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The need for detailed planning is becoming increasingly important and complex. No longer is it enough to simply build something. You have to look beyond the physical context and take into account everything from social and cultural insights to long-term strategic objectives, ensuring that these form part of the solution from a micro to a macro level.

The construction of a bridge is not just a matter of structural engineering, but utilises a host of disciplines ranging from cost-benefit analysis and transport planning to stakeholder involvement and sustainable mobility strategy. Similarly, planning urban development successfully in a city involves all aspects of sustainability, including the environmental, economic and social dimensions.

The Danish capital, Copenhagen, is exemplary in showcasing the many facets of urban master planning and, as the feature article in this issue illustrates, successful planning is sometimes born of necessity while on other occasions it is a response to particular needs.

Other cities are beginning to take note. When New York was looking for a climate adaptation study with integrated cost-benefit analyses, the city took into account all aspects of sustainability, including the extent to which new green areas improve residents’ health and quality of life.

Cities and their infrastructures constantly evolve and careful attention needs to be paid in allowing for change while maintaining functionality. In London, for example, authorities can increasingly see the value in keeping rail stations and roads operational while they are repaired. And when the Danish healthcare company Novo Nordisk refurbished one of its factories, planning of almost surgical precision was required in order to keep closing days to an absolute minimum.

Other projects require another type of flexible approach. Designing a new district heating system, for example, entails not only taking into account existing energy sources but also planning for any potential changes along the way.

Whatever the project, planning integrates our engineering expertise and strategic consulting, and this issue of Response reveals just how central a role it plays in developing business and societies around the world.

Enjoy your reading.

Jens-Peter Saul
Group CEO
As temperatures and water levels rise, and more people migrate to urban areas, we have to prepare our cities, infrastructure and public and private energy systems. According to some planning experts one major potential for governments, cities and companies alike lies in replacing patchwork solutions with all-inclusive, integrated solutions.

“There is a growing demand for holistic approaches to tackle the multiple challenges of urban development – and thus also for planning,” says Simone Sandholz, Research Associate at the Institute for Environment and Human Security at the United Nations University in Bonn, Germany.

**Copenhagen as a global role model**

By 2050 the number of people living in urban areas will have climbed from 54% to 66% of the world’s population. At the same time, a globally growing middle class is demanding a higher quality of life, especially in emerging economies. This increases the risk of resource scarcity, pollution and other environmental problems. Climate change also poses risks – and demands solutions.

Simone Sandholz highlights that the growing demand for holistic approaches has been stated in some of the main international documents produced in connection with the Post-2015 Agenda. These include the United Nations Sustainable Development Goals, such as goal 11: “Make cities and human settlements inclusive, safe, resilient and sustainable.” Another example is the recently adopted New Urban Agenda, which calls for sustainable and coordinated urban development.

“This certainly requires new ways of planning cities and education – and global case studies like Copenhagen have proven that such holistic approaches are seen and can serve as global role models,” Simone Sandholz says.

**THE DYNAMIC TRIO**

Technical excellence in engineering details and strong strategic advisory skills is not enough. Planning is the glue needed to bind the two together.
NYC needed a 360-degree solution

Ramboll has been working closely with the City of Copenhagen for more than 30 years trying to ensure sustainable development in the Danish capital. Henrik Seiding, Executive Director of Ramboll Management Consulting, emphasises that planning must incorporate a variety of offerings to be adequate for a client and society as a whole.

“You need deep knowledge of different disciplines to be able to see and paint the whole picture – and to deliver a 360-degree solution. Technical excellence in engineering details is not enough. Very strong skills in strategic advisory won’t do it either. Planning is the glue needed to bind the two together – and the binder that ensures sustainable development,” Henrik Seiding explains.

He mentions an example. When Ramboll was selected to do a climate resilience study for New York City (see page 14) the hydraulic expertise from Ramboll Water was not enough for the city’s Department of Environmental Protection. Neither were strategic considerations about the general policies and goals for climate adaptation. It was the combination of the two – plus a cost-benefit analysis that took the economic, environmental and social aspects into account. And this was true sustainability in the broad sense of the word.

Naturally, the challenges for governments, cities and companies differ in several ways, stresses Henrik Seiding. But one thing they all have in common is the need for an integrated approach – and it is here that Ramboll’s expertise within urban masterplanning, energy planning and infrastructure planning comes to the fore.

“There is a growing demand for holistic approaches to tackle the multiple challenges of urban development.”

Simone Sandholz
Research Associate, United Nations University
WHEN NECESSITY SPARKS URBAN INNOVATION
It all started with a vicious circle. “And the vicious circle was most evident right in this area of Copenhagen,” says Søren Hansen. He is the planning director of Ramboll Transport and one of the most experienced consultants in Danish masterplanning – the holistic approach by which much of the world is increasingly inspired.

Søren Hansen sits with a latte in a café in Nørrebro, a trendy Copenhagen neighbourhood. Nearby are hipster dads with long beards worthy of a lumberjack, gently rocking baby carriages while women in suits and high heels handle their laptops.

Back in the early 1980s when Hansen was studying to be an urban planning engineer, Nørrebro looked very different. Its citizens

arence.

The city was not attractive for growing companies or for families with children.

Søren Hansen
Planning Director, Ramboll Transport
were angered by the way the municipality was tearing down century-old buildings in their cosy neighbourhood, the city was close to bankruptcy, and living a full, rich and healthy life in Denmark’s capital seemed like a distant dream.

Some chose an activist response – occupying empty apartments – others moved or were rehoused in newly built suburbs. The latter often found a very alien environment – high-rises based on the mass-housing philosophy of French architecture guru Le Corbusier in neighbourhoods with nothing to bring people together.

“It was planning with the systems in focus, not the people. The people coming from Nørrebro had been used to bumping into friends and acquaintances on the street, but now the environment made them lonely. They got lonely and depressed”, Søren Hansen remembers.

Traffic planning was cars, cars, cars

Copenhagen was in a deep recession – well over half of its inhabitants were retirees, jobless people, students or other social benefits recipients, and the taxpayers were moving away with increasing speed.

“The city was not attractive for growing companies or for families with children. This neighbourhood still had rats in the large piles of garbage lying in dark courtyards,” remembers Søren Hansen.

He became interested by the question: How do you make cities attractive and retain people in the city? And after graduating in 1984, he got his first job answering just that question in a traffic-planning consultancy that had just been acquired by Ramboll.

“Before the 1980s, traffic planning was basically about cars, cars and cars. Other road users should just behave. And Denmark nearly made the same mistake as Stockholm and Paris – destroying their waterside recreational areas by building high-speed roads,” remembers Søren Hansen, shaking his head in disbelief.

