EPFL found that fitting a heat-recovery system along 50%-60% of the route could produce enough heating for 1,500 standard 80-square-meters apartments, in the process cutting the city's CO2 emissions by two million tons per year.

In Japan, the focus is on hydrogen, which produces zero CO2 at the time of combustion. The Tokyo 2020 Olympic Games (currently scheduled to take place in 2021) will be a key demonstrator for the technology, using hydrogen produced by renewable electricity generated in Fukushima to power the athletes' village.

Other R&D is exploring novel concepts for energy storage required to capture heat or power, and make it available at times of peak demand. Channa Karunaratne, regional director for energy within the Sustainable Development Group at Aecom, says: "Eventually, we will have truly integratable development-scale energy storage systems. In the UK, the Coal Authority is looking at storing hot water in old disused mines across the country. The cavernous spaces would act as a massive thermal sink."

The need to look beyond the site boundary to access novel energy resources is a tough proposition. It could increase project costs and result in elevated risks, delays, or contractual issues.

The risks are technical, commercial, contractual, and policy-based, says Price. "There is the commercial issue of who pays for the time and effort to make the interconnectors and how to guarantee that energy is provided at a reasonable cost. It is necessary to look at who underwrites projects — is it the local authority running a municipal energy company, or a commercial operator such as an energy company?" adds Price.

"There is lots of richness and complexity with the potential to unleash a lot of value, but developers will need the right advice to get projects through to financial close." ■

2m tons

Anticipated per year reduction in CO2 emissions by adopting heat recovery system on Lausanne M3 metro line.

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