

# THIS IS COWI



COWI

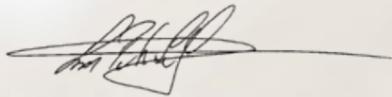
## LET'S SHAPE A SUSTAINABLE AND LIVEABLE WORLD TOGETHER

More than half of the world's population are living in urban areas. By 2050, that number is predicted to rise to 68%, adding another 2.5 billion people to cities all over the world. This puts an enormous pressure on transport systems, building stock, natural resources and the environment. Add climate change, and you have a cocktail of megatrends that cry out for intelligent solutions.

At COWI, we are dedicated to delivering answers to these pressing needs. Working in teams across disciplines, geographies, gender and culture, we provide solutions within infrastructure, buildings, environment, water, energy, industry and planning. Combining our world-class expertise and experience globally and locally, we help societies move forward.

Like many engineers, I am motivated by solving problems. Together with my skilled colleagues, COWI strives to bring about long-term solutions to the benefit of people, business, society and the environment.

Lars-Peter Søbye  
President, CEO



# HARVESTING THE POWER OF WIND

## LONDON ARRAY, UNITED KINGDOM

Covering 100 km<sup>2</sup>, the London Array comprises 175 massive turbines and two substations laid out in neat rows like a vast plantation of mechanical palm trees. It produces up to 630 megawatts of electricity – enough power for more than half a million homes a year.

Great variations in the sea bed were among the major challenges when designing London Array, requiring unique solutions for every foundation and position of the wind turbines. Gigantic steel structures made of cylindrical steel tubes were driven into the seabed – 5.7 meters wide, up to 100 metres tall and weighing as much as 1,000 tonnes in total.

To provide innovative solutions, while having the necessary control measures in place, COWI created COPILOD – a complex software platform that incorporates the latest design knowledge, stores all design information and compiles data and drawings. The tool enabled a five time faster production of the foundation design, reducing resources and costs by up to 80%.

This vast wind farm symbolises the increasing focus on renewable energy sources in the world. At the same time, the offshore wind industry is changing. No longer being highly subsidised, the industry's levelised cost of energy (LCOE) must be reduced, even as projects become more complex.

### FACTS

Location: North Sea

Year: 2009-2011

Client: Aarsleff Bilfinger Berger  
Joint Venture

### COWI SERVICES:

- › Structural design
- › Geotechnical design
- › Hydraulic calculations
- › FEM (finite element method) analysis.