A six-lane motorway by the lakes

We’re now driving by the Copenhagen Lakes, where a six-lane motorway had been well underway
So the traffic planners’ first job was to make streets that accommodated not only cars but also cyclists and pedestrians.

“Bike paths, lower speed limits in certain areas, space for sidewalk cafés, you name it. This might sound banal today, but it was all new at the time,” stresses Søren Hansen.

Planners and architects collaborated to develop a new approach to urban planning. Instead of demolishing all the buildings and trying to make people live in square boxes, they tore down the darkest rear buildings and planted trees and other greenery in the new courtyards – thus making it attractive for families with children to live in the city too. The Danish state helped with some of the financing – acknowledging that a country cannot have a capital on the verge of bankruptcy.

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MAYOR OF COPENHAGEN: LONG-TERM PLANNING IS KEY

Long-term planning and collaboration are two concepts characterising the partnership that Ramboll and the City of Copenhagen have nurtured. When asked to pinpoint the value of having had Ramboll as a close advisor since the early 1980s, Morten Kabell, Mayor for Technical and Environmental Affairs at the City of Copenhagen, says:

“Now more than ever, we must work for a green agenda, and Copenhagen has raised the bar here. Because of this, the whole world looks our way to see how we are working together to meet climate challenges. We try to create goal-oriented partnerships that can help spread the solutions we think we’ve got right. The best example is our co-creation with New York, which is designing its own climate quarter based on the experiences of the Danish company Ramboll.”

We try to create goal-oriented partnerships that can help spread the solutions we think we’ve got right.

Morten Kabell
Mayor, Copenhagen.
How to develop a prairie

Other visionary planners took a critical look at – or rather down in – the harbour. Like many other capitals in the 20th century, Copenhagen placed a lot of industry on its waterfront in order to optimise, e.g., infrastructure, but this ended up contaminating the water with chemicals, heavy metals and other pollutants.

“You could get very sick if you jumped in the harbour here. It’s difficult to believe today,” says Søren Hansen, nodding at one of the Copenhagen Harbour baths, where citizens now swim in the summer.

“Cleaning up the harbour wasn’t exactly cheap – but compared to the advantages for the citizens and the city’s image, it was peanuts,” he stresses.

We leave the inner city and drive along in a shared car to Ørestaden, home of Ramboll, several other international companies and Denmark’s biggest shopping centre. When Søren Hansen took a field trip here with other consultants and the City of Copenhagen around 20 years ago, they walked around on something akin to a prairie.

The Danish capital was no longer in recession, but companies still moved away when they reached a certain size. The city was also running out of space to house the staying families and the newcomers.

This area, Amager Fælled, had space and cheap land. But there was no reason to move out here.

“So we recommended that the politicians adopt a metro and massive building plan along the road out here. Bus lines wouldn’t have been enough, because they can be moved. A metro is stationary and a promise to entrepreneurs and private investors that the area will be continuously developed,” explains Søren Hansen.

Innovative financing of the metro

The City of Copenhagen followed the experts’ advice. The decision pushed up property prices because of the expected development – just as planned – and the City sold its properties as the metro came close to completion, when prices were high. The revenue was used to repay the loans for the metro.

“That was a world’s first: financing a metro by the expected urban development it created,” says Søren Hansen.

The next leg of the metro will reach the newest city development area – in the northern part of Copenhagen. This is where the City, Ramboll and partners are building Nordhavnen, a new sustainable and climate-resilient city area with room for 40,000 inhabitants and 40,000 jobs.

Contrary to some of the older harbour apartments in the south of the city, where flooding has frequently come within centimetres of apartment floors, this urban area is planned for the future.

Parts of Nordhavnen are artificial islands made with excavated soil from the underground metro stations.

“That’s really holistic,” smiles Søren Hansen.

A new ring road to limit congestion

We have reached the final destination of our trip – a multi-storey carpark in Nordhavnen with a playground, a mini-fitness centre and barbecue areas on the rooftop. Søren Hansen often takes foreign delegations up here, for three reasons:
The recreational area is a good showcase for Danish holistic thinking: There is a nice view over the now clean harbour to ‘Amagerbakke’, Copenhagen’s new waste-to-energy facility, which not only emits so little pollution that it can be placed in the middle of the city but will also have BIG architecture, including a ski slope on the rooftop.

And last but not least, the area overlooks the places where Søren Hansen’s next vision will rise from the ground – an eastern ring road tunnel from Nordhavnen to Ørestad with strategically placed roads connecting it to the surface.

Copenhagen is about to drown in its own success; population projections talk about 10,000 new citizens every year until at least 2025 – a growth rate in Europe that is second only to Stockholm, according to the Swedish economist Peter Stein.

“Their cars will worsen the congestion we already have in Copenhagen – unless we build a new ring road to lead through-traffic under and around the city,” explains Søren Hansen.

“And the excavated soil from the tunnel can perhaps be used to build more artificial islands with room for new citizens out there,” he says, pointing to the northern entrance to the harbour. “If we combine it with a climate-resilient flood barrier it would continue the holistic tradition in a very fine way.”

A BLUE SEAL FOR A GREEN APPROACH

In 2016 Ramboll’s green approach got a blue seal of approval from independent experts at the National University of Singapore, Zeppelin University in Germany, Harvard University’s Graduate School of Design and the Massachusetts Institute of Technology (MIT). The experts delivered input to a study spearheaded by Ramboll’s Liveable Cities Lab, and revealed the multiple, interrelated benefits associated with blue-green infrastructure:

- It improves water quality and very effectively controls stormwater and flooding.
- It increases urban resilience and adaptability to climate change compared to traditional grey infrastructure.
- It creates enhanced spaces for mental and physical recreation and social activities, thereby also attracting residents, businesses and tourism.
- At its best, blue-green infrastructure contributes to a city’s symbolic capital.
In Frankfurt am Main, Germany, the financial district is about to be revitalised. It comprises four high-rise towers with a multistorey plinth, mixed-use programmes, large public spaces and incorporated subsidised housing. The new neighbourhood will provide workplaces for about 3,000 people, 1,000 people will live there, and the complex will also include catering, retail outlets, hotels, local shops, a children’s playground and adventure areas.

The towers will be up to 228 metres high and thus redefine the Frankfurt skyline. Ramboll Studio Dreiseitl’s project tasks will mainly include landscape architecture services such as plaza and public realm design, podium gardens and, potentially, façade greening.

“The project will play a pioneering role in the transformation of Frankfurt’s banking district into a mixed-use quarter,” states Mike Josef, City Councillor of Frankfurt: “A new space with a publicly accessible roof area and affordable living space will be created. The centrally located site, which has been closed for a long time, will now be open to the public. This will become a lively neighbourhood, not only for working but also for living.”

