LIFE WITH NATURAL RESOURCES
SOLUTIONS FOR SUSTAINABLE GROWTH AND RESOURCE PROTECTION
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Until a few years ago, in the global scheme of challenges, reusing materials was not really a priority: it was easier to obtain more primary resources, and cheap to dispose of them when they reached the end of their use. From the 1850s to around 2000, declining real resource prices, were the dominant engine of economic growth in advanced economies.

That has changed. Drastically.

The unprecedented pace and scale of economic development in emerging markets means demands for resources are surging. Commodity prices overall increased by nearly 150% from 2002 to 2010 - erasing the entire last century’s worth of real price declines, according to World Economic Forum.

This resource price inflation - combined with higher price volatility - could increase as new supplies of some resources become more expensive to extract. At the same time the extraction, processing, transport, use and disposal of materials required to meet the demand creates environmental pressures - on water quality and availability, air quality, the climate, ecosystems and human health. To make things worse; many resources are finite.

And there is no sign that demand is slowing. On the contrary: The Brookings Institution in Washington, DC, estimates that the size of the global middle class will increase from around 3.2 billion in 2015 to 5.2 billion in 2028.

All this will affect economic growth, public finances, the well-fare of citizens and the environment.

The resource challenge needs to be solved. This publication explains how Ramboll is contributing.
THE KEY WORD IS SUSTAINABILITY

This year, Earth Overshoot Day fell on August 2. Earth Overshoot Day marks the day where we have used up more natural resources from the planet than it can renew in one year.

Today, we extract approximately 60 billion tonnes of raw materials a year and use around 50 percent more natural resources than we did only 30 years ago. If that trend continues, the extraction of natural resources could increase to 100 billion tonnes by 2030.

At the same time, the world has since around 2000 experienced completely unprecedented resource price inflation – and higher price volatility.

Too many of these resources are literally turned to waste. Over the past 100 years, the amount of waste that humanity produces has increased by almost 10,000 percent.

The growing population and especially growing middle class indicates that we need to take a giant step to turn this around.

Reduce our ecological footprint
This highlights that it is a matter of urgency to significantly improve the way we protect, use and reuse our resources. If the world is to achieve both economic growth and sustainable development, we have to reduce our ecological footprint by changing the way we produce and consume goods and resources.

The first step is of course to try to prevent waste by designing with fewer or more durable and renewable resources. Products should have a longer lifetime, with better possibilities to repair, upgrade, disassemble and recycle. And we must ‘upcycle’ for example take materials from dilapidated products and produce new and more valuable things from them.

The UN is among those who point to more efficient natural resource management as an important milestone to reach a more responsible production and consumption.

Ways to make a difference
Next, we must secure better disposal of pollutants and a reduction in the use of chemicals, and industries, businesses and consumers must recycle and reduce waste, and if that cannot be done, generate energy from it, instead of dumping it on landfills.

Ramboll contributes to achieving this every day, when we work with our projects and clients. The challenges can seem unsurmountable, but there are many ways in which we can make a difference – both large and small.

One example is to utilise resources more efficiently and innovatively when it comes to building and construction. That is vital if we are to keep pace with urbanization as growing numbers of people move to large cities (see page 6-9).

We also need to dramatically reconsider how we treat waste. According to the OECD, about one fifth of global material extraction becomes waste. Improving and increasing our efforts to recycle and recover energy will help us move from a linear to a circular economy, turning waste into a resource (page 10-15).

Growth and urbanization are also affecting the biodiversity of our ecosystems. Learning to balance and to improve preservation of our natural assets is the key to release pressure on nature and create a more sustainable future (page 16-20).

In our effort to safeguard the world’s perhaps most valuable resource, water, we can benefit from a circular approach, too.

It has significant advantages for water utilities and users alike in capturing, conserving and recycling water, improving infrastructure, and safeguarding supply (page 22-25).
WE MINED OUR WAY TO GROWTH.
WE BURNED OUR WAY TO PROSPERITY.