# BUILDING THE WORLD'S MOST SUSTAINABLE AIRPORT

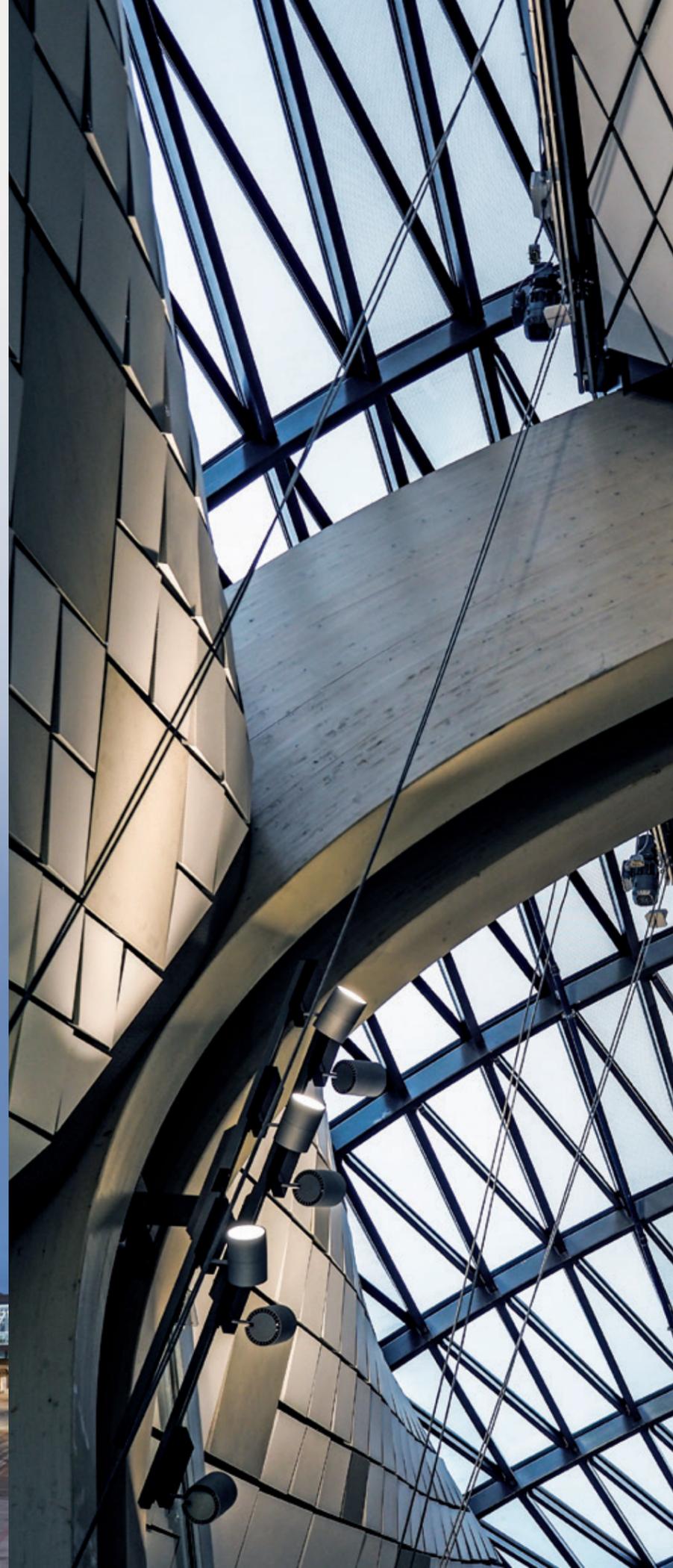
## OSLO AIRPORT GARDERMOEN EXTENSION, NORWAY

Back in 1998, Norway's main international airport was built to handle 17 million passengers a year. However, already in 2001, the number had reached 21 million. Together with Avinor and the project group TEAM-T, COWI added one more pier and extended the central terminal with one clear aim; to double the airport's capacity while leaving a minimal environmental footprint.

The oval design of the pier optimises energy usage due to its ability to turn its back towards the sun in the summer and holding its warmth in the winter. At the same time, the oval shape enables the same thickness of insulation to be used across the roof and down each side, ensuring high-level insulation throughout the building.

A new ventilation system reclaims 85% of the building's energy, and glass with exceptional insulation qualities reduces energy loss. In the summer, melting water from snow pools is used for cooling and treated sewage from a local treatment plant heats the terminal in the winter.

Growing from 148,000 m<sup>2</sup> to 265,000 m<sup>2</sup>, the new T2 terminal is effectively Norway's largest room with a capacity of 32 million travellers. By integrating sustainable solutions from the start, Gardermoen airport sets new standards for energy-efficient airports.