As one of the fastest-growing capitals in Europe, Stockholm is preparing for a future with a significant peak in the number of inhabitants as well as an increased flood risk due to rising water levels combined with a higher frequency of heavy rainfalls.

In order to address these challenges in a sustainable way, the Stockholm city planners have asked Ramboll to provide inspiration for a strong flood-risk management strategy. Ramboll is also developing guidelines for stormwater handling in public areas in the city.

The Swedish capital has a complex stakeholder landscape with different interests in how to use and utilise public spaces. Therefore, a large part of the strategy is about providing the right process for stakeholder involvement in order to gain strong and broad support for the objectives.
Nestled in the mountains along the coast of the United Arab Emirates (UAE), Fujairah, the UAE’s fifth-largest emirate, has embarked on a plan for the comprehensive development of the area. The aim of this project is to achieve sustainable development in Fujairah in light of its rapid economic growth, by establishing an effective infrastructure that is balanced and environmentally friendly.

According to Director General Mohamed Al Afkham from the Fujairah Municipality, Fujairah 2040 is an innovative strategic plan, e.g., with community workshops with senior communal representatives.

“Ramboll’s multidisciplinary services on the project have been professional with high technical excellence,” he says.

In the Middle East, the megacity of Jeddah, Saudi Arabia, has also discovered that the cost of doing nothing can be an incentive for investment. An environmental degradation study by Ramboll shows that Jeddah, which has 3.5 million inhabitants, will lose 2-4% of its annual GDP unless something is done to address rapid population growth, water scarcity and pollution.

To meet these challenges and enhance public life, Ramboll developed an environmental and social masterplan that not only has the potential to save the city EUR 1-2 billion annually but also improved its water and air quality, established an effective waste management system and created green, recreational areas within the city.

The multidimensional plan, which has been highlighted by institutions like the University of Southampton, is serving as a decision-makers’ guide and could make Jeddah a model for sustainable development in the Middle East.

In January 2017 it rained cats and dogs for several days in a row in Singapore. Unlike earlier tropical cloudburst episodes, however, the roads and paths of the city’s big Bishan Ang-Mo Kio Park were not flooded.

The episode showed that the redevelopment of the park – conducted with the participation of Ramboll Studio Dreiseitl – had fulfilled its two purposes: to create more recreational spaces and increase the capacity of the Kallang channel along the edge of the park.

The climate adaptation project in Bishan is just one of several examples of how holistic planning is also gaining ground in this Asian megacity. Ramboll has also participated in a revamp of the Esplanade Forecourt Garden, bringing out two of the city’s most valuable elements – its water and lush vegetation.

Native coastal flora, including yellow and golden rain trees, lemon grass and rabbit’s foot ferns, make up the garden’s plant palette, attracting butterflies, brightly coloured birds and fascinated children back to the city.

In a similar project residents of the suburb Sembawang can look forward to a new, integrated sports and community hub with facilities ranging from a swimming pool in natural settings to forest trails and an eco-friendly hawker centre.

The overall approach for the project, in which Ramboll architects are participating, is to build facilities into the forested area rather than planting trees around the facilities.
US cities are increasingly inspired by an integrated way of looking at urban planning.

By Michael Rothenborg

A few years ago North American cities began talking about “Copenhagenizing”, and leading magazines like Wired wrote feature articles on how the Danish capital inspired bike lanes and other two-wheel-friendly initiatives in cities like New York, Montreal and Detroit.

Now, experts and researchers point to the fact that US cities are also seeking broader, more general inspiration for urban planning.

“We need to create long-term solutions for our cities,” says Malik Benjamin, an architecture professor at Florida International University. “If we want to make smart changes and add value, not just in terms of dollars and spreadsheets, but for citizens’ quality of life, we need to move to a more open, transdisciplinary conversation. Holism and public involvement are keywords.”

Malik Benjamin recently visited Copenhagen – as one of the increasing number of American guests on inspiration tours.

“I’m very inspired by the holistic approach to cities that I’ve seen here in Copenhagen,” said
other aspects into the big calculation – and simplify it. Cost-effectiveness means not only the amount of savings in terms of avoided property damage but also the extent to which the new green areas will improve residents’ health and quality of life,” Alan Cohn explains.

In other words, Ramboll used integrated planning to combine knowledge about hydraulic engineering with New York City’s strategic goal: to become more climate resilient within a socio-economic context.

Stakeholder involvement
The study provides insight into ways of advancing climate resiliency projects and traditional stormwater solutions that can mitigate inland flooding and accommodate future increases in rainfall intensity by being integrated with ongoing urban planning development.

Drawing on this insight, Ramboll has now been engaged to take the study a step further and develop a number of pilot projects in the Southeast Queens catchment area.

“In line with the first resiliency study with NYCDEP, focus will be on integrated planning and stakeholder involvement throughout the process,” explains Trine Stausgaard Munk, Project Manager at Ramboll Water and project lead on the New York studies.

Landscape architecture in-house
In a related project in Washington, DC, Ramboll will assist the Department of Energy and Environment in assessing the effect of flooding from the Potomac River in terms of rising sea level, storm surges and extreme stormwater events.

In this case and in New York another decisive factor was that Ramboll has its own experts when it comes to landscape architecture and how urban planning affects people.

Ramboll has consolidated its expertise in this field and has set up a ‘Liveable Cities Lab’ in Boston.

The Danish company also has projects in Chicago and on the US West Coast, for example, in San Francisco. The Californian metropolis, which is highly prone to more intense rain and higher tides, has approached Ramboll on three major frameworks for planning services.

Mayor Jeri Muoio of West Palm Beach, Florida, on the same trip.

The right combination of skills
The flow of holistic planning ideas across the Atlantic is not new. For decades the famous Danish architect, Jan Gehl, has been a central figure in the drive to create vibrant, people-centric cities around the world. But collaboration is growing more widespread. Ramboll, for example, has partnered with the City of Copenhagen on exporting Danish solutions, which has led to agreements with US cities like New York and Washington, DC.

In New York it was the combination of Ramboll’s technical hydraulic expertise and its holistic cost-benefit calculations that made the city pick Ramboll to conduct a “Cloudburst Resiliency Planning Study”, according to Alan Cohn, Climate Program Director at The New York City Department of Environmental Protection (NYCDEP).

“Ramboll not only has the water engineering techniques but can also factor them and all the

Cost-effectiveness also means the extent to which the new green areas will improve residents’ health and quality of life.

