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**EDITORIAL**

**NAVIGATING THROUGH CHANGE**

Transitional change is occurring everywhere in modern society: in countries, regions and cities. In big and small companies. In energy systems and in production and consumption patterns. Right now, perhaps, more than ever. Dwindling resources, climate change and the financial crisis are reshaping our lives, even as the digitalisation seen throughout society opens new possibilities.

These profound changes give rise to new challenges and expectations when it comes to our cities, infrastructure, goods and services and to the environment.

Sometimes the way through a transitional change is obvious. But not often. In most instances, the destination is clear, but not how to get there. Dilemmas will emerge, as well as an urgent need for innovation and out-of-the-box thinking.

Tough circumstances may engender transitions, and dilemmas may be hard to solve, but for a sustainable society consultancy like Ramboll helping clients navigate transitional change has kept us on our toes since 1945.

There are no simple answers to transitional dilemmas. They all call for balanced, holistic solutions.

In this issue of Response we take a deep dive into some of the dilemmas that face modern societies and businesses: For instance; should we stop investing in renewables because surplus energy is difficult to store efficiently? What should we do with old rigs when an oilfield is depleted? And should we recycle waste or burn it at waste-to-energy plants – or both?

Enjoy your reading.

**Jens-Peter Saul**  
Group CEO

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Cover: Vojens District Heating  
Credit: Polfoto.
ENERGY STORAGE – A KEY TO THE GREEN TRANSITION
The road from the Paris Agreement to a low-carbon society could go through the small Jutland town of Vojens. This might seem an unlikely detour at first, but a look at two central publications from the International Energy Agency (IEA) will show its plausibility.

In “IEA Energy Technology Perspectives” the agency zooms in on how to keep global warming below 2 degrees Celsius – a de facto fulfilment of the pledge politicians made in Paris – compared to the business-as-usual scenario of 6 degrees warming. Take electricity, for example. Today fossil fuels dominate the energy mix with a 68% share, but this must be effectively reversed by 2050, when renewables should account for roughly the same share.

Achieving this reversal, however, greatly depends on having the ability to store renewable energy, say experts from Yale University and Standard & Poor’s. The credit rating agency calls storage “the final piece in the global energy transition puzzle”.

Professor Steven Cohen, Executive Director at the Earth Institute, Columbia University, USA, puts it this way:

“Renewable energy is central to the sustainable economy. And because solar and wind power are intermittent, storage, energy efficiency and smart grid technology are critical to the increased use of renewable energy,” he says.

A continuous source of fuel

Here’s the challenge: Running a commercially viable power plant requires a continuous source of fuel.

Giant pools of hot water can help control the supply of solar and wind energy – and thus help fulfil the ambitions of the Paris climate agreement.

By Michael Rothenborg

Storage, energy efficiency and smart grid technology are critical to the increased use of renewable energy.

Steven Cohen
Professor, Columbia University

Storage plays a crucial role in the necessary energy evolution, according to the IEA.
of fuel. That is no problem with coal, gas or uranium isotopes, but the supply of solar or wind energy cannot be controlled despite its infinite abundance. Electricity grids cannot function without a balance between supply and demand. Imbalances cause voltage fluctuations, and money is also an issue – heating, for example, will be too cheap in summer, when demand is down, and too expensive in winter.

This is why storage plays a crucial role in the necessary energy evolution, says Maria van der Hoeven, Executive Director of the IEA, in the foreword to another publication from the agency, ‘Technology Roadmap on Energy Storage’. “Energy storage technologies can help to better integrate our electricity and heat systems and can play a crucial role in energy system decarbonisation,” she writes.

**Two world energy records**

One of the best practice cases the IEA promotes in its roadmap is the consumer-owned Marstal district heating system in Denmark, where, with Ramboll’s help, hot water from solar heating is being stored in a covered pit.

The Marstal storage system had some initial sealing problems, as birds and cats were able to get into the pit, and at that stage the technology still needed subsidies.

Today, however, the pit storage system has been secured and further developed by Ramboll elsewhere in Denmark – which brings us to Vojens. The consumer-owned district heating system there now holds two world energy records: a 70,000-m2 solar heating plant and a 200,000-m3 heat storage – a giant pool of sorts, 13 metres deep and 610 metres in circumference – in an old gravel pit. What is more, the pool is commercially viable under Danish conditions.

It takes about five months to fill the pit to its maximum of 200 million litres. “The floating cover makes it possible to store the hot water for the Danish winter season when consumers turn on their radiators,” says Flemming Ulbjerg, Senior Consultant at Ramboll Energy.

The large-scale investment, which will increase the share of solar heating to 50% of the annual heat demand, provides consumers with annual savings of 10-15% on their heating bills, and the plant saves 6,000 tonnes of CO2 per year.

The next stage will be to use electric boilers and heat pumps to harvest the cheapest electricity and generate the remaining 50% heat with electricity from wind energy – an integration already established by the district heating company in a similar, but slightly smaller pit in the nearby town of Gram.

**Thermal storage will become more common**

“This type of energy storage is still rare, but that’s about to change,” says Sven Werner, Professor of Energy Technology at Halmstad University in Sweden and one of the world’s leading experts on district heating and cooling.

“It’s inevitable that thermal storage will become more common in order to increase the efficiency of our heating systems,” he says.

Like Sven Werner, Brian Vad Mathiesen, Professor of Energy Planning at Aalborg University, believes we have to move away from a sole focus on the electricity sector to a look at the energy demands in the heating, cooling and transport sectors as well. Combining various utility systems can help provide the cheap storage needed for electric vehicles, hot water and cold water.

“The sole focus on one grid is a problem. We need to focus more strongly on district heating grids in combination with the power grid. If we combine heat and power grids, we can use cheap heat storage to reduce the fossil fuel-based production of heat and power by using excess wind or solar power for heat production. Heat storage can even enable seasonal storage of renewable heat such as in the covered pits in Vojens and Gram. Whether we have a colder climate or a hotter climate like those in the Middle East or parts of Asia, water storage and the combination of utility grids is key to cost-effectiveness,” Brian Vad Mathiesen says.
THE BUSINESS MIX IS GETTING GREENER

Companies around the world are adapting to the new reality borne of the Paris Agreement and the UN Sustainability Goals.

By Michael Rothenborg

In 2011 the four top coal companies in the USA were worth USD 32 billion, according to Thomson Reuters. Five years later three of them had gone bankrupt.

In April 2016, for the first time solar power in the UK generated more electricity than coal did. Big nations like India recognised that solar is cheaper than coal, and financial institutions like the World Bank, the investment bank JP Morgan and the world’s biggest sovereign wealth fund Norwegian Pension Fund decided to make even heavier investments in clean energy. which – according to Bloomberg New Finance – already outpaced investments in fossil fuels two to one.