WE BELIEVED IN CONSUMPTION
WITHOUT CONSEQUENCES.

THOSE DAYS ARE GONE.

Ban Ki-Moon, former UN Secretary General
World Economic Forum, 2010
INNOVATIVE APPROACHES TO REDUCE RESOURCE PRESSURE

Whether it is using existing materials more efficiently or being resourceful in utilising new, sustainable construction methods, the building industry is beginning to turn to more environmentally friendly and resource-efficient solutions.

RESOURCE-CONSUMING

The buildings sector is one of the most resource-consuming sectors in Europe, accounting for approximately half of all extracted materials, half of total energy consumption, one-third of water consumption and one third of waste generation.

Source: European Commission

Increasing urbanisation is putting a strain on resources like never before. According to a McKinsey report from 2016, the development of adequate housing and infrastructure has not kept up with demand. And as the need for more building and construction grows, so too does the urgency to find more sustainable and environmentally-friendly methods and materials from which to build.

While challenges such as the increasing costs of material and labour, as well as constraints in the supply chain, are commonplace, promising solutions are emerging.

The reuse and recycling of building materials such as concrete for example is proving to be both environmentally and economically sustainable.

Offsite manufacturing, where components are produced in a controlled offsite environment to increase efficiency, also provides numerous benefits - increasing safety, reducing cost, accelerating build time and improving quality control and sustainability.

And the use of timber as a building material for large constructions is increasing in popularity. Timber has many advantages over traditional material: it can be prefabricated and therefore shorten construction time, its light weight allows for smaller building foundations and it can often make a building carbon neutral.

Not all solutions need to be so all-encompassing. Finding new ways to use formerly uninhabitable land or by being innovative in the way we undertake the refurbishment of infrastructure can also greatly ease the pressure on resources.

Dalston Works

At Dalston Works in Hackney, London, Ramboll has helped design the largest Cross Laminated Timber building (by volume) in the world.

3,852 cubic metres of timber make up the external, party and core walls, floors and stairs, and the structure has nearly 50 percent less embodied carbon when compared to a traditional concrete frame. The timber also acts as carbon storage with over 2,600 tonnes of CO2 locked into the material, making the building carbon-negative for the first years of its usage.

The light construction weight of the material allows the foundations to be smaller, a feature critical to the Dalston Works site, as it sits atop the major High Speed 1 and Crossrail rail lines.

Refurbishing the Hammersmith flyover

Upgrading infrastructure can be time-consuming and costly, but in London a major refurbishment extended the life of the Hammersmith Flyover without significantly disrupting traffic.

The flyover, a vital transport corridor in London that carries over 70,000 vehicles per day, was in need of repair after its post-tensioning system had suffered significant corrosion.

However, by using ultra-high performance fibre-reinforced
concrete (UHPFRC), Ramboll was able to keep the structure open and extend its life for many years to come. It is believed to be the first time such a pre-stressing system has been installed in a bridge where the original could not be removed.

Such techniques, along with the intelligent use of 3D scanning technology, are driving life extension and design efficiency, as well as eliminating programme and safety risks, speeding up repairs and minimising disruption to the public.

The refurbishment shows how making the best use of existing infrastructure plays an important role in securing the increased capacity and reliability cities need.

**Reusing contaminated concrete in Oslo**

As part of a planned life science centre at the University of Oslo (UiO), a new access road, bike path, walkway and entrance to the University of Oslo in Norway was constructed using recycled concrete.

The material used was taken from two demolished buildings on campus and Ramboll environmental experts assisted in ensuring the concrete was decontaminated and correctly classified to meet stringent environmental standards.

This has saved the project 1.8 million Norwegian kroner and had clear environmental advantages as the contaminated and potentially hazardous concrete was not landfilled. It also saved the purchase and transport of 2,500 tons of new material.