Alan Cohn
Climate Program Director,
New York City
DETAILED ENERGY PLANNING SAVES MONEY AND CO2
A growing number of US cities are striving to lower their carbon footprints. District heating with flexible use of energy sources is a cost-efficient way of achieving this. An energy technology professor sees a huge potential.

By Michael Rothenborg

Low-carbon organisations and networks like The Carbon Neutral Cities Alliance (CNCA), Compact of Mayors and C40 continue to attract new members and partners, also in the USA. One of the most active cities in the field, Cambridge in Massachusetts, has chosen Ramboll to prepare a masterplan to significantly decarbonise its energy supply.

Green energy city planning is increasingly a competitive parameter for US cities attempting to attract the best and most progressive students, academics and businesses. Cambridge is home to two of the world’s most prestigious universities, Harvard and the Massachusetts Institute of Technology (MIT), both of which have made a low-carbon future a priority.

“The state of Massachusetts has ambitious carbon reduction targets, as do a lot of US cities and colleges, which creates a competitive drive between sustainability managers in the respective locations to get to carbon neutrality first,” says Isidore McCormack, project manager at Ramboll Energy.

Lack of experience
He explains that there is a lack of experience in the USA when it comes to carbon reduction energy...
planning and the integral role district heating can play when a city implements its carbon neutrality strategy.

“This provides an opportunity for us, as we have Copenhagen and other cities as tangible examples of our energy masterplanning capability,” says Isidore McCormack.

Energy planner Seth Federspiel from the city of Cambridge confirms this:

“We selected Ramboll to conduct the Low Carbon Energy Supply Study because of Ramboll’s deep technical experience in energy systems planning, particularly at the district scale, as well as the company’s willingness to consider innovative opportunities for meeting Cambridge’s goal to become a carbon-neutral city.”

Campus and university focus

Establishing district heating in the USA is usually more complicated than in Europe. The widespread private ownership and lack of regulation for hot water district energy pipes makes it difficult, for example, to lay pipes in the roads. Ramboll’s main strategy for exporting district energy services to the USA is therefore to focus primarily on private campuses and universities, which are centrally owned as in Europe.

“But in our experience, if a US city really wants district heating, it too can be integrated into the city’s urban planning, climate resiliency planning and energy planning in a holistic and cost-efficient way that benefits citizens,” says Isidore McCormack.

A flexible energy system

Cambridge’s goal is to be totally carbon neutral in 2050 and to have zero emissions from buildings by 2040. Today, the city’s heating and electricity primarily come from oil and gas. So, Ramboll is investigating a potential lever that involves converting some of this fossil fuel supply into solar or wind energy imported from outside the city. Sources could include, for example, the offshore wind farms whose potential the state of Massachusetts is currently studying and which may be a viable solution in low-density areas.

Even without changing the energy source, however, massive savings on CO2 – and money – are in the pipeline. European-style district energy based on hot water can save up to 30% in operational costs compared to traditional US district heating systems, which are steam-based and fairly inefficient.

With the right planning, the hot-water-based system is flexible, so the energy source can be changed at a later time.

The most sustainable solution

To date, Ramboll’s local subcontractor, Vanderweil Engineers, has assisted with collecting data on Cambridge’s present energy use. The next project development stage is to identify potential scenarios for the city that are energy efficient and sustainable from the environmental, social and economic perspectives. This will result in an energy road map enabling the city to achieve its objective of decarbonising its energy supply.

Ramboll has expanded its Boston office to accommodate the growing demand for energy planning. That could prove a very wise move, according to external experts:

“The market share for district heating in North America is only a few per cent. So the potential market is huge,” points out Sven Werner, Professor of Energy Technology at Halmstad University in Sweden and a world-leading expert on district heating.

Apart from Cambridge, Ramboll is participating in district energy projects in the urban areas of St Paul in Minnesota, Bridgeport in Connecticut and Guelph in Ontario, Canada. Ramboll also has projects at MIT, Dartmouth College in New Hampshire, Wesleyan University in Connecticut, and Sheridan College in Canada.

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The potential market is huge.

Sven Werner
Professor, Energy Technology,
Halmstad University
According to the industry organisation Euroheat & Power, Germany, together with Poland, is the biggest market for district heating and cooling in the European Union in terms of absolute numbers. Despite the ongoing decline in heating demand that has resulted from thermal insulation measures, the replacement of old buildings and demographic changes, the district heating share within the overall heat market remains stable due to the growth of existing and development of new networks.

Thus, interest in new and improved schemes is also rising in Germany, and Ramboll is among the consultancy firms benefiting from this trend.

The Danish company has had several mid- and large-sized planning projects in places like Schleswig-Holstein, Hamburg (photo), Dortmund and Bremen – the latter based on a digital model of the city – and has just finished a big project in Düsseldorf.

The main focus of the Düsseldorf project was on the planning and hydraulic investigation of a 17-km heat transmission line across major parts of the city – designed to combine waste heat sources, generating plants and supply areas. Once built, it will make district heat supply in Düsseldorf greener and more efficient.

“In Germany it is very important to keep the deadlines, and Danish experience and inspiration are also regarded as a competitive advantage in this area,” says Eckhard Ritterbach, Business Development Director, Ramboll Energy.
A new EUR 370-million government scheme will boost energy efficiency in UK homes and businesses. The clients need planning expertise from the micro to macro levels.

By Michael Rothenborg

Implementation of district heating in the UK was slow for years, but that has all changed. The government has recently decided to invest GBP 320 million (around EUR 370 million) over the next five years in schemes that will supply low-carbon heat to keep homes and businesses warm nationwide.

The press release from The Department of Energy and Climate Change specifically mentioned that the inspiration for this came from the Nordics:

"Dubbed ‘central heating for cities’, heat networks are already used widely across Scandinavian cities to keep homes warm in winter. And with the potential to reduce heating costs by more than 30% for some households, this investment is exciting news for the country’s towns and cities,” the department wrote in June, 2016.

This reference gives Ramboll a unique selling point.

“We certainly leverage our Danish heritage and long-term knowledge of district heating,” explains Crispin Matson, head of Ramboll’s energy systems department in the UK.

The web around Wembley

He adds that the clients are seeking planning expertise not only on an overall macro level but also on the micro level:
“We have unique offerings, for example, detailed design of the pipework, including the stress calculations and the use of heat pumps utilising industrial waste heat sources. The latter is more carbon efficient than the usual source of heat for district energy schemes in the UK – from combined heat and power plants (CHP),” says Crispin Matson.

At the same time, planning must bind the strategic level (the government’s goal) and the engineering details (the technical potential) together.

Ramboll is already planning district heating around Wembley Stadium (photo), where more than 5,000 homes are being connected to the network – one of the biggest projects in the country since the London 2012 Olympics.