In the same month a new analysis was published by We Mean Business – an international coalition of green business and investor groups designed to highlight the business opportunities provided by the Paris Agreement. According to the analysis, over the next 15 years climate pledges made by countries as part of the agreement will deliver at least USD 13.5 trillion of investment in the clean energy sector alone, and a further USD 90 trillion in clean infrastructure.

The Paris Agreement is not the only call for action motivating big companies to focus more strongly on the green transition: The UN Sustainable Development Goals also have a great influence, especially number 12, which calls for phasing out fossil-fuel subsidies "where they exist, to reflect their environmental impacts" and substantially increasing the share of renewable energy in the global energy mix.

At the Global Green Growth Forum (3GF) in Copenhagen earlier this year, high-level politicians and experts established that the Sustainable Development Goals are a trillion-dollar business, and global consultancies like PwC have developed a “Global Goal Business Navigator” to help companies understand which goals are most relevant given their countries and sectors of operation. According to PwC the UN goals compel international companies to rethink their core strategies – so they align with both government requirements and customer demands.

GLOBAL ELECTRICITY GENERATION MIX

Source: IEA (2 degrees scenario).
A few years ago Carlsberg brewed beer here – with slogans like: “Tuborg makes life a little greener”. Today Carlsberg City has a cooling facility that makes energy consumption in this new Copenhagen neighbourhood a lot greener. Under the old brewery lie two enormous storage tanks, each holding 2 million litres of water storage capacity for energy-efficient – and economically sound – district cooling for 300,000 m2 of office buildings.

“It’s a big investment but no doubt the right one, because it pays off. A district cooling system in this sustainable city district enables us to provide the cheapest and most environmentally friendly solution to tenant companies, which avoid having to install their own decentralised cooling systems,” says Jens Nyhus, CEO of the development company Carlsberg Byen.

District cooling is replacing individual cooling, just as district heating has replaced individual heating in many parts of Copenhagen and other big cities.

Ramboll is also helping to establish district cooling elsewhere in Denmark – at Copenhagen Markets, for example, a 67,000-m2 roofed hall, 10 metres high and the largest Northern European wholesale market for fruits, vegetables and flowers. Similar projects are underway in the USA, Australia and Russia.
The cooling process is done at night
At Carlsberg City the water in the tanks is chilled through a process that draws cool air from outside or through compression cooling - or a combination of the two. The cooling process is usually done at night, because the air is generally cooler, and because more renewable electricity for the compressor is available at a lower cost. The fact that so many consumers are connected to the storage tanks also produces economies of scale that thus drive the cost per unit down, and the cooling process is not only cheaper but also more environmentally and climate friendly.

At the next stage of the project, a heat pump will even enable the cooling system to generate surplus heat for the district heating system. By exploiting the full potential of district cooling, Denmark can reduce heating and cooling costs by almost EUR 1.5 billion, shows a strategic study by Ramboll.

Other advantages for users include far fewer technical complications and economic risks, no on-site chemicals handling, better use of space and less noise.

And as Lars Riemann, Group Market Director at Ramboll Buildings explains, district cooling does not require a big piping system running from a power plant to the area where the cooling is used - as district heating usually does.

“All it takes is a storage tank. It’s easy to install and can be used in small areas, for example a block in Manhattan with a tank just three storeys high,” he points out.

However, district cooling can also be used at a much larger scale. Ramboll is participating in one of the world’s biggest projects, a 500-MW district cooling system in Makkah, Saudi Arabia.

In the Middle East region 70% of electricity production is used for air conditioning even though district cooling is 50% more efficient than individual chillers. So district cooling could make life a lot greener in arid climates too.

It’s a big investment but no doubt the right one, because it pays off.

Jens Nyhus
CEO, Carlsberg Byen

DISTRICT ENERGY AND STORAGE IN THE EU

The EU countries can save at least EUR 100 billion annually - and cut carbon dramatically - by making district heating and cooling a key factor, and the EU’s Energy Efficiency Directive requires all member states to conduct a comprehensive assessment of the national potential.

District energy is closely related to energy storage, and in a working paper the EU Commission states that “energy storage will play a key role in enabling the EU to develop a low-carbon electricity system” because it can supply more flexibility, improve efficiency and reduce costs.

Batteries and thermal storage are the most important types of renewable energy storage. The use of renewables in the transport system requires batteries, which are becoming more efficient but remain quite expensive. Thermal storage is the cheapest storage means, but can only be used when connected to district heating or cooling.

Sources: Heat Roadmap Europe and others.
TOWARDS A GREENER WASTE CYCLE
The increasing pressure on resources makes it clear that waste must be turned into a resource in a circular economy – an economy that only functions optimally if it includes recycling as well as energy recovery.

By Michael Rothenborg

The figures speak for themselves. The UN projects global population growth of more than 2.5 billion by 2050, and other forecasts expect 3 billion more people to aspire to the standard of living enjoyed in Western economies. If these projections prove true, by 2050 we will have to extract triple the amount of resources annually extracted in 2000 – the consequence being extra pressure on land, water and energy usage.

The OECD estimates that about one fifth of global material extraction becomes waste, and the International Solid Waste Association (ISWA) estimates that 70% of global waste is still disposed of in landfills. The OECD expects municipal solid waste to rise by 0.69% for every 1% increase in national income. Economic development produces more waste and taps into virgin materials – the Earth’s stock of natural resources.

In 2016 Earth Overshoot Day (EOD) fell as early as August 8. The Global Footprint Network has designated the annual EOD as the day that human resource consumption exceeds the environment’s capacity to renew those resources in the same year. This drives home why experts are calling for a paradigm shift in how we consider resources and waste. Waste can no longer be waste – we have no choice but to make it a resource.

“We will examine how waste-to-energy processes can be optimised.”

Julio Garcia Burgués
EU Commission Head of the Waste Management & Recycling

Ramboll has been a consultant on KARA/NOVEREN’s waste-to-energy facility in Roskilde, Denmark.
WHAT IS A CIRCULAR ECONOMY?

Ideally, in a circular economy no waste or pollution is produced, and there are two types of material flows: biological nutrients, designed to re-enter the biosphere safely, and technical nutrients, which are designed to circulate in the production system without entering the biosphere, as well as being restorative and regenerative.

Only a few idealists believe that a fully circular economy is possible, but almost all experts agree that the mounting pressure on the Earth’s resources means we must take big steps away from the traditional linear economy and its “take, make, dispose” production model.

Two factors are driving the emergence of the circular economy in its present form: long-term price increases for raw materials and environmental legislation/green taxation.

Source: ISWA

Ambitious EU GOALS

“This is why the European Commission has adopted the ambitious recycling objectives in the Circular Economy Package proposed in December 2015,” explains Julio Garcia Burgués, Head of the Waste Management & Recycling Unit at the Directorate General Environment.