“This method has great potential,” says Kristin Juul from Statsbygg in Norway. “Many buildings from the 1960s are made of concrete and when they are demolished, it is an ideal opportunity to reuse the material.”

**Renovating sustainably**

Katrinedalskolen, a public elementary school in Copenhagen, Denmark was renovated and redeveloped completely with sustainability in mind.

Roof tiles on the building are made of wooden tiles that are lightweight and reusable. The advantages of timber in construction are highlighted in the project, showcasing the innovative use of cross-laminated timber – a lighter, more sustainable material.

The advantages of timber - Dalston Works in London showcases the innovative use of cross-laminated timber - a lighter, more sustainable material.
of recycled material from a hospital while the bricks are held together with the world’s first ‘Cradle to Cradle’ certified cement-free lime mortar (the Cradle to Cradle mark recognises a product’s ongoing commitment to sustainability). The recycled tiles have reduced the building’s CO2 emissions by 70 percent.

Solar power supplies some of the school’s energy while an underground reservoir copes with drainage in the event of flooding.

The school also takes into account the social dimensions of sustainability with interiors designed specifically for each class and age group, with classrooms that can be changed according to the needs of the class.

Outside, green areas are popular not only with the school’s pupils, but encourage use by local residents after hours.

**Eco-friendly land development**

In Hanoi, Vietnam, soft soil makes up thirty percent of the city’s land area, making construction and engineering particularly challenging. It also means that some of the city’s areas are virtually uninhabitable.

However a pilot project looks to change that outlook with a programme to replace non-renewable natural resources with recovered materials in earthworks such as cement or ash to stabilise the soil. Named UUMA2 (a Finnish acronym for eco-efficient material solutions and the commercialisation of earthworks with recycled materials), the project has already succeeded in stabilising a 200-metre stretch in an area once unfit for development. This eco-friendly and cost-effective solution has not only increased the value of the land but also eased a housing shortage. With this method, it is not necessary to remove soft soil from the construction site, and replacement materials do not have to be hauled on site from great distances, minimising natural resource use and the need for heavy transport.

The UUMA2 technology has been developed over the past twenty years and another major pilot is being conducted in Jätkäsaari, a former cargo port on the southern peninsula of Finland near Helsinki, to transform the area into an urban district housing 17,000 people.

According to Leena Korkiala-Tanttu, Professor of Geotechnical Engineering at Aalto University, Finland, “The UUMA2 programme has great potential for many countries that are struggling with few natural resources or resources of a low quality. For example, countries like the Netherlands, Russia and the Baltic countries could all benefit from this know-how and technique in the near future.”

**Innovative refurbishment**

The busy Hammersmith flyover in London was repaired using innovative engineering techniques that allowed it to remain open to traffic while work was carried out.

**70 percent reduction in CO2 emissions**

From recycled roof tiles to the environmentally friendly mortar, Katrinedalsskolen in Copenhagen is designed completely with sustainability in mind.
INCREASING URBANISATION IS PUTTING A STRAIN ON RESOURCES
LIFE WITH NATURAL RESOURCES

The world’s resources are being stretched to the limit. According to the UN, the world’s population is expected to grow by more than 2.5 billion by 2050, and if this projection holds true, then the extra pressure on land, water and energy use will mean that we will have to extract triple the amount of resources annually extracted in 2000.

As this pressure increases, it is becoming more and more vital to focus on the role recycling and energy recovery can play in the sensible use of our resources.

Turning waste into a resource for example is an active way of meeting these challenges. Waste represents an enormous loss of resources in the form of both materials and energy, and the amount produced can not only be seen as an indicator of how efficient we are as a society, but also has enormous environmental consequences.

The Organisation for Economic Co-operation and Development (OECD) estimates that about one-fifth of global material extraction becomes waste, and the International Solid Waste Association (ISWA) estimates that 70 percent of global waste is disposed of in landfills.