Technical Manager Johan Liebenberg from the development and investment company Quintain says that he is “very happy to bring Danish district heating expertise to Wembley Park”.

“In particular, Ramboll’s expertise and experience in district heating pipework design detail has been essential in coordinating this service through the complex web of utilities that surround the National Stadium,” Johan Liebenberg says.

**Going underground**

Another big assignment has been the feasibility study and the design and network needed to connect over 15,000 homes on the Greenwich Peninsula in East London – a network that will eventually save over 20,000 tonnes of carbon dioxide per annum.

In addition, in a pioneering project from next year Ramboll will be capturing the waste heat from a Northern Line Underground shaft in Islington, using heat pumps to “upgrade” the heat from 18-28 degrees Celsius to approximately 80 degrees – enabling another 500 homes to be connected to this central London district heating system.

A report commissioned by the Greater London Authorities has found that enough heat is wasted in London to meet 70% of the city’s heating needs. London is inherently the place with the biggest potential in the UK, and the mayor has included district heating in a lot of planning schemes. But there are also projects in other big cities. Ramboll has, for example, built a whole new network in the centre of Sheffield.

The UK government has been cutting down on other plans and projects that lower carbon, but has scaled up the district heating schemes, not least because of their cost-effectiveness. The current plan is to increase the percentage of buildings connected to district heating from two to 18-20 before 2030.”
More and more countries, regions and cities are making energy strategies. That’s a complex planning task, especially if the goal is to be fossil-free and cost-efficient.

By Michael Rothenborg
output – and what is technically possible. This requires planning that combines and optimises these two factors.

**District heating with storage**

Ramboll recently conducted a study for the Danish Ministry of Energy, Utilities and Climate on the possible challenges and barriers to establishing a smart energy system in Denmark and potential solutions to them.

The main recommendation is to electrify the entire Danish energy system in order to reach the goal of being a fossil-free society by 2050. “This would, for example, allow surplus wind power to be put into big heating pumps and thus used in the heating system,” explains Morten Pedersen, Ramboll’s Project Manager on the study.

A smart energy system that relies on fluctuating energy sources such as wind and solar power requires new, flexible energy usage and storage solutions. In turn this requires meticulous, long-term planning.

The study recommends exploiting the already extensive district heating system as a cost-effective means of using and storing energy from electricity, rather than investing in new transmission lines to other countries.

**Carbon-free cities**

Also at the urban and regional levels, efficient energy management depends on there being a strategy for producing and utilising energy in place.

Copenhagen has a layout that favours public transport and an extensive district heating network, so the target – to become CO2 neutral by the year 2025 – is arguably within reach if energy efficiency is improved and the share of renewables increased.

In Norway, the City of Oslo aims to halve its fossil fuel emissions by 2030 and become fossil-free by 2050 in a strategy that Ramboll has also helped to develop. Here, as elsewhere, the transition requires major investment, but investment that is cost-efficient seen over decades.

**We have to connect the different sources and consumption areas better.**

Brian Vad Mathiesen
Professor, Energy Planning
Aalborg University

The large scale of a city can be used as an advantage to integrate renewable energy. District heating and cooling systems are built where it is economically advantageous while production, conversion and storage facilities can be placed in areas that are suitable for them. By doing this we can improve the synergy between gas, district heating and cooling, waste, biomass and waste water – from both an environmental and an economic point of view.
The price of offshore wind energy is falling rapidly, but onshore wind is generally still cheaper – at times even competitive with coal.

Thus, several forecasts show that the growth potential of onshore wind continues to be great. The International Energy Agency (IEA), for example, predicts an almost 40% increase in just four years, from 433 GW in 2016 to 602 GW in 2020. Growth will be strongest in developing countries, but even in a relatively mature market like Europe, the increase will exceed 20%, from 141 GW to 170 GW.

However, planning onshore wind farms is increasingly challenging. Smart energy systems are necessary to optimise wind energy use (as described on pages 22-23). And optimising wind farm construction is also far from easy.

Legislation and the surrounding environment form a multi-faceted net of political, ecological and socioeconomic boundaries.

“In many EU Member States wind farms face regulatory challenges,” says Benjamin Wilhelm, spokesperson of WindEurope – formerly the European Wind Energy Association:

“In Southern Germany, for instance, the distance between a wind turbine and residential areas must be at least 10 times the tip height. And in the UK, developers face tip height restrictions and cannot build structures taller than 125 metres,” he continues.

Local ownership and collaboration
According to Benjamin Wilhelm, a closer collaboration between governments, citizens and the wind industry helps optimise the planning and produce the best technical solutions.
Stefan Chun, General Manager at Ramboll Energy, agrees.

“Involving the local community is crucial in the planning of onshore wind power and is something that hasn’t been done in the past,” says Stefan Chun. “Making the local community a part of the development process raises awareness about the planning process and fosters ownership and collaboration.”

Other physical challenges also need to be addressed: Environmental assessments now encompass not only wind and groundwater assessments but also geophysical and geotechnical analyses.

In addition, when developing a complete wind power system, planners must address the design of aerodynamic blades, hubs, controls, supporting structures and the foundation. Further questions arise when road infrastructure and health and safety at the construction site are added to the equation.

**WIND ENERGY IN NUMBERS**

10.4% of Europe’s electricity demand was covered by wind power in 2016.

14.9% of Europe’s electricity demand will be covered by wind power in 2020 (12% onshore and 2.9% offshore).*

EUR 27.5 billion was invested in wind energy development in 2016 (5% more than the total investment in 2015).

51% of total power capacity installations in 2016 were wind power.

Source: WindEurope, World Wind Energy Association

* Note: These figures might underestimate growth, because the forecasts did not foresee the dramatic price decreases in the second half of 2016 and first half of 2017.

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**AN ONSHORE WINDFARM IS NOT AN ISLAND**

When an onshore wind farm is built factors such as landscape, vegetation, groundwater, wind and soil conditions have to be considered, along with legislation, road infrastructure, distance to housing, construction site safety and connectivity to the electricity grid.
Europe has one of the best-functioning energy markets in the world, yet some gaps need to be filled to secure energy supply. One of the biggest is getting Norwegian gas through Denmark to Poland.

By Michael Rothenborg

"We are building missing energy links; we are uniting markets, we are improving security of supply and increasing competition by providing alternative supply channels. But more importantly we are ending the energy isolation of Member States."

These were the words of European Commission President Jean-Claude Juncker at the signing ceremony of the ‘Balticconnector’ pipeline with the Estonian and Finnish Prime Ministers in October 2016.