Europe currently loses around 600 million tonnes of reusable or recyclable material contained in waste each year. Although Europe is making efforts in this area, in 2014 the EU recycled, on average, only 44% of its municipal waste, landfilled 28% and incinerated 27%.

Some countries, however, already generate a lot of energy from their waste – Austria, the Netherlands, Belgium, Sweden and Denmark, for example. Waste generates more than 30% of the total district heating in the Greater Copenhagen Area.

The Circular Economy proposal is primarily aimed to promote global competitiveness, create new jobs and support sustainable economic growth. It contains several ambitious goals, including that landfill should constitute no more than 10% of municipal waste and that 65% material of municipal waste should be recycled, both by 2030. In 2015, only 34% of household waste from the City of Copenhagen was recycled.

The ambitious goals raised concerns from some industry professionals that the EU wants waste-to-energy (WtE) to play a diminishing role in the future. But contrary to some beliefs, recycling and waste incineration are complementary when it comes to sustainable waste management and the circular economy. Julio Garcia Burgués explains that the circular economy actually depends on waste-to-energy.

“Vestforbrænding is the largest waste incineration plant in Denmark. The future holds a place for waste-to-energy solutions,” he says.

Linear economy on the decline

Bettina Kamuk, Ramboll’s Head of Department for Waste-to-Energy, and Björn Appelqvist, Ramboll’s Head of Department for Site Solutions & Waste Management, look to the circular economy as a common guideline.

They both took part in a Task Force on Circular Economy at ISWA, which has produced six reports on the circular economy. All conclude that the
linear economy is on the decline, and that WtE supports the circular economy.

“There is a limit to recycling. For example, recycled paper and textile fibres wear out over time. Therefore, efficient handling of residual waste, such as waste-to-energy, is an essential part of the mix,” says Björn Appelqvist.

Bettina Kamuk adds: “The more we recover, the less we can burn in our waste-to-energy plants. However, tonnes and tonnes of material are being unnecessarily dumped in landfills today. What cannot be recycled, we can use in the plants instead.”

Bettina Kamuk and Björn Appelqvist explain that incineration can also be a means of recovering resources. For example, the small electronic devices inside plastic toys can be difficult to recover. However, when the toys are incinerated, the plastic curls, thus enabling valuable metals to be recovered from the ashes.

**Most efficient techniques**

Julio Garcia Burgués of the European Commission points out that just over 1% of all electricity consumption and 10% of the total heat delivered through district heating networks in the EU come from waste. This contribution is expected to increase as more combustible waste is diverted from landfills, and the technology is optimised. By end-2016 the Commission will adopt a communication on waste-to-energy as part of the renewable energy package.

“This will highlight the most proven and efficient techniques available to extract energy and materials from waste, clarify the position of energy recovery in the waste hierarchy and map out the waste-to-energy capacities in the EU and the waste flows for energy recovery amongst member states. All in all, it will examine how waste-to-energy processes can be optimised without compromising the achievement of higher reuse and recycling rates, and how the energy potential embedded in waste can best be exploited,” explains the Commission’s Head of the Waste Management & Recycling Unit.

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**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.

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“Tonnes and tonnes of material are being unnecessarily dumped in landfills.”

**Bettina Kamuk**
Head of Department, Ramboll Energy
Director Jens Kallesøe from Afatek grabs a ballpoint pen and starts to dismantle it.

“This ordinary ballpoint pen contains four different materials: On the outside is a belly belt and a clip, both made of stainless steel. Two pieces of plastic tubing hold it all together. Inside is an ink tube made of plastic. One end has a stainless steel spring, and the other a small brass piece, where the ink comes out. So we found two types of plastic and two types of metal with sizes down to 1 mm,” he says, now with four different pen pieces in his hands.
“Basically, you now have two ways of putting this into a circular economy: You can let people do the job of dismantling the ballpoint pen by hand. Or you can take the pen to a waste-to-energy plant for recovery. There, the plastic is incinerated and recovered as heat and electricity. This frees the metals, which can now easily be separated and recovered in our new metal sorting plant. This is both economically and environmentally efficient because we can do it on a large scale. That’s what we do here.”

Outside Jens Kallesøe’s small office on Copenhagen’s island of Amager lie mounds of ash from waste-to-energy (WtE) plants. In other countries much of this material ends up in landfills. But here at Afatek ashes are not just ashes. Jens Kallesøe and his employees recover valuable metals and mineral resources from this dust. Few do this better than the small Danish company. The technology at the new plant can identify and reuse metals down to 0.5 mm, thus creating a new industry standard much better than yesterday’s 4 mm.

**Lower consumption of natural resources**

Afatek is owned by five public waste companies and covers one third of the Danish market. The trucks that pass through the company’s gate unload around 200,000 tonnes of bottom ash a year. In the company’s new plant, which Ramboll assisted in constructing, the ash typically dries for two months before being put on the conveyer belts.

The new separation technology was developed with support from the Danish Environmental Protection Agency. The technology features magnets for ferrous recovery, fast-moving magnets for non-ferrous recovery and sensor machines for recovering stainless steel.

“The fine-line conveyer belt is where you find the technology that can recover the piece of brass from the ballpoint pen – which is just over 0.5 mm thick,” says Jens Kallesøe.

The new technology increases the recovery rate for brass, aluminium, copper, zinc and stainless steel by 50%. It also lowers the consumption of natural resources – thereby saving CO2.

In total Afatek comes close to recovering 90% of the metals in bottom ash. The residue – a kind of gravel – is a valuable resource in road construction. In Denmark a total of 600,000 tonnes are recovered each year, thus reducing human interference with the ecosystems present in and around traditional gravel pits.

**Recovers heating and electricity**

The key to creating this part of a circular economy is to combine the thermal sorting done at WtE plants with the mechanical magnetic sorting done at plants like Afatek.

“The thermal process reduces complexity and recovers energy – in terms of not only 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,” explains Jens Kallesøe.

After a few years’ scepticism from other circular economy industries, companies like Afatek are now considered both economically and environmentally viable. And the export potential is about to be realised.

The biggest order so far has been placed by another metropolitan island – Singapore – where Afatek has worked with Ramboll to supply know-how to the biggest WtE facility in the world.

“This is both economically and environmentally efficient.”

*Jens Kallesøe*

Director, Afatek
WASTEWATER IS A RESOURCE TOO

As technology improves, experts are recovering energy, nutrients and other valuable things from wastewater. The Walt Disney World Resort has embraced this innovative development.

By Michael Rothenborg and Martin Zoffmann

From a necessary evil to a valuable resource. The status of wastewater has improved tremendously over the past few years. This is mainly because water and wastewater treatment (W&WT) plants have become more efficient and innovative, enhancing their processes and thus maximising output use by recovering energy and nutrients, recuperating organic matter and producing clean, reusable water – sometimes even drinkable.