And in Europe, currently around 600 million tonnes of reusable or recyclable material contained in waste is lost each year, despite the gains made in this area. In 2014 the EU recycled, on average, only 44 percent of its municipal waste, landfilled 28 percent and incinerated 27 percent. Increasing and improving our recycling and energy recovery efforts are not only good for the environment, they are also economically responsible.

The Energy Tower

Outside Roskilde in Denmark, a waste-to-energy facility converts waste to electricity and district heating extremely efficiently. Named the Energy Tower, the plant’s waste treatment process turns 85 to 90 percent of the energy content of the waste into steam, which is subsequently converted to energy.

Energy efficiency is further increased by utilising flue gas condensation so that the temperature of the district heating water returning from the city is raised and heat production is further increased by approximately 10 percent.

The electricity produced by the Energy Tower is sold to the national grid, while the heat is sold to a district heating network which supplies the equivalent of 150,000 families.

Outside, a large, amber-coloured façade designed by Dutch architect Erick van Egeraat, covers the plant and at night the backlighting of the perforated skin transforms it into a glowing beacon, symbolising the energy production inside the facility.

MOVING TOWARDS ENERGY EFFICIENCY

While a significant amount of the world’s energy consumption still comes from the burning of fossil fuels, the scales are beginning to tip in favour of more sustainable methods. Recycling and turning waste to energy for instance are fast proving to be both efficient and cost-effective.

RECYCLING AND RECOVERY

Recycling of waste is defined as any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but not energy recovery/incineration. The primary form of energy recovery is waste-to-energy – the process of generating energy in the form of electricity and/or heat from the primary treatment of waste.

(Source: EU Commission)
More efficient energy production
Generating heat and power, the Energy tower in Roskilde, Denmark turns waste to energy effectively and efficiently to make a major contribution to carbon-neutral energy production. Image: Niels Bo Dybdahl.
Because it combines the generation of both heat and power, the Energy Tower is a prime example of utilising waste to energy effectively and efficiently to make a major contribution to carbon-neutral energy production.

**Recovering resources from ash**

Even extremely efficient waste-to-energy plants will produce some surplus material, usually in the form of ash. In Copenhagen, the Afatek company is a world leader in recovering valuable metals and mineral resources from ash that would otherwise end in landfills.

Afatek and Ramboll have constructed a facility that is capable of identifying and reusing metals as small as half a millimetre. The ash is dried for two months before being sorted using separation technology developed with support from the Danish Environmental Protection Agency. In this process, magnets are used for ferrous recovery, fast-moving magnets for non-ferrous recovery and sensor machines for recovering stainless steel.

The recovery rates for metals such as brass, aluminium, copper, zinc and stainless steel is increased by 50 percent and overall the plant comes close to recovering 90 percent of the metals in the ash. The remainder, which is a type of gravel, is a valuable resource in road construction. In Denmark a total of 600,000 tonnes of this are recovered each year, thus reducing dependency on traditional gravel pits and the environmental impact they can cause.

The key to the success of this type of mechanical recovery is combining it with the thermal sorting of waste carried out at waste-to-energy plants and thereby creating a lifetime cycle of circular economy.

According to the Director of the Afatek plant Jens Kallesøe, “The thermal process reduces complexity

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**FROM WASTE TO ENERGY**

When applied to waste, the circular economy approach provides an efficient and cost-effective solution.
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and recovers energy – not only in terms of heating but also electricity. And the mechanical sorting further reduces complexity – which results in sales-quality metals and minerals for use as gravel for road construction.”

Recycling textiles
While clothes and textile recycling is a well-known and popular practice, little research has been carried out to determine where these items actually go and what effect their recycling has on the environment.

To answer these questions, Ramboll, on behalf of the Nordic Council of Ministers, undertook the first-ever mapping of used textiles to determine the flow of used textiles collected for recycling in the Nordic countries, as well as an investigation of the effects of textile exports on the environment, waste management, employment and other aspects of the local economy in recipient countries.