The Balticconnector is an offshore gas transportation pipeline about 81 km (50 miles) long interconnecting the Finnish and Estonian distribution networks. But the Baltic Pipe is an even more important step in the plan to strengthen European energy market resilience and is thus an EU project of common interest.

Natural gas – the most climate-friendly of the fossil fuels – represents around a quarter of the EU’s overall energy consumption. As gas demand is projected to remain relatively stable, supply security has moved up on the EU’s foreign policy agenda.

The Baltic Pipe aims at creating a new supply corridor in the European gas market and will for the first time enable shippers to transport gas directly from Norway via Denmark to the markets in Poland and neighbouring countries like Lithuania and the Czech Republic.

Moreover, shippers will be able to transport gas bi-directionally from Poland to the Danish-Swedish market, thus improving Denmark’s and Sweden’s security of gas supply.

Credible cost-benefit analyses
Ramboll recently performed a feasibility study for the Baltic Pipe in a joint venture with local partners Gazoprojekt and Ernst & Young, thoroughly assessing the project’s socioeconomic, financial and technical feasibility. The study rated the various technical alternatives and proposed a market model that will ensure Baltic Pipe capacity is used more efficiently.
Ramboll brought its broad experience from pipeline design, its understanding of the challenges associated with gas interconnectors between countries and, last but not least, its history of energy planning around the Baltic Sea, starting back in the 1980s.

“One of the main reasons our team was chosen was because our cost-benefit analyses had very low uncertainty, thus giving policy-makers a sound and unbiased decision-making basis,” explains Senior Director Per Jørgensen of Ramboll Oil & Gas.

A significant step
The Danish energinet.dk confirms that the Ramboll team was selected for its high-quality analyses:

“Establishing the viability of the project is a significant step towards a common goal of providing affordable, secure and sustainable energy to the citizens of the Nordic and Central Eastern European community,” says Sofie Leweson, Project Manager, energinet.dk.

Energy and environmental experts from Ramboll are involved in, for example, the concept study for the offshore gas pipeline and an environmental impact assessment that will determine optimal landing points and potential sites for a gas compressor station on the Zealand coast.

Ramboll has offices in all three countries concerned – Poland, Denmark and Norway. The Baltic Pipe is expected to be completed by 2022.

“Establishing the viability of the project is a significant step towards the common goal.”

Sofie Leweson
Project Manager, energinet.dk
LIVEABILITY IN EXTREME CONDITIONS

Scientists and operational staff from the British Antarctic Survey (BAS) are at work delivering frontier science that affects us all. Alongside them are Ramboll engineers and consultants, who are preparing masterplans for development at two research stations.

By Eleanor Fox and Michael Rothenborg
Working in the Antarctic is like working nowhere else on earth. It requires extraordinary planning and insight into this unique environment. Attention to detail is vital, because even small things can make a big difference.

That is clear as the modernisation programme to upgrade BAS research stations and infrastructure gets underway in preparation for one of the world’s most advanced polar research ships - the RRS Sir David Attenborough. Two BAS research stations are being redeveloped with masterplans to accommodate the larger vessel and its cargo tender and improve station efficiency and liveability for station personnel.

During the harshest weather, snow accumulating alongside buildings can reach upwards of 5 metres...
at the largest research facility, Rothera. As such, reducing snow clearance has been a key driver of the masterplan that will improve the wellbeing of and environment for station staff. Furthermore, the new plan links the marine facility to the Bonner laboratory, creating a seamless sea-to-land transition for the scientists and divers.

Contrasting needs
Conversely, Signy is one of BAS’s smaller stations, accommodating up to 12 people in four buildings. Ramboll has carried out a liveability study to understand daily life at these small stations.

The concept of liveability is concerned with how well each base supports the wellbeing of its community - physically, socially and culturally - while remaining sensitive to the environment and protecting natural resources.

Kate Bunting, principal consultant at Ramboll UK, explains:

“Community is so important here, because the teams are so isolated. We’ve identified the contrasting needs of those who spend most of their days outside and those who spend most time inside, and we found that the proximity of living and working quarters needs careful planning. This will help base personnel and scientists maintain a clear distinction between the working day and their own time.”

David Season, project manager from BAS, explains that Ramboll was chosen not only because of the company’s “multi-disciplinary expertise and global engineering skills but also because its cultural values and teamwork were a good alignment with the way we work at BAS. This is an important factor in a working environment as challenging as the Antarctic.”

For more information visit www.bas.ac.uk
Here’s a paradox: When cities strive to solve congestion problems, the problems only worsen while the cities try to solve them. Repairing a road or a railway usually means shutting it down – fully or partially – causing even more congestion for months or even years.

This is why rail and road authorities the world over are increasingly demanding that daily traffic must continue to flow while existing infrastructure is upgraded.

Three cases from Europe’s most congested city, London, show that such smooth operations are possible.

When Langdon Park Station on the Docklands Light Railway needed to be upgraded as a central part of a regeneration plan, precast and prefabricated elements were constructed to fit around the existing train line and thus keep the station operating throughout the project.

Designing the platforms, a new footbridge and the lifts required careful planning and 3D modelling to ensure the geometric fit of the different elements. To reduce the foundation works, engineers modified the footbridge at an early stage, thus saving substantially on steelwork tonnage.

Ramboll is also involved in a similar, still ongoing rail project, the Bermondsey Dive Under – a key component of the Thameslink project to make London Bridge station more accessible, reduce congestion and increase passenger capacity by 50%.

The dive-under project involves untangling the old track on the approaches to London Bridge, the key technical challenges of which are to develop designs that minimise disruption to the live railway and coordinate with the existing structures.

Yet another example is the refurbishment of the Hammersmith Flyover, a vital link in West London, carrying over 70,000 vehicles per day.

The post-tensioning system had suffered significant erosion that threatened to close the flyover unless the system was repaired. This is probably the first time an all-new, pre-stressing system has been installed in a bridge where the original could not be removed. Here too, planning and 3D scanning eliminated programme and safety risks, speeding up repairs and thus minimising disruption to the public.

Managing Director Paul Bottomley from the post-tensioning sub-contractor Freyssinet calls the work in this complex, EUR 130-million programme unique:

“Fully replacing all the old post-tensioning without first removing it on such a significant structure is truly impressive,” he says.

SMOOTH OPERATOR

People need to keep moving when transport infrastructure is being repaired.

By Michael Rothenborg
SAFER TRAIN STATIONS WITH 3D TECHNOLOGY

Computational fluid dynamics (CFD) measures wind pressure at railway stations, ensuring passengers are not knocked off their feet. It can save time and money too.