“These plants are becoming multifunctional: The original prime function is, of course, to improve public health. The biggest new value is good water resource management and a healthy natural water ecosystem,” says Mark van Loosdrecht, Professor of Environmental Biotechnology and Wastewater Engineering at Delft University of Technology, the Netherlands.

He adds that energy recovery can sometimes also be a good business case – for example, when it reduces the cost of sludge disposal. Moreover, he points out that systems that truly generate income from wastewater treatment

A MODERN PLANT CARVED INTO FINNISH BEDROCK

The plant in Blominmäki in Finland will not only treat wastewater but also produce energy. Surplus heat from the plant will be recovered from treated wastewater, and electricity produced from biogas generated in the anaerobic digestion facilities will meet more than the half of the plant’s total electricity requirement. Ramboll is assisting on the project with a range of services.
In Finland the Blominmäki wastewater treatment plant is being carved into the bedrock (opposite and above, top). In Florida, the Energy Garden is the USA's first organics management and renewable energy facility.

have a major advantage because they are used not only in countries with big public sectors but also in countries where private companies handle wastewater treatment.

**COMBINING WASTE AND USED WATER IN A SINGAPOREAN MEGA-PROJECT**

Singapore’s new Integrated Waste Management Facility (IWMF) will be the world’s largest energy recovery facility. The facility will be co-located next to a water reclamation plant, and, together, the facilities will efficiently treat the nation’s solid waste and used water, thus reaping the potential synergies of the water-energy-waste nexus. Ramboll is managing the part of the project dealing with waste, as well as providing advice on water synergies.

**COPENHAGEN: FROM CONSUMER TO PRODUCER OF ENERGY**

Biofos, Denmark’s largest wastewater treatment company and a longtime Ramboll client, focuses strongly on recovering gas and energy from wastewater. So, one of Biofos’ plants is now selling two and a half times more energy units than it consumes. The plant also produces around 20% of the gas used in Copenhagen’s ‘city-gas’ system, supplying, e.g., the gas for Copenhageners’ gas cookers. The goal is to reach 60% in 2020 and hence support Copenhagen’s overall goal of becoming CO₂ neutral in 2025.

From sludge to heat, power and fertiliser

Global Service Line Leader at Ramboll Water, Janet Egli, sees multifunctional as “an integrated treatment approach that not only cleans wastewater but also recovers its resources”.

“Wastewater treatment used to be considered a bit of a burden, really, but as the technologies improve, more clients are becoming aware of the resources in their wastewater and recognising the potential not only to optimise their processes but also to contribute to achieving a sustainable society,” she says.

A good example of this transition is Harvest Power’s Energy Garden in Central Florida, an organics management and renewable energy facility that is the first of its kind in the USA. The Energy Garden helps businesses and communities across Central Florida reduce and reuse organic material, increase renewable energy production and revitalise soil to boost local agriculture. Restaurants, hotels and food processing facilities throughout the region are now able to send food scraps to the Energy Garden. The Walt Disney World Resort was the facility’s first customer.

“More than 100,000 tonnes of organic waste each year can now be combined with the waste-activated sludge from the local municipality and processed to produce 5.4 megawatts of combined heat and power and over 6,000 tonnes of usable fertiliser instead of being disposed of in local landfills. The overall design of the facility incorporated a mixture of both well-established and novel solutions to maximise recovery of the wastewater resources,” Janet Egli explains.

More clients are becoming aware of the resources in their wastewater and recognising the potential.

Janet Egli
Global Service Line Leader, Ramboll Water
ECO-FRIENDLY LAND DEVELOPMENT ON THE RISE
In a time of resource scarcity and urbanisation, recycling and land development must go hand in hand. A new technology using recovered materials transforms formerly uninhabitable areas into prime neighbourhoods - benefiting the environment and economies around the world.

By Ina Johanne Mønsted

Traffic congestion, soaring property prices, severe pollution and rampant illegal construction. These are some of the challenges developing cities like Hanoi, Vietnam, are facing in the wake of booming growth and the resultant acute lack of housing.

Soft ground has made some of the city’s central areas uninhabitable. However, these derelict areas will soon pulse with new life, now that the city has been chosen for a pilot project testing the Finnish UUMA2 programme.

UUMA2 (a Finnish acronym for eco-efficient material solutions and the commercialisation of earthworks with recycled materials) is a programme that aims to replace non-renewable natural resources with recovered materials in earthworks via techniques like mass stabilisation.

So far, a 200-metre stretch in an area once unfit for development has been stabilised in central Hanoi. This eco-friendly and cost-effective solution has not only increased the value of the land but also eased the housing problem. The soft soil does not have to be removed from the construction site, and replacement materials do not have to be hauled on site from great distances, all of which minimises the use of natural resources and the need for heavy transport.

Case-specific recipes
Leena Korkiala-Tanttu, Professor of Geotechnical Engineering at Aalto University, Finland, is one of the researchers involved in the project. She explains the fundamentals:

“By using cement or ash as binders instead of natural rock resources, for example, we can optimise the properties of our construction materials. Local soil conditions and climate mean the exact recipe is always project-specific, so our main focus is to gain a thorough insight into the properties of all the UUMA materials, so that we can create the best match in each particular case,” she says.

The binder and soil materials are acquired from surplus ground, industrial by-products and waste, as well as from mildly contaminated soil and materials from old earthworks. These can be used as they are or as components for replacing untouched rock material or improving soil properties.

Pilot projects lead the way
Ramboll Finland has developed the UUMA technology over the past 20 years. One of the major pilot projects is being conducted in Jätkäsaari, a former cargo port on the southern peninsula of Finland’s fast-growing capital, Helsinki. The area is now being transformed into a dense urban district that will house 17,000 inhabitants when finished in 2025.

“Through UUMA technology, areas like Jätkäsaari that are undeveloped due to difficult soil conditions can now be transformed into urban zones. Sediments from the nearby sea are used to stabilise the area, making the process cheaper and more eco-friendly,” says Marjo Ronkainen, Head of Unit, Environmental Geotechnics, at Ramboll Finland.

Global potential
Many other cities worldwide are struggling with housing shortages, and developing urban areas neglected due to technical difficulties is key to solving the problem.

In Vietnam, ground stabilisation was an unknown method with no common standards for using the technology until the country got involved in the UUMA2 programme. Today, plans are in place for setting standards that will help make the technology more widespread.

“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,” says professor Leena Korkiala-Tanttu.

"The programme has great potential for many countries.

Leena Korkiala-Tanttu
Professor, Aalto University

The new Finnish recovery technology has been used successfully in Hanoi, Vietnam.
HOME OF THE INNOVATIVE
Critics and leading magazines have flocked to endorse the Tate Modern extension.