The study revealed that there was a high level of reuse and recycling, resulting in significant environmental benefits such as a reduction in water use and CO2 savings. In addition, the export of recycled textiles supports thousands of jobs and is an important factor in reducing poverty.

In the past, textiles were often donated in the form of aid, which sometimes meant that the wrong type of clothing was supplied and led to unnecessary waste. Donated textiles also competed directly with textiles produced domestically in the recipient country.

Innovative flow model for cost-effective waste solutions
Helping companies and organisations promote and implement recycling was the impetus behind a new material flow model developed by Ramboll in Finland. Waste management projects are sometimes hindered by companies not having the means to recycle and can lead to situations were fully reusable material is wasted.

The new Flow2Map model helps highlight the cost-effectiveness of various solutions and helps minimise waste streams.

Users include regions and municipalities aiming to support local business development and optimise land-use planning, and the infrastructure, construction and

Mapping the recycling of textiles
By determining exactly what happens to used clothing and textiles when they are recycled, we can improve the way they impact the environment and minimise waste. Image: Rohrohroh-Dreamstime.
industrial sectors can also greatly benefit.

The model has already been piloted in Lappeenranta, Finland, where it was used to survey suitable waste rock produced by quarries, as well as assess the profitability of transporting waste to construction sites. All major waste flows of the Lappeenranta area were analysed to allow for significant symbioses with entrepreneurs.

**Recycling paper towels**
While the recycling of paper is common, recycling of paper hand towels has until now not been possible. The global hygiene and health company Essity and its Swedish brand Tork have developed the world’s first recycling service that allows their customers to collect their used hand towels and recycle them locally into new tissue products.

The company has run pilots in Germany and the Netherlands to further develop the concept and the service has now been implemented across fifteen locations in Frankfurt.

It has been a key goal to raise customer awareness about recycling and change consumer behaviour to ensure that they dispose of their towels in the correct waste bin.

Ramboll supported Essity with legal advice and waste and product safety expertise, ensuring that the recycled product is proven to be both safe for health and environment, and in compliance with European and national legislation.

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**MODEL FOR COST-EFFECTIVE WASTE SOLUTIONS**

With the use of local data, the model allows for surveys of suitable waste material (e.g. rock produced by quarries), and assesses the profitability of transporting this waste to new production cycles (e.g. construction sites). The smart data treatment allows for significant symbiosis with owners of both production cycles (e.g. entrepreneurs).
USING DIGITAL INNOVATION TO PROMOTE ELEMENTS OF A CIRCULAR ECONOMY
MAKING NATURE FLOURISH

Our ecosystems and their biodiversity are the foundation of civilisation, helping to clean our water, purify the air, regulate the climate and provide us with food. Therefore we need to be vigilant against the damaging effects of factors such human activity and climate change.

UN DECADE OF BIODIVERSITY

In 2010, the United Nations adopted a strategy for biodiversity for 2011-2020, with the goal of significantly reducing biodiversity loss, and promoting the implementation of a strategic plan on biodiversity and its overall vision of living in harmony with nature.

Protecting biodiversity and ecosystems is crucial for human well-being and economic development. But as cities all over the world become more populated, there are serious implications for nature, land use and resources.

As this urbanisation process continues, focusing on ways to strengthen and protect biodiversity in our cities is becoming paramount. Sometimes this requires rethinking the way we use an urban area such as a waterway; in other cases, it involves bringing nature to the city.

Reversing the decline of biodiversity is not just a challenge in urban areas; even rivers and oceans are not immune from human activity. The best results are often borne out of a combination of approaches that allow nature and people to flourish side by side.

A holistic approach to biodiversity

The Bermondsey Dive Under rail viaduct forms a vital part of the Thameslink railway line in London. When Ramboll started work on the project, the site contained soil heavily contaminated with asbestos, hydrocarbons and Japanese knotweed.