By Michael Rothenborg

Had Holmestrand Station been completed according to its initial design, passengers would have literally been blown away. Trains passing through the Norwegian mountain where the station is located can reach speeds of over 150 km/h – meaning a wind pressure of 15 metres per second in the access tunnel, which makes it very difficult for someone to stand upright.

Ramboll discovered this using CFD as a planning tool. And this is just one of many examples of how this 3D technology can significantly benefit clients and society in general.

“Just as meteorologists can predict the weather, we can use CFD to predict how the wind will blow, how smoke will move and what happens when a train passes into and out of a tunnel,” explains Jens Christian Bennetsen, Senior Project Manager at Ramboll Transport.

He has worked with CFD for over 20 years, initially on projects with building interiors where the technology helped to dimension ventilation...
systems and optimise fire safety. This gradually extended to other areas like urban planning in Hong Kong and baseball stadiums in the USA. For well over 10 years, the technology has been a fellow passenger on some of the most advanced railway and high-speed train projects in the Nordics.

A wind-proof station
“CFD determines how physical things operate without anyone having to build them,” explains Jens Christian Bennetsen. “We can base the design on facts and optimise it to make it cheaper, while also more accurately taking into account security requirements from authorities, price requirements from operators and other factors. This also helps prevent unnecessary costs after commissioning because the design requires less adaptation than usual. This reduces the project risk.”

In Norway, Ramboll proposed enclosing Holmestrand station and the access tunnel with a wind-proof lock with two doors at each end. When the station opened to the public in November 2016, it was free of wind pressure problems. And the stakeholders were impressed: “Never before have we built a station inside a mountain with trains running at such high speeds,” said Knut Edmund Knutsen, Project Manager at Jernbaneverket to the Norwegian industry magazine Byggeindustrien.

Ramboll is working on a similar project in Sweden, where the new Barkeby station is also located in a tunnel. Ramboll experts have recommended designing platform screen doors to protect passengers from wind and to improve ventilation.

More precise measurements
CFD is also becoming more relevant in Denmark, which is phasing in high-speed trains. Ramboll has examined all the small tunnels on the new railway line between Copenhagen and Ringsted, part of the Fehmarn Belt fixed link project to connect Denmark and Germany, and has also done calculations on a tunnel under Vejle Fjord. The findings from these projects show that the more precise calculations enabled by CFD open the possibility of building narrower tunnels.

“Without CFD you often act conservatively, making the diameter of the tunnel larger – too large, in fact – and thus putting more concrete in the tunnel. With CFD, we get detailed insight and data that can save time and money on these parameters,” Jens Christian Bennetsen points out.

While CFD calculations obviously come at a cost, they pay off in the long run, especially when combined with high-performance computing. These aerodynamic analyses often provide insights that can be used in a number of other areas. At Holmestrand Station, for example, Ramboll and Jernbaneverket obtained knowledge about not only the wind pressure in the tunnel but also ventilation and antifreeze precautions.

“CFD can find the optimal balance between laws, rules and requirements, on the one hand, and the operator’s demand for value-for-money on the other,” says Jens Christian Bennetsen.

"CFD determines how physical things operate without anyone having to build them."

Jens Chr. Bennetsen
Senior Project Manager, Ramboll Transport
LET’S PLAY THE WORLD BETTER USING VIRTUAL REALITY

The new Children’s Universe in Grindsted, Denmark, saves money while easing life for city planners, parents and other citizens by merging four centres into one.

Guided by the slogan “Let’s play the world better”, Billund municipality has joined forces with the LEGO Foundation to realise a vision to become Denmark’s Capital of Children.

In Grindsted, the largest town in Billund, the municipality’s vision has resulted in a strategy to centralise all the town’s current daycare centres into two big, integrated institutions. The last to be built – the Children’s Universe in southern Grindsted – will offer new, modern facilities for the local children and ease life for their parents by merging four centres into one located in a town area with less traffic. The economies of scale obtained will also save money.

Users have been highly involved in the planning process, having participated in more than 20 meetings and workshops with institution staff.

“We try to avoid buildings that are pedagogically dysfunctional by engaging users as much as possible in the process. I trust that the many workshops undertaken in this project will result in long-term solutions and happy end-users,” says Mona Frederiksen, Project Manager at Billund municipality.
The institution will serve as a reference building for the municipality, as the design integrates functionality and architecture with the special pedagogical needs of each section - all of which coalesce to become a coherent and inspiring children’s universe.

**Macro-buildings, micro-design**
Mona Frederiksen also highlights the use of digital technologies as one of the municipality’s project requirements:

“The use of 3D models ensures that we can spend more money on optimising the building and buying quality materials instead of spending it on detecting and correcting errors. The visual representations also make it easier to match all parties’ expectations,” she says.

While buildings are generally getting bigger, design planning is ‘getting smaller’ as 3D technologies allow an unprecedented level of detail to be considered early in the design process. The same goes for Children’s Universe Grindsted South:

“The building information modelling, or BIM, process has been extremely detailed. We even painted the walls in our 3D programs, so we could calculate the exact amount of paint needed for this project,” says Morten Sparvath Thomassen, Head of Department at Ramboll’s Architecture & Integrated Design unit. Ramboll is the Nordics’ biggest employer of architects.

**Easier collaboration**
These micro-level calculations make collaborating with painters, bricklayers and carpenters much simpler, as their fees and the amount of materials to be purchased can be extrapolated from the model. Using 3D BIM, architects and engineers can virtually enter buildings while designing them, thus enabling them to make modifications much faster and reducing the risk of error. During the construction phase, the model can generate time schedules for each phase of the process and gather all important information in one device.

Digital tools place new, exacting demands on the way architects and engineers collaborate. However, engineers and architects have the opportunity to work on the same model from day one, a potential not possible with the traditional approach where the work process is divided into separate phases.

In other words, virtual reality and 3D technologies not only allow us to “play the world better” by creating cheaper, faster and safer buildings – they are also game changers that enable a new, dynamic form of planning and collaboration.

“**We try to avoid buildings that are pedagogically dysfunctional by engaging users as much as possible in the process.**

Mona Frederiksen
Project Manager, Billund municipality
From the Oresund Bridge between Sweden and Denmark, to the Hong Kong-Macau link, new bridges create significant opportunities for business, populations and prosperity.

Apart from creating impressive engineering infrastructure, bridges play a vital role in developing regional economies through growth, improved travel time for commuters and more efficient distribution of goods and services.

According to an OECD study, the Oresund Bridge, for example, has been instrumental in driving economic growth and increased business cooperation in the Oresund area, while it is estimated that since its opening in 2000, the bridge has injected more than EUR 4 billion into the Danish economy.