By Michael Rothenborg
Photo by Daniel Shearing

"It all started with the Tate Modern," wrote ‘The Economist’ under the headline ‘Home of the Brave’, when, after an ambitious rebuilding, London’s great museum gallery reopened in June 2016. The article highlights that Tate Modern was originally a power plant whose turbine hall was transformed into a huge exhibition space – a world’s first that museums and galleries have copied in cities around the world – in Milan, San Francisco and Shanghai to name but a few.

Tate Modern continues to push the boundaries of how a museum looks – and how it is built.

Now standing 10 storeys tall, the new EUR 350 million transformation offers visitors an enhanced experience with a 60% increase in display space.

Appointed by the Trustees of Tate, Ramboll played an integral role in helping to realise the Tate’s vision for the extension, which is built on top of three disused oil tanks, two of which create new, unique gallery spaces.

Herzog & de Meuron’s architectural vision has a brick façade that envelopes the truncated, twisting pyramid structure. The corners are column free, emphasising the continuity of the surface while also providing a 360° view of the River Thames, St Paul’s Cathedral, The Shard and the city beyond. In total, the building was clad with 336,000 bricks between August 2014 and February 2016, an installation process that used a new, “all-weather” system.

Ramboll’s integral role in Tate Modern’s extension included structural engineering, geotechnical engineering, façade engineering, civil engineering and environmental consultancy.

At the opening critics agreed that the Tate Modern is now as brave and innovative on the outside as the inside.

“One of the most spectacular buildings London has seen in decades,” commented Robert Bevan, architecture critic for London’s Evening Standard.
With more than half the Earth’s population now living in urban areas, some changes in the indoor and outdoor climates of cities are bound to occur. Climate scientists’ greatest concern is traditionally the urban heat island (UHI) effect – city areas where temperatures can be several degrees higher because there is lots of concrete and little blue or green infrastructure like lakes, rivers and parks. But another effect – air flow – can also cause serious health problems.

Skyscrapers or other prominent buildings change the wind flow through a city, which can, for example, interfere with the intake of fresh air in buildings. Air pollution at street level can also worsen, or wind can strengthen and hinder pedestrians or cyclists or even compromise safety.

The problem has been described in scientific papers, including a survey by the US National Library of Medicine that examines ‘High-Rise Buildings versus Outdoor Thermal Environment in Chongqing’ and concludes that cities can improve their urban thermal environment if they change their architectural and engineering structures and layouts.

Better layout of city blocks
Drawing on 15 years’ experience in the field of climate engineering, Ramboll has reached the same conclusion.

Ramboll designers study the urban landscape of a particular area by assessing its natural systems: its landforms, hydrology, vegetation and climate. Creating more sustainable urban design requires an understanding of the urban microclimate – its wind distribution, pollutant level and thermal comfort characteristics – at every stage of the design process.

In Hong Kong, the SARS outbreak in 2003 caused nearly 300 deaths, thus prompting the city to take measures to improve its environmental hygiene. The aim was – and is – to mitigate the urban heat island effect and other negative consequences of urbanisation through initiatives that promote a better layout of city blocks.

“Since 2005, air ventilation assessments have become an essential part of town planning, concentrating on how planning can influence and improve the general living environment, quality and sustainability of Hong Kong,” explains Steve Lo, environmental consultant at Ramboll Environment & Health in Hong Kong.

3D air simulation tool
Ramboll’s air ventilation assessments typically entail identifying open playgrounds, bus stops, footbridge entrances and other important pedestrian areas.

For that purpose, Ramboll has applied the 3D air simulation tool ‘Computational Fluid Dynamics’ – a way of investigating the flow, energy transport, chemical reactions, combustion, etc., in an urban setting.

The tool can also be used on a smaller scale. In the Danish town of Køge, Ramboll is analysing how local winds from the open sea affect the planned city development – and using the findings to optimise the shape and location of buildings and thus create pedestrian and living zones that afford maximum comfort for future residents.

Air ventilation assessments have become an essential part of town planning.

Steve Lo
Consultant,
Ramboll Environment & Health
Globally, one in eight premature deaths – seven million people annually – is linked to air pollution. The World Health Organisation (WHO) has identified the problem as the world’s worst environmental health hazard, and one of the hardest hit regions is Africa.

“It’s time Africa features in global plans to manage air pollution,” says Rebecca Garland, Senior Researcher in Climate Studies, Modelling and Environmental Health Research Group, Council for Scientific and Industrial Research in South Africa.

She highlights that a country like Nigeria has an annual mean PM10 level of 594 μg/m$^3$, nearly 30 times greater than the WHO guideline of 20 μg/m$^3$ (PM10 is particulate matter that is 10 micrometres or less in diameter). In the air these tiny particles can get into the lungs, potentially causing serious health problems.

And Nigeria’s population is by no means the only one exposed to a high health risk.

“Ensuring all players work together towards more visibility, collaboration and support for air quality in Africa is crucial,” says Rebecca Garland.

**African transition to green growth**

The African Development Bank is focusing more strongly on air pollution. As part of the bank’s 10-year strategy to facilitate Africa’s gradual transition to green growth, the bank has awarded Ramboll a contract for transport emission mapping and monitoring as well as capacity building in five cities around Africa.

Although indoor air pollution is the greatest problem, vehicle emissions are also steadily climbing, driven by urban sprawl, rapid motorisation and low levels of institutional capacity to manage traffic and its impacts. The United Nations Environment Programme (UNEP) estimates that vehicle emissions account for 90% of urban air pollution in developing countries.

The main objective of the African Development Bank project is to advise city authorities and policy-makers on efficient and accurate methods for collecting, storing and analysing data as well as mapping air pollution levels in cities, and to identify options for financing low-emission transport technologies. The project will cover the cities of Abidjan in the Ivory Coast, Yaoundé in Cameroon, Dar es Salaam in Tanzania, Lusaka in Zambia, and Rabat in Morocco, which will be hosting the UN’s COP22 Climate Change Conference 2016. The ambition is to implement the project results throughout Africa.

“This represents a significant step forward for further developing air quality services on the African continent,” says Frederic Pradelle, who heads Ramboll’s air quality division in France and is managing the project.

In addition to the assistance of Ramboll France, Ramboll Management Consulting in Denmark will provide cost-benefit expertise, and specialists from a Finnish transport team will also be involved.

Rebecca Garland thinks the project is promising.

“It sounds like a step in the right direction, as the underlying data for generating emission inventories to then feed into air quality models is often missing,” she says.

“Ensuring all players work together is crucial.”

Rebecca Garland
Council for Scientific and Industrial Research, South Africa
Asia also has among the highest numbers of premature deaths linked to air pollution, especially in countries with high growth rates. Within a few years India, which has the highest growth rate of the G20 countries, will surpass China as the world’s most populated country. With rural to urban migration severely straining city infrastructures in India, the Indian government plans to invest EUR 6.5 billion in creating 100 smart cities. The aim is to facilitate sustainable urban growth, for instance, by using smart technology to provide adequate water systems, stable power supplies, and reliable public transport.