Over 21,000 tonnes of contaminated material was removed and replaced by 765 m2 of green walls and a colourful mix of native wildflowers. The railway embankments now function as green corridors and stepping stones to the wider area, and the project has increased biodiversity in the area by 113 percent.

In an industrial area in the River Main in Offenbach, Germany, innovative natural water treatment systems such as cleansing biotopes are being integrated into park spaces, with new, natural habitats created for riparian flora and fauna.

And at Bishan Ang Mo-Kio Park in Singapore, an award-winning climate adaptation and green-area restoration project turned a utilitarian concrete channel into a naturalised and healthy river. Sixty-two hectares of park space with plants and trees also attracts many different species of birds and insects, significantly increasing the area’s biodiversity.

Saving an endangered species

In Southern Jutland, Ramboll is part of a large-scale EU-financed rescue plan for one of the rarest fish in Northern Europe - the houting, a whitefish belonging to the Salmonidae family.

Until recently, Danish fish farms were damaging the conditions for the houting and other salmonids as meandering creeks were turned into straight canals and weirs, making it impossible for the fish to reach their spawning grounds upstream.

The houting was near extinction but with the removal of the weirs and reversion of the creeks to their natural path, the fish are breeding...
The conversion of an industrial area in Offenbach, Germany to a new sustainable district is a prime example of how climate adaptation can be achieved in an urban environment to create attractive neighbourhoods.

Again in areas that were previously impassable. At the same time, the fish farms produce more responsibly and sustainably.

This combined approach – making nature and man-made activities flourish side by side – can also been seen in our work at Casco Bay on the southern coast of Maine, New England.

Here, Ramboll was engaged by the Casco Bay Estuary Partnership, which is devoted to protecting and restoring the water quality and fish and wildlife habitat of the Casco Bay ecosystem, while ensuring compatible human use. Our work has included sediment contamination studies, and ensuring adequate mapping of the cleaning progress.

**Cut the costs for nature and client**

Improving water quality in rivers that have been affected by human activities such as mining can be challenging. The main objective of a project in Cumbria in the UK was the reuse of river sediment impacted by abandoned metal mines and improving the downstream water quality of the River Nent, which is currently impacted by heavy metals associated with historical mining.

To provide a sustainable and economically viable solution to the excavation and disposal of...
LIFE WITH NATURAL RESOURCES

Increasing biodiversity in the inner city
After contaminated material was removed on site, the railway embankments on Bermondsey Dive Under in London will be green corridors that will increase biodiversity in the area by 113 percent. (Left)

Urban nature
The Esplanade Forecourt Garden in Singapore uses landscaping and water features to create a cool, green garden in the heart of the financial and tourist district. (Right)

the impacted sediment, Ramboll assessed the chemical and physical composition of the sediments and evaluated options for treatment, potential re-use and disposal.

The case study provides a model for reducing metal loading into the river, using an innovative ‘riddle bucket’ method, which cut the client’s costs by 60 percent while offering a host of environmental and efficiency benefits.

Oil rigs as environmental assets
Off the California coast in the US, some of the richest maritime ecosystems in the world can be found in a highly unlikely place: on old oil rigs.

The traditional method for decommissioning oil platforms is to remove them but according to marine biologists and scientific studies, dumping the rig after thorough cleaning can actually be a better and more environmentally friendly option.

A study published by the Proceedings of the National Academy of Science (PNAS) in 2014 showed that fish production on the average platform is almost 30 times greater than on natural reefs due in part to the unique vertical structure of an oil platform.

In the US, where this practice is most common, rigs-to-reefs is a nationwide programme, and in 2012 about 10 percent of all decommissioned platforms had been converted into permanent reefs. Ramboll is now trying to bring this approach to the North Sea, where several oil rigs are being phased out in the coming years.

Preventing ocean pollution
Pollution in the North Sea can occur in the most unexpected places. When a German World War II U-864 submarine off the Norwegian west coast was discovered in 2003, it prompted concerns that its cargo of mercury could severely pollute the surrounding waters.