Relieving congestion
The Queensferry Crossing, nearing completion over a 2.7 kilometre-wide section of the River Forth in Scotland, is a valuable addition to one of the most vital transport corridors in Scotland. The bridge will relieve increasing congestion on the existing Forth Road Bridge, which was designed to carry up to 11 million vehicles a year but is currently crossed by 24 million.

Ramboll has worked closely with the main contractor FCBC and the project client
Transport Scotland to design the bridge, improve the surrounding road networks and bridge approaches, as well as to integrate smart motorway technology for the first time. This technology utilises overhead gantries that provide lane and speed control – as well as informing motorists about traffic and congestion – to improve traffic flow, reduce congestion and improve road safety.

The design of the connecting roads is the result of a lengthy development process that included extensive consultation with local communities and other stakeholders and will provide a major improvement to the trunk road network in the east of Scotland, as well as resulting in less impact on the environment, properties and communities.

Public transport users will also greatly benefit, as once the Queensferry Crossing is completed, the existing Forth Road Bridge will be maintained as a dedicated public transport corridor that will increase capacity and make journey times more reliable.

“Queensferry is more than just a bridge,” says Design Joint Venture Project Director Peter Curran from Ramboll UK. “It forms an essential part of the strategic road corridor to the eastern side of Scotland, and is vital for the economic wellbeing of the area.”

**QUEENSFERRY CROSSING FACTS AND FIGURES**

- It is the UK’s tallest bridge and the world’s longest three-tower cable-stayed bridge.
- The design is a result of more than 20,000 production drawings.
- It is 210 metres above water level (at high tide), equivalent to about 48 double-decker buses stacked on top of each other.
- There are 37,000 kilometres of cabling – nearly enough to span the circumference of Earth.
- The bridge deck weighs a total of 35,000 tonnes, the equivalent of 80 Boeing 747s.
- The cables can be replaced as part of normal maintenance works without closing the bridge.
An integral part of modern life, chemicals are used in a wide variety of products. However, the traditional model for selling chemicals is based on a conflict of interests. Suppliers sell them in bulk, aiming to sell as much as possible because, as every salesman knows, the more you sell, the more you earn. On the other side, the buyers of the chemicals want to use as little as possible. Not only does this model reward the inefficient use of chemicals, it can also cause environmental hazards and compromise human safety.

Chemical leasing turns this model upside down. Instead of selling chemicals by volume (such as litres or tonnes), suppliers provide a value-added service to users, who then pay only for the service rendered – for example, the number of parts painted or the amount of water treated. In this way, both parties have a commercial and economic interest to do the job using the fewest chemicals possible.

This is a win-win situation. It increases the efficient use of chemicals because both supplier and user collaborate to lower the amounts for both. It also improves the economic and environmental performance of companies, and reduces human health risks brought about by the use of chemicals.

**A unique opportunity**
The United Nations Industrial Development Organization (UNIDO), together with the Austrian government, introduced the chemical leasing concept in 2005, and late last year Ramboll was present at the signing of an international joint declaration on chemical leasing.

Ramboll’s unique offering provides a wide range of managerial and consultancy services for companies wishing to use the leasing concept. For instance, we ensure that they meet all the appropriate sustainability criteria for chemical leasing and subsequently provide the relevant certification; this certification is similar to the ISO standards such as the 14,000 family that measures environmental responsibility.

We also use our broad consulting experience to advise clients and support them with market studies, contracts, environmental assessments and so on. For example, we have recently advised Safechem, a German subsidiary of Dow, on the implementation of its leasing model, which helps clients with cost transparency and economic value.

By utilising this approach, Ramboll is helping transform an outdated business model, marking a paradigm shift from the selling of chemical goods to the delivery of chemical services that will ultimately lead to more efficient use of chemicals. If we are to ensure a sustainable future, then sustainable chemical management is vital. Chemical leasing is the answer.

**GOOD CHEMISTRY**
CHEMICAL LEASING IS GOOD FOR BUSINESS AND THE ENVIRONMENT

By Reinhard Joas
Managing Principal, Ramboll

**SUBSTANTIAL BENEFITS**
According to a UNIDO study, chemical leasing can provide companies with substantial economic and environmental benefits. In the industrial cleaning sector, for example, companies that consume more than 2.6 million tonnes of chemicals per year could save up to 1.2 million tonnes of solvents and cleaning agents.

The study also suggests that some companies could potentially see a reduction of waste and emissions by more than 100,000 tonnes per year, as well as energy savings of at least 300,000 tonnes of CO2 equivalents. There are also significant health benefits for workers due to reduced exposure.
YOU CAN’T REALLY REFURBISH a production facility without taking the existing process elements out, can you?

Well, you can if you have to. And Ramboll had to when we were asked to design the refurbishment of a Novo Nordisk facility in Bagsværd, north of Copenhagen. The facility carries out the initial recovery of multiple biopharmaceutical fermentation products.

“The scope of this refurbishment was very unusual, but quite clear: to cut, carve and adapt existing structures and building services without disturbing or removing the process elements within the facility,” explains Nick Bernabe, Project Director of Ramboll’s Pharma division.

“This was a first. And it really took some careful planning by Ramboll, Novo Nordisk and partners like the engineering consultancy Jacobs,” he adds.

The purpose of the refurbishment was to make the new classified processing areas suitable for manufacturing products under conditions that meet today’s requirements. Time was the key driver, and by adhering to an ultra-tight schedule, the design team was able to keep the shutdown period to a minimum, thereby ensuring that Novo Nordisk could re-start production as soon as possible.

“Thus, we had to keep the vessels, centrifuges, homogenisers, pipes and other delicate process equipment in there and cover them while working around them with almost surgical precision in a very small area,” Nick Bernabe explains.

One of the most difficult tasks was making room for new pipes in the existing floor – without damaging the ribs in the slab and risking the floor’s collapsing. So, Ramboll basically X-rayed the floor with ground-penetrating radar, thus identifying the positions where the voids in the slab could be penetrated – without new ones being made in the ribs.

Another big challenge was the new requirements regarding the risk of explosion or toxic gas and cross-contamination between rooms.

These called for a new pressure regime and an incorporated control system for the new airlocks separating the different areas. This, in turn, demanded that the ventilation system be upgraded, giving rise to another ‘surgical’ procedure to get the upgraded version to fit precisely within the existing plant room.

Ramboll used its Fast Track Model – a strategy where construction commences before the design is completed and where the number of sequential relationships are reduced and replaced with parallel relationships.

“But we couldn’t have delivered on time without constant brainstorming with the client and the other consultants involved or the will to work after hours and at weekends,” Nick Bernabe stresses.
CITIES HAVE ENERGY
(WHEN IDEAS HAVE POWER)

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