Taking some of the first major steps in the initiative, Ramboll is conducting a pilot study in the historic city of Udaipur in Rajasthan. The pilot study is intended to build understanding of the challenges and determine how international experience from places like the Nordic countries and Singapore can benefit Indian cities.

“Studies from around the world reveal that when cities grow environmental quality and thus also liveability deteriorates. Many Indian cities also suffer from water and air pollution. But it doesn’t have to be that way. It is possible to decouple pollution from growth,” says Neel Strøbæk, Group Market Director for Planning & Urban Design at Ramboll.
Cities around the world have been implementing cycling strategies for the past 20 years. Walking strategies are still rare – but on the go.

By Michael Rothenborg

Toronto, Sydney, Auckland, Birmingham. More and more big cities are walking the talk and adopting walking strategies. Institutions like the London School of Economics are recommending that cities create “a better pedestrian flow”. Some experts even say the era of the car-dominated city is coming to a close.

Walking strategies seem to be the next big step towards creating more liveable cities. The main advantages include less congestion, lower CO2 emissions and better health.

The French city of Lyon is a particular case in point. In the past decade the city has reduced the number of cars within its perimeters by 20% – while its population has grown. Deputy Mayor of Lyon Gilles Vesco sums it up this way in a press release: “The goal is to rebalance the public space and create a city for people – a city with less pollution, less noise, less stress – a more walkable city.”

Like other progressive politicians, planners and experts, Gilles Vesco now speaks explicitly about the possibilities of a car-free inner city. Caroline Shaw, Public Health Physician from the University of Otago Wellington in New Zealand, also believes that “car-free inner cities should be part of any policy plan.”

“In New Zealand, both cycling and walking have been neglected in recent decades. We are now investing in cycling, which is long overdue, but we need to ensure the focus does not come off walking,” she says.

Oslo is on the go too

The Norwegian capital of Oslo has similar aims – and is looking to the UK, Australia and New Zealand for inspiration.

Earlier this year the Oslo city council recognised that pedestrians have a lower priority in the city’s traffic planning, and cycling and public transport behaviour has been mapped in far greater detail.
than pedestrian flows. So the city invited Ramboll Norway to design a walking strategy before the end of 2016.

To complete the assignment, Ramboll will line up experts from Transport, Planning and Urban Design (PUD) and Management Consulting, taking a multi-faceted approach to achieving the three main objectives:

More people should walk for a longer period of the year. Walking should be an attractive – and safe – option for everyone. And walking should be incorporated into all urban planning. For example, pedestrians should have their own footpaths separate from cyclists, because the two groups move at very different paces, and Oslo has also seen a significant rise in the number of cyclists.

Norway’s National Transport Plan 2014-23 aims to ensure that traffic does not increase in major cities, and that traffic should only grow as regards public transport, cycling and walking. Because Oslo’s public transport system gets overloaded during rush hour, a main purpose of the new walking strategy is to encourage people to walk the shorter stretches instead of taking a city bus a few stops.

“We especially see potential in walking to work and school – and in people’s home districts,” says Frida Andersson, expert in urban mobility at Ramboll Norway.

Oslo city council wants walking to be an attractive and safe option for all people.

“Car-free inner cities should be part of any policy plan.”

Caroline Shaw
Physician, University of Otago Wellington
A TRAIN TO THE FUTURE
Helsinki to Stockholm in less than half an hour? No, it is not a Utopian fantasy – the Hyperloop high-speed rail plans are making the prospect more and more realistic.

By Michael Rothenborg

It sounds a bit like a far-out sci-fi movie from the 1970s: Sending a train full of people through a giant, depressurised tube. As the tube is a near-vacuum, the train can move at speeds of over 1,000 km per hour, much faster and in a more climate friendly way than any commercial aircraft – and at around three times the speed of the Japanese Shinkansen and other modern bullet trains.

Make no mistake, however. The Hyperloop train might be coming to a capital near you within the next decade – and thereby solve a lot of congestion problems.

“As a long-term researcher in the field I look positively on the project, which will take current train technology to a new level of innovation,” says Folke Snickars, Professor and Research Leader at KTH, Royal Institute of Technology in Stockholm, Sweden.

He is not alone with his optimism. This type of low-air-resistance tube transport has been widely touted as the new future of mass transport, and those flirting with the idea range from French national rail company SNCF to the biggest investor in Uber and Airbnb, Shervin Pishevar. Leading magazines are writing more serious articles about the technology than they were just a year ago. For example, TechNewsWorld has a headline proclaiming “Hyperloop dreams are getting real”.

And engineers from the Massachusetts Institute of Technology (MIT) have designed passenger pods to be built and tested in a prototype tube in the USA. They hope to refute sceptics’ argument that a train ride that fast will inevitably be unpleasantly bumpy, with rollercoaster-like acceleration.

Competing with airline and car travel

In a paper written in 2012, American entrepreneur and Tesla Motors CEO Elon Musk first envisioned the Hyperloop technology as “a fifth mode of transport” – a way to compete with domestic airline and car travel.

Two companies are conducting tests and vying to be the first operator. Hyperloop Transportation Technology (HTT) is planning a track in Quay Valley, California, slated for completion by 2017 and ready for public use the following year.

Hyperloop One will invite the public to a full-scale demonstration of the complete system in early 2017. The company’s development partners include Deutsche Bahn, transport planning consultants Systra, public accounting firm KPMG, architectural firm Bjarke Ingels Group – and Ramboll as a technical advisor. KPMG and Ramboll have conducted a pre-feasibility study on the plans to link the two capital cities of Sweden and Finland with a tube that will cut the 500-km journey to less than half an hour.

“Our expertise has been within rock engineering; civil engineering; environmental planning for a sub-Baltic sea corridor, a rock tunnel between the countries, and two land-based corridors, one in Sweden and one in Finland,” explains Malcolm Sjödahl, Head of Business Development at Ramboll Sweden.

Ramboll has also helped calculate the costs of the project, which are forecast to hover around EUR 19 billion. However, this will still be cheaper than traditional high-speed train projects like the UK’s London to Birmingham fast rail and California’s high-speed rail. Moreover, factors like ticket sales, saved transport time and other advantages connected with creating a new, super-city of five million people – a megaregion far larger than Greater Copenhagen and Malmo – could mean a yearly profit of EUR 1.15 billion.

On the basis of the findings, the city of Salo, Finland, has signed a letter of intent with Hyperloop One to become the first city along the proposed Helsinki-Stockholm route.

“"The project will take current train technology to a new level of innovation.

Folke Snickars
Professor, Royal Institute of Technology, Stockholm"
In a post-Brexit world Britain can still lead the way towards a low-carbon future, argue experts.