Following the decision to cap the wreckage and install a supporting counter-fill, Ramboll was commissioned in 2016 to support the Norwegian Coastal Administration in the environmental monitoring of the marine operations.

The counter-filling operation involves laying some 100,000 cubic metres of sand and rock in a controlled and precise manner from a specially designed ship in order to stabilise the seabed. This in turn will reduce the risk of movement by unconsolidated sediments and thereby mitigate any associated pollution.

A hotspot for biodiversity in Singapore
The Esplanade Forecourt Garden combines vegetation and water to create a lush, wild garden in the heart of Singapore.

The garden is designed to complement the urban space in front of Singapore’s national performing arts centre and has been revamped using native and coastal plants and water features to highlight a multi-functional and flexible plaza that can serve a diverse group of activities and public.

The forecourt is surrounded by biodiverse shrubbery and signature native trees such as Gelam, Sea Tristiana, Rainbow Eucalyptus and Yellow Rain.

And throughout, water features provide active and flexible performative spaces as well as pocket spaces of refuge. As visitors meander through the garden, the landscape itself becomes a performance changing constantly with time, light and the surroundings.
WATER COVERS 70% OF THE PLANET BUT ONLY 3% IS FRESH
PROTECTING OUR MOST VALUABLE RESOURCE

We take water for granted but in many areas of the world, consumption outgrows supply and protecting supply and providing safe water is paramount.

Water is one of the earth’s most precious resources but it is also the resource that is in most demand. Factors such as population growth, increasing urbanisation, over-industrialisation and irrigation, combined with changing weather patterns resulting from the effects of climate change, are all causing increasing demand for water.

While it covers 70 percent of the planet, only 3 percent of the world’s water is fresh. As a result, some 1.1 billion people worldwide lack access to water, and a total of 2.7 billion find water scarce for at least one month of the year.

According to the World Wildlife Fund (WWF) this situation will only get worse at the current rate of consumption with potentially two-thirds of the world’s population facing water shortages by 2025.

That is why preserving and maintaining precious water supplies is simply a must for companies, organisations and society as whole. Achieving this can be helped by a range of solutions – from sophisticated technology to the simple planting of trees. Whatever the solution however, it is our responsibility to contribute to the protection of our most valuable resource.

The Soul of Nørrebro

The effort to make cities liveable requires collaboration between a wide range of interests. The ‘Soul of Nørrebro’ project in Copenhagen is an urban park that will manage rainwater from cloudbursts using blue-green infrastructure and is being created in close cooperation with architects, biologists, engineers and most importantly, local residents. They have been widely involved in the project and their views and priorities have been incorporated into the final design.

Led by the architectural firm SLA and with Ramboll as Technical Lead, the project centres on the renewal and climate adaptation of Hans Tavsens Park and Korsgade in Inner Nørrebro. When implemented, it will transform the park into a series of multifunctional rainwater catchment basins from which the excess rainwater is purified biologically by the park’s greenery as it is lead via the adjacent Korsgade into the Copenhagen lakes.

A flagship example of how cities can deal with cloudbursts in dense inner city neighbourhoods while adding unique social, cultural and natural values to increase the life quality of its residents, the ‘Soul of Nørrebro’ recently won the prestigious Nordic Built Cities Challenge competition.

Mapping groundwater

During the latter course of the 20th century, Denmark experienced an increase in groundwater pollution and there was a serious risk that there would not be enough drinking water for future generations. This crisis resulted in the forming of the Danish National Groundwater Mapping Programme in 1999.

Ramboll has carried out a large portion of this programme which comprises multidisciplinary...
hydrogeological projects. Our services include performing field surveys, data processing and interpretation, geological and groundwater 3D modelling and making general recommendations regarding water supply strategies for specific extraction areas.