### FACTS

Location: Oslo, Norway

Year: 2009-ongoing

Client: Avinor

### COWI SERVICES:

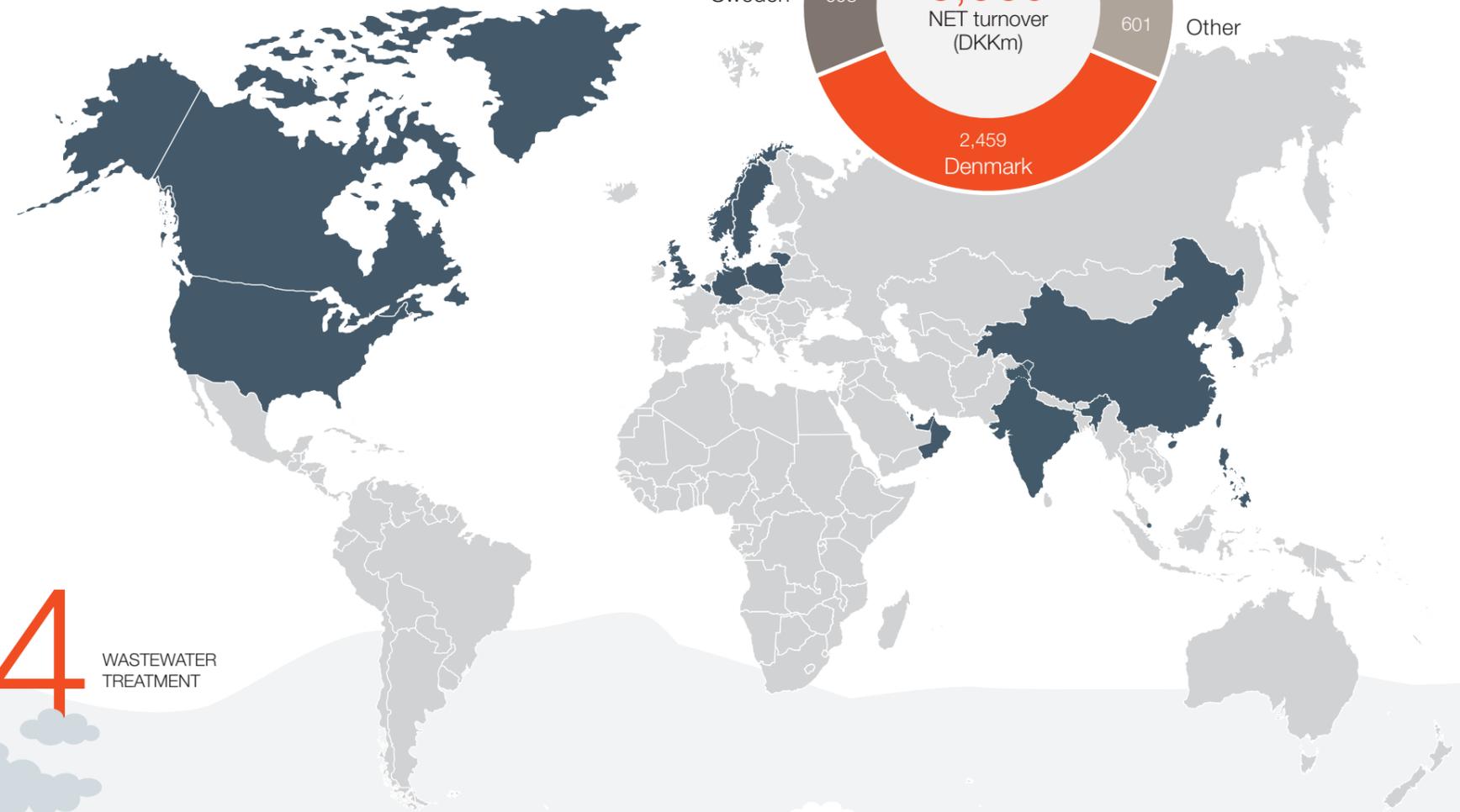
- › Energy
- › IT systems
- › Fire safety
- › Acoustics
- › HSE (health, safety and environment) and risk and vulnerability analysis
- › Outdoor and indoor environment
- › HVAC (heating, ventilation, and air conditioning).

# COWI AT A GLANCE

COWI is a leading consulting group that creates value for customers, people and society through our unique 360° approach. Based on our world-class competencies within engineering, economics and environmental science, we tackle challenges from many vantage points to create coherent solutions for our customers.

With offices all over the world, we combine global presence with local knowledge to take on projects anywhere in the world – no matter how large or small. At any given moment, we are involved in **more than 9,000 projects**.

We have more than **90 years of experience** in the business, and COWI is a leader within its field because our **6,800 employees** are leaders within theirs. Together, we create coherence in tomorrow's sustainable societies.