By Kristine Barenholdt Bruun

The Brexit vote in June 2016 has cast uncertainty over what the UK’s economy and green transition will look like in the future. What form will environmental legislation take moving forward? Will it continue to be guided by European law, as is the case in Norway? Or take a new, independent course?

Jonathan Gaventa, Director of the London-based think tank E3G, has no doubts about the continuation of the UK’s green transition: “A vote to leave the EU may have left many distraught, but the underlying fundamentals of the low-carbon economy are strong, and the direction of travel for the transition to a low-carbon economy remains largely unchanged,” he explained recently in his blog at www.climatechangenews.com.

Tim Clare, environmental expert and Principal at Ramboll UK, agrees: “The international agreements on climate change and other environmental issues signed by the UK, not to mention the public’s ever-growing power as consumers, will continue to drive the sustainability agenda in the UK.”

Thousands of green jobs

Shortly before the Brexit referendum, Ramboll was appointed to provide engineering consultancy on the Lynemouth power station conversion from coal to 100% biomass. When finished, the project will reduce the plant’s CO2 emissions by 90%. The project is the largest of its kind in the UK and one of the largest bioconversions in the world – and Ramboll is providing 50 man-years towards its completion.

According to experts, projects like Lynemouth are proof of the UK’s continued political commitment to converting the country’s rundown coal plants into sustainable energy sources. The UK is still bound by international agreements like the Paris Agreement from COP21 – and nothing indicates that this will change.

Furthermore, the British Trade Union Congress has claimed that the green economy could offer vital support for a post-Brexit Britain.

In a new report, ‘Powering Ahead – How UK industry can match Europe’s environmental leaders’, the congress argues that the UK’s clean-tech sector has the potential to create thousands of jobs while simultaneously decarbonising energy generation. According to the report, to meet the climate change commitments while also supporting balanced economic growth, both the UK and Europe must have a sustainable industrial strategy. 

The Lynemouth power station continues the conversion from coal to biomass.
With growing congestion in many cities across the country and the ensuing impact on productivity and liveability, the UK could be in danger of squeezing itself into a proverbial transport corner.

By Nicki Marsh

THE CHALLENGE OF MODERNISING UK INFRASTRUCTURE

In March 2016 traffic analyst INRIX named London the world’s most congested city. Fortunately, the UK government already had plans for solutions, committing to GBP 100 billion of investment in infrastructure by 2020/2021. The plans address the transition of existing infrastructure and the introduction of huge new infrastructure projects. The pipeline includes such transformational projects as High Speed 2, Crossrail 2, the Thames Tideway Tunnel and a new airport runway, among others.

Experts cited in leading media like the ‘Financial Times’ have, however, said that the UK’s recent exit from the EU and the surrounding political turmoil have caused some uncertainty about these programmes. While some projects, such as High Speed 2, seem to enjoy widespread support, the decision on the new runway has already been postponed.

Alan Pauling, Ramboll’s Group Transport Market Director, highlights that the UK government has invested in projects to modernise, strengthen and squeeze capacity from existing infrastructure. Ramboll has been working on many such projects, ranging from reinforcing the Hammersmith Flyover to widening the M25 motorway and upgrading many of Transport for London’s assets.

“But there will soon come a point where optimising capacity begins to conflict with providing safe and reliable journeys. There is no slack on the rail network, the motorway network or at our major airports. The UK, without new infrastructure and routes, is in danger of squeezing itself into a proverbial transport corner,” Alan Pauling says.

Chancellor Philip Hammond has talked about “resetting the economy”, but what the market wants above all is some long-term consistency and certainty to enable the industry to plan, recruit and train personnel and to deliver infrastructure schemes as efficiently as possible.

Dan Harvey, Ramboll’s Executive Director of Transport in the UK, adds:

“Ramboll is already working with our partners on the planning phases of a number of big schemes and hopes to enjoy further work on such mega-projects. I hope the Government will soon confirm their post-Brexit plans and bring about the confidence the industry needs.”
BUILDING STRONGER WITH DIGITALISATION

To create better quality and avoid cost overruns, the entire engineering and construction sector needs to digitalise.

By Kristine Barenholdt Bruun
VIRTUAL SINGAPORE

As the first country in the world, Singapore is creating a full 3D digital replica of the entire country, with data on everything from the rocks underground to traffic on the streets.

This digital twin city, an advanced version of Google Maps, enables users to look into buildings and beneath them and visualise how wind flows between skyscrapers.

The overall idea is to compile the maximum data possible in one model for the benefit of all – companies, scientists, citizens and authorities.

For example, authorities will be able to do simulations that help determine how to move big crowds to and from an event. Or companies will be able to visualise how water runs through the streets after a heavy rainstorm.
LEAVE OUT DIGITALISATION – AND LOSE 13% OF THE REVENUE

A new Danish report, ‘IT in Practice’, by Ramboll and the Danish IT Society shows that if no further digital initiatives are taken, one in 10 businesses will lose 25% of their revenue. On average, 13% of revenue is at risk across all industries.

Digitalisation is changing the market extremely rapidly, which makes it necessary, now more than ever, to continuously assess the market and the strengths and weaknesses of one’s company, the report concludes.

“Collaboration and integration are crucial if new technologies are to be used across the industry. It is not enough that Ramboll generates 5D models and uses smart applications. We have to carry the technology all the way from the consultants in the design phase to the contractors and the construction workers on the actual building site,” Troels Hoff explains.

With good collaboration and smart technology, consultants can build models that are easy for contractors to expand. Construction workers can carry the models with them on tablets and ensure that the reality matches the model.

“Imagining construction’s digital future”, an article recently published by the management consulting company McKinsey, also explains that so-called crew-mobility solutions will have a catalytic effect on productivity. Central-planning teams have long had difficulty connecting with onsite construction teams and sharing information about progress in real time, the article concludes.

Creating more safety with 3D

Digitalisation involves more than better budgets and fewer mistakes. It also creates better safety. Ramboll’s interactive 3D computer game helps construction workers anticipate and avoid accidents onsite. When construction of a super hospital in Gødstrup, Denmark, was in its initial phase, employees performed a range of safety tasks and procedures in a 3D simulation before gaining access to the site. This reduced the accident rate to only half the industry average.

The use of 3D laser scanning can eliminate risks throughout a project – from its design to installation – thus increasing human safety, e.g. on an offshore platform. The technology enables ‘as built’ assets to be generated digitally, which safeguards against geometrical errors and ensures new designs are precisely tailored to fit existing layouts.

“Embrace new technologies and create better results.”