The lessons learnt from Denmark are now being used in California, an area that has recently come through a six-year-long drought and will, according to scientific studies, be among the regions hardest hit by water scarcity in the future climate.

Ramboll is engaged to help authorities reduce the risk of seawater infiltrating fresh groundwater in a large area near Monterey Bay. The data is collected by using SkyTEM technology, which involves flying a helicopter carrying electromagnetic sensors to scan the geological layers of the area below.

**Scarcity in Sweden**

Access to sufficient and safe drinking water can also be a challenge in the Nordics. In 2011 the microscopic parasite Cryptosporidium contaminated the water in Skellefteå in northern Sweden, meaning that for seven months its inhabitants had to boil their drinking water.

The municipality replaced the old, dilapidated waterworks with a new treatment plant – a project that is the largest of its kind in Sweden. This new setup includes artificial groundwater recharge followed by three steps of oxidation, filtration and disinfection.

**Tree-planting against pollution**

In Southern California, an innovative technology called Phytoremediation was used to redevelop old industrial sites. Essentially it involves the planting of tree groves to degrade contaminants by safely absorbing impacted groundwater.

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**WATER FOOTPRINT**

The water footprint of a product, good, commodity or service is the volume of freshwater used to produce the product measures at the place where the product was actually made. It refers to the amount of water used in the various steps of the production chain. One drop as shown in the illustration is equivalent to 50 litres of virtual water. Source: virtualwater.eu.

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<td>Shower (10 min)</td>
<td>110</td>
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<tr>
<td>Toilet per flush</td>
<td>23</td>
</tr>
<tr>
<td>Coffee per 750ml pot</td>
<td>840</td>
</tr>
<tr>
<td>Tea per 750ml teapot</td>
<td>90</td>
</tr>
<tr>
<td>Cheese per 500g piece</td>
<td>2500</td>
</tr>
<tr>
<td>Beef per 300g steak</td>
<td>4650</td>
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Clean and pure Proper water treatment and purification is vital in maintaining safe and clean supplies.
However, applying phytoremediation in the arid conditions of California required that Ramboll had to plant more than 300 trees in a borehole drilled at depths eight feet below the ground.

A proprietary bacterial endophyte that further degrades contaminants once inside the trees was also used, enhancing overall tree growth.

These innovative techniques cost less to implement overall compared to traditional approaches, and reduced long-term operations and maintenance needs while expanding and enhancing wildlife habitats and water reuse.

Safe drinking water in Bangladesh
In Bangladesh, naturally occurring arsenic is widely abundant in the groundwater and more than 40 million people drink water with arsenic concentrations exceeding WHO’s safe drinking water guidelines.

Ramboll is working alongside the Royal Institute of Technology in Sweden and UNICEF to design a water safety programme that aims to improve the safety of drinking water in Bangladesh and mitigate the negative impacts of water contamination on health.

It also aims to create sustainable strategies for scaling up safe water access including steps to develop capacity at local governmental institutions and in the private sector, which provides 90 percent of the tube well installations in the country.

Integrated water plan for Bucharest
Like all other cities around the world, Bucharest in Romania needs to adapt to the effects of climate change. With extreme weather predicted, including more intensive rainfall, Romania is actively preparing a water masterplan that takes into account climate adaptation and flood-risk management.

In Bucharest this involves making the city’s water systems more efficient and sustainable and Ramboll is developing a comprehensive masterplan for the city centre and surrounds. This includes an analysis of both the natural and the socio-economic characteristics of the area, related to water consumption and discharge.

Safe drinking water
A run-down water works in Sweden has been replaced with a new treatment plant to ensure access to sufficient and drinkable water.
2/3 of the world’s population will face water shortages by 2025
HELP US CREATE SUSTAINABLE SOCIETIES

The projects and clients we showcase here vary in scope and size but all share a common approach in wanting to implement solutions that use our resources responsibly.

We invite you to reach out to us to learn more about how we can support you in your contributions to sustainable societies.

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