## TOP RANKINGS IN ENGINEERING SOLUTIONS

Source: Engineering News-Record (ENR) Global Sourcebook

No. **14** WASTEWATER TREATMENT

No. **3** BRIDGES

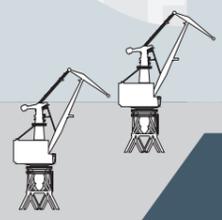
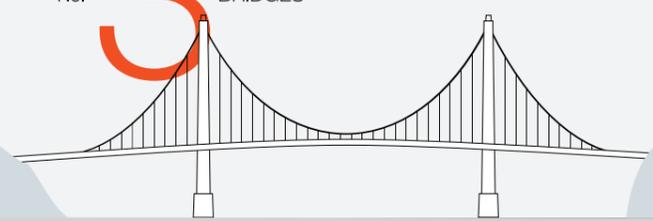
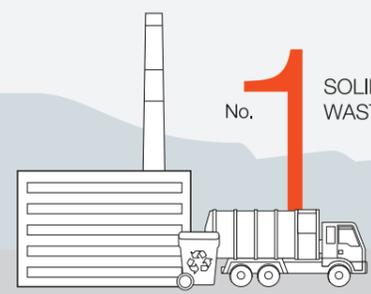
No. **1** SOLID WASTE

No. **6** WIND GENERATION

No. **11** MASS TRANSIT

No. **39** OUT OF THE TOP 150 GLOBAL DESIGN FIRMS BY TURNOVER

No. **5** MARINE AND PORT FACILITIES



## ØYSTEIN: DESIGNING THE URBAN FUTURE

Since Øystein Berge joined COWI's office in Oslo in 2013, he has contributed to our technical consultancy services with his expertise in humanities and economics. Øystein holds a master's degree in economics, and together with his studies in social anthropology, history and philosophy, Øystein has a set of skills that meets the growing demand among urban planners to understand the development of liveable cities.

"In COWI, we try to move society in the right direction. We do our best to come up with smart solutions to the key challenges of our time. We wish to promote and enhance the benefits of urban life," says Øystein.

Among recent projects, Øystein has worked on the design of a new sustainable city from scratch; the Sollihøgda Plus City – an ambitious environmental laboratory for smart urban development with autonomous buses, elements of shared economy and sustainable energy solutions.

Privately, Øystein is enjoying the city life in Oslo with his two children. They live just 200 metres from the kids' school and 600 metres from the COWI office. They do not own a car, as Oslo has developed alternatives that make urban life with children convenient even without private cars. Instead they walk, use public transport and, when necessary, car-pool.

"I'm very lucky to be able to live a modern life with the advantages modern technology and organising provide. It shows that it's possible to solve many infrastructure and environmental issues by reducing the need for privately owned cars. This can be done by better city planning. A shift away from private cars will obviously give us a greener city, but the increased density will also lead to co-effects such as higher productivity and wealth," says Øystein.



# GREENER TRANSPORTATION

## AARHUS LIGHT RAIL, DENMARK

Aarhus, the second largest city in Denmark, is growing both in terms of population and workplaces. To handle the increasing pressure on existing transportation infrastructure, a light rail has been established – the first of its kind in Denmark. COWI has been leading the consultancy at all project stages from early planning to final construction supervision.

The new light rail system connects Odder in the South and Grenaa in the North by converting the 98 kilometre existing rail line with diesel trains into a light rail running on electric power. A 12 kilometre light rail alignment has been established throughout the city centre. The light rail trains run at up to 100 km/h outside the city centre and up to 60 km/h inside the city.

Incorporating the light rail into constricted urban spaces and narrow streets put great demands on creating a balance between the light rail, the dense urban infrastructure and the city's existing transportation modes.

The new light rail offers the citizens of Aarhus an attractive, greener transportation option. Studies show that rail-based modes of transport receive stronger commitment from the public because of their comfort and regularity and can, when well-integrated into the city, attract at least 10% more passengers.



### FACTS

Location: Aarhus, Denmark

Year: 2000-2017

Client: Aarhus Letbane I/S

### COWI SERVICES:

- › Project and stakeholder management
- › Preliminary investigations
- › Conceptual and preliminary design of all railway disciplines
- › Environmental impact assessment (EIA) for stage 1
- › Functional requirement for transportation system
- › Tendering and contracting of all works and supplies
- › Detailed design of all civil works
- › Construction and supervision
- › Land acquisition and relocation of utilities.