Michael Max Buehler
World Economic Forum
HIGHER QUALITY STRENGTHENS GLOBAL ENGINEERING COLLABORATION

By Pawan Maini
Managing Director, Ramboll India and Ramboll Engineering Centre

In spring 2014 Ramboll had the opportunity to bid for one of the most iconic and demanding projects in Finland – the Helsinki Central Library. To prepare the bid, Ramboll called on experts from its various business units, including Ramboll Engineering Centre (REC) in India, which contributed steel structure calculations and 3D modelling for the beams and trusses of this nearly zero-energy building.

Collaborating with REC engineers in India gave Ramboll the edge it needed to win the project, as the partnership ensured not only a lower price but also high quality output. The Helsinki Library is now a reality and part of a growing outsourcing trend that benefits both company and client. The Manchester Smart Motorways project in the UK and the Lisbjerg Power Plant in Aarhus, Denmark, offer other concrete examples of the benefits of outsourcing, for the field of global engineering and its clients.

According to a report published by Information Services Group (ISG), a leading technology advisory company, the engineering market is in the midst of a dramatic transition, with outsourcing in the industry having grown substantially in recent years. The market research company Technavio expects engineering outsourcing to grow a further 27% by 2019 – both because costs need to be cut and because Europe has a shortage of experienced engineers.

Analyses show that India’s large pool of technical and professional talent, combined with its good infrastructure and flexibly priced, state-of-the-art technologies, is the reason the country has become the preferred outsourcing destination for European and American firms. However, outsourcing is hardly a no-brainer. To tap Indian expertise and use it on global projects, Ramboll had to create a multicultural work environment. For this purpose, employees in Europe and India underwent training so they could better understand each other’s business cultures and backgrounds.

According to Asmita Jondhale from Ramboll India, a senior designer who had a chance to work on the Helsinki Central Library, regular communication and dialogue with her counterparts ensured the best results for the project – and was the key to improving quality and profitability for the client.
HOW OLD RIGS CAN BECOME ENVIRONMENTAL ASSETS
A growing number of the 600 oil and gas installations in the North Sea are to be decommissioned. The traditional approach is to remove them, but leaving some structures in place is emerging as a sustainable solution, both economically and for marine life.

By Jesper Toft Madsen

High costs and low oil prices are compelling offshore operators to prolong the lives of existing platforms. When old rigs finally retire, however, they must be removed, reused or disposed of to prevent contamination and potential safety risks to shipping.

The decommissioning process is a complicated and expensive affair. Removal was the traditional method for dealing with North Sea rigs, but a new approach is catching on. Marine biologists have pointed out that, over decades of rig operation, marine life has flourished around the deep-sea substructures. In fact, oil rigs off the California coast can house some of the richest maritime ecosystems in the world.

“They’re more productive than coral reefs, more productive than estuaries. It just turns out by chance that platforms have a lot of animals that are growing really quickly,” says Milton Love, Professor of Marine Biology at the University of California, Santa Barbara.

Keep it simple
Tim Martin, Managing Director of Ramboll Oil & Gas in the UK, welcomes the marine biologists’ endorsement.

“Leaving some structures behind is a more pragmatic solution that can save operators and society a lot of money, while also preserving

Platforms have a lot of animals that are growing really quickly.

Milton Love
Professor, University of California

A diver inspects sponges, coral, anemones and invertebrates on an old oil platform off the California coast.
There are over 600 oil and gas installations in the North Sea, many of which have been producing oil and gas for almost 40 years. In the decades to come, a growing number of oil and gas installations will be decommissioned.

Source: Decom North Sea

RIGS-TO-REEFS

Some structures end their days giving new life to marine flora and fauna in the rigs-to-reefs programme, through which decommissioned oil and petroleum rigs are converted into artificial reefs. In the USA, where the practice started and is most common, rigs-to-reefs is a nationwide programme, and in 2012 about 10% of all decommissioned platforms had been converted into permanent reefs.

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.

More industry collaboration

Offshore operators tend to work out their decom processes individually, which poses its own set of challenges. Joining forces with other operators to obtain permits, conduct environmental analyses and bear removal costs can create economies of scale, explains Nathan Swankie, Principal at Ramboll Environment & Health.

“Operators often claim that competing interests make it difficult for them to work together. We help them navigate between their interests and facilitate dialogue. Everyone wants a strong business case, and they will get it by collaborating,” says Nathan Swankie.

He adds that if oil companies fail to procure the relevant permits – often several years before the actual removal starts – already tight schedules risk being delayed.

Professor David Lusseau from the University of Aberdeen, School of Biological Sciences, backs the need for more industry collaboration, environmental optimisation and cost-efficiency. He is currently working with lawyers, economists, ecologists and engineers to understand all the consequences of completely removing platforms from the North Sea.

“Some argue that we should remove everything and return the North Sea to its original condition. But what is the pristine condition and how do we return it to that state? Ecosystems are complex adaptive systems, and it’s difficult to predict the outcomes of state shifts. So the remove-all approach is set to fail, I think, and may actually work against its original intention. Instead, we should aim for decom to maximise the health of the current ecosystem and its resilience. We need to develop a comprehensive decision-making process that considers what benefits the removal of each component might bring and what impact they might cause,” says professor Lusseau.
A tunnel with an extra storey every 1.8 km? Why? Because these special elements will make the Fehmarn tunnel safer and easier to maintain, with no disruption to traffic.

By Michael Rothenborg

With record-breaking dimensions, the Fehmarn tunnel project has created major challenges at every turn, not least the challenge of operating and maintaining the tunnel without disrupting traffic. In shorter tunnels machinery and installations – like power supply and pump sumps for discharge – are put directly under or beside the road and rail track. However, these areas may be hard to reach when maintenance is required, thus causing traffic delays because all or part of the tunnel has to be closed.

The single-storey solution would have been too cumbersome for the Fehmarn tunnel, which runs 18 km below sea level with no external access points but the portals at each end, one on the Danish coast and one on the German. The Ramboll-Arup-TeC Joint Venture thus recognised the need for special features.

After a lot of thinking and discussions with the Oresund and Great Belt tunnel maintenance teams, the project team came up with an innovative and unprecedented solution: A tunnel with intermittent two-storey elements, the lower of which would be dedicated to installations.

"Traditionally, all tunnel elements are a single storey. With two storeys, there is enough room for the power supply, the pump sumps and machinery on the lower level – so you don’t have to stop traffic on the upper level when you do maintenance,” explains Susanne Kalmar Pedersen, Project Director at Ramboll Transport.

The tunnel will be constructed from 79 standard elements and 10 special elements to be located at 1.8-km intervals. All mechanical and electrical equipment requiring space and frequent maintenance will be gathered in these special elements, thus simplifying the technical production of the standard elements, which will be more uniform and, therefore, better suited for mass production.

The tunnel elements will be manufactured on land, towed to the tunnel alignment and immersed one by one in a pre-dug trench. Once in place, the elements will be covered with sand and a protective stone layer, and in a few years’ time, the natural seabed will have been completely re-instated.
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