# IMPROVING BIG CITY LIFE

One in eight of all urban dwellers live in the world's 33 megacities with more than 10 million people. By 2030, the number of megacities is predicted to reach 43. At the same time, the fastest growing urban areas are cities with less than one million inhabitants, standing for close to 60% of people living in cities today.

When managed well, cities can drive prosperity and human progress. However, not all cities are geared to tackle the increasing pressure on infrastructure, housing and resources following urbanisation. Adding climate change to the equation, the planning and design of our future cities do not become any easier.

To unleash the societal potential of urban life, we need to think smart and come up with intelligent solutions to complex challenges. Solutions which COWI, together with our partners and customers, are committed to developing for tomorrow's sustainable cities.

## PIONEERING URBAN PROJECTS



To prepare for Singapore's long-term needs for wastewater collection, treatment, reclamation and disposal, COWI is, in partnership with CPG Corporation, constructing the Deep Tunnel Sewerage System (DTSS) Phase 2 for PUB, Singapore's National Water Agency. The 40 kilometre deep tunnel sewers, stretching across the western part of Singapore, convey wastewater by gravity to water reclamation plants, where it is purified into ultra-clean, high-grade reclaimed water – known as NEWater – or discharged into the sea through outfalls.



In Oslo, Norway, COWI is, together with North Bridge, creating Sollihøgda Plussby – Europe's first 'plus city' that will generate more energy than it consumes. The design of the city is based on all the knowledge we possess about climate change and how to build zero-emission neighbourhoods in the future (ZEN – the Zero Emission Network). Moreover, the city has been planned with green and intelligent solutions for mobility, which should make it more attractive to choose public transport than to own a private car.



The town of Nye in Aarhus, Denmark, is an urban development project focusing on sustainability and liveability, not least in the form of visionary water and climate management. One of the main services that COWI has developed for our client, Tækker Group, is a new water system for the town. A system which has allowed the local water utility, Aarhus Vand, to develop a treatment plant which uses collected rainwater and supplies the town with secondary water for all toilets and washing machines, producing a saving in drinking water resources around 30 million litres a year.

## AMY: ENGINEERS CAN ENHANCE PEOPLE'S QUALITY OF LIFE

For as long as Amy Campbell can remember, she has had a natural curiosity about the world around her, forever trying to figure out why things are the way they are. As a child, if she was not outside building something, Amy was in her attic adding to her LEGO city. Combining her love of problem-solving and seeing things come to life, a career in civil engineering seemed like an obvious choice.

"Being an engineer, I get to work on solutions to some of society's biggest challenges", says Amy, who is currently working on the Lower Thames Crossing (LTC), a major new highway tunnel crossing the Thames east of London that will ease the commute for millions of Londoners every year.

"I discovered an interest in tunnels and tunnel engineering when I was at university and now I'm working on what will be the largest tunnel in the UK. For me, one of the best things about being a civil engineer is that, through projects like LTC, you positively contribute to society and enhance quality of life."

The LTC will provide more than 70% additional road capacity to the highly congested area, unlock major investments and create new jobs.

Though she is an engineer by training, Amy's role on LTC has been a wide-ranging project management job, giving her a deeper understanding of the complex planning process for a major infrastructure project.

"My work for COWI and my involvement on LTC has encouraged me to recognise the importance of each project phase in shaping the overall solution," Amy explains. "As engineers, we have a responsibility within each phase to challenge and influence many different aspects as we work towards the optimal solution."



# CHALLENGING THE LAWS OF PHYSICS

## AULA MEDICA, SWEDEN

No proper auditorium was built when Campus Solna took shape back in the 1930s and 40s. But thanks to a private donation in 2008, Akademiska Hus and Karolinska Institutet could initiate the design and planning of a new lecture hall facility; Aula Medica.

To make the most of the limited space, the architects at Wingårdh came up with the idea of sloping the façade 33 degrees, making each floor larger than the one below. With a top floor overhanging the perimeter of the ground floor by 23 metres, great demands were placed on the development of the design structure and choice of materials.

Aula Medica's total floor space is 12,600 m<sup>2</sup>, housing a lecture hall seating 1,000 people, where people from all over the world come to attend Nobel lectures, scientific symposiums, academic ceremonies and conferences at the new facility.

In 2014, Aula Medica was named "Building of the Year," and won the International Award of Merit in 2015. Together with Akademiska Hus, Wingårdh Arkitektkontor and the steel contractor Normek, COWI also won the Swedish Steel Structure Award in 2015.



FOTO: TORD-RIKARD SÖDERSTRÖM

### FACTS

Location: Stockholm, Sweden

Year: 2010-2012

Client: Akademiska Hus  
Stockholm

### COWI SERVICES:

- › Compiled schematic design
- › Construction drawings
- › Detailed design workshop
- › Drawings for the steel structures.

# STORY

## DESIGNING THE FUTURE SINCE 1930

Founded with a passion for knowledge, COWI has been shaping the world for almost 90 years. Established in 1930 by the 29-year old engineer Christen Ostenfeld, COWI has grown from being a small studio firm to becoming a part of the world's elite within civil engineering.

Despite our long journey, the values defining our work have remained fundamentally unchanged; integrity, respect, financial independence, professional capability and freedom guide COWI's interaction with colleagues, partners and customers.

**1931**  
NATIONAL-  
SCALA



Around the corner from Ostenfeld's office in Copenhagen, his first major assignment was a comprehensive renovation of the run-down Scala theatre. With a short deadline, Ostenfeld introduced prefabricated steel structures, which allowed the contractors to keep up the pace, even in the cold Danish winter.

**1946**  
W. JØNSON  
NEW  
PARTNER



After some busy years with growing interest in Ostenfeld's work, Wriborg W. Jønson became full partner and the company, which now had 25 employees, changed its name to "Chr. Ostenfeld & W. Jønson, Rådgivende Ingeniører". In short, COWI.

**1953**  
THE  
OSTENFELD  
SILO



One of COWI's first groundbreaking projects was the Ostenfeld Silo. Despite its huge dimensions, the walls were just 25 centimetres thick, making it significantly cheaper to build. Using prestressed concrete, the walls could bear the pressure from within and remain sealed. A choice of material which later turned out to be useful for more than just silos.

**1970**  
THE LITTLE  
BELT  
BRIDGE



In 1960, two suspension bridges at Uttamo and Pargas in Finland marked a breakthrough for the firm's bridge division, shaping the design of the first of two iconic bridges in Denmark; the Little Belt Bridge. The pylon legs rise 121 metres above sea level. At 70,000 tonnes each, the two buried anchor blocks resist 17,000 tonnes of force from the main cables.

**1998**  
THE GREAT  
BELT LINK



Tying the eastern and western part of Denmark together, the 18 kilometre Great Belt Link, with a main span of 1,624 metres, was designed to have the world's longest suspension span at the time of construction. Taking tricky aerodynamics into account, designing for large ship impact, operating road and rail, and protecting the marine environment, the Great Belt Link became a reality, breaking new ground for bridge engineering.

**2018**  
ARKITEMA  
ARCHITECTS



After 88 years as an engineering company, COWI acquired the well-reputed 50-year-old architectural firm Arkitema, adding around 550 new colleagues to the Group.

# CREATING MOBILITY IN SOUTHERN CHINA



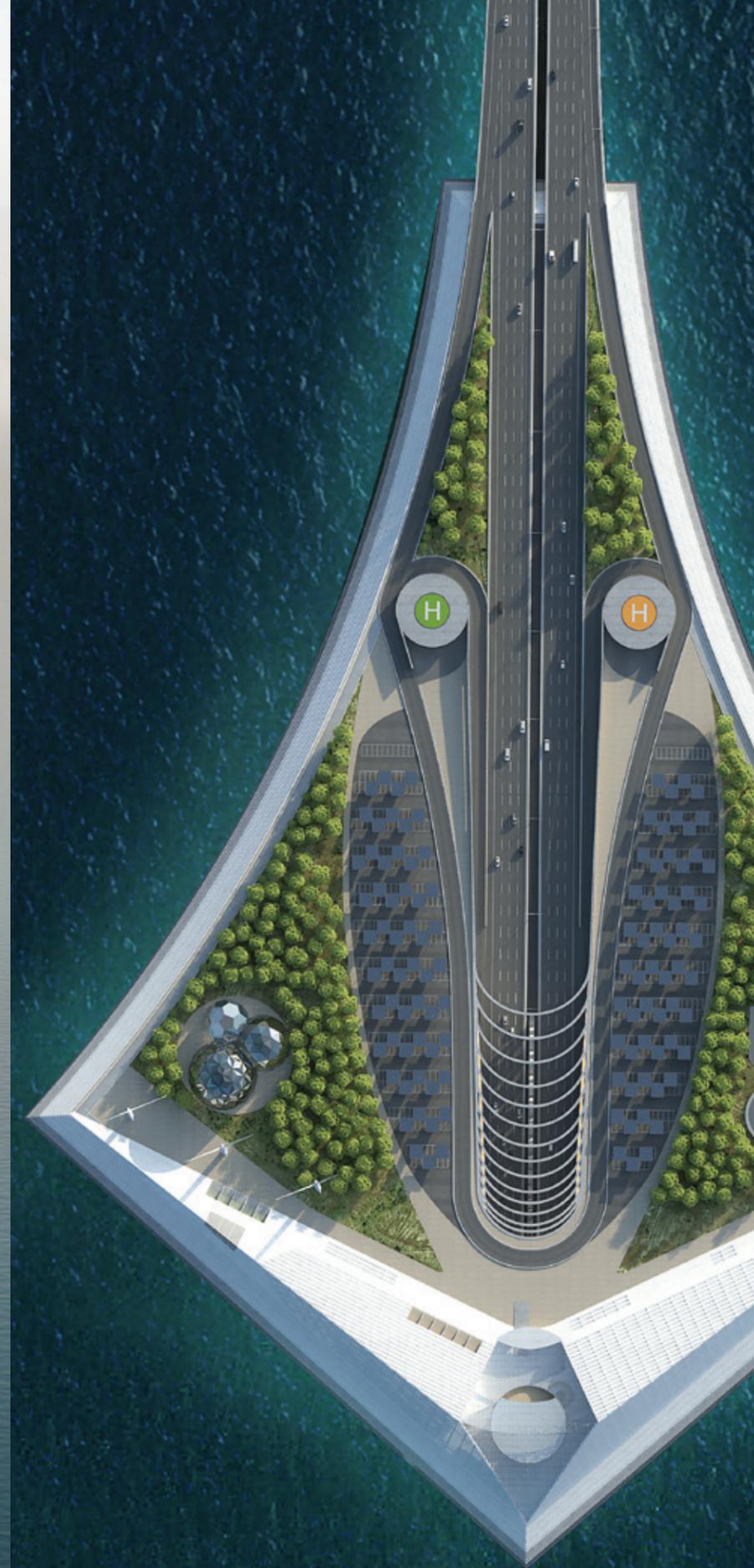
## SHENZHONG LINK, CHINA

The Pearl River Delta, in which the cities of Shenzhen and Zhongshan are situated, is one of the most densely populated areas in China where increasing urbanisation keeps on asking for infrastructure solutions. The Shenzhong Link is one of the new transport connections in between cities in the delta, creating a megacity of 50 million people.

The link will be 24 kilometres long and consist of two artificial islands, two bridges and the world's widest immersed tunnel. With eight lanes of traffic in dual directions and a capacity of 90,000 cars per day, the link will ease traffic flows in the Guangdong province as well as support growth in the entire Pearl River Delta.

For the long-span suspension bridge, the Lingding Bridge, a triangulated cable system together with a twin box concept for the bridge deck were chosen to accommodate for strong typhoon winds due to its superiority when it comes to aerodynamic stability.

A classic kite provided inspiration for the link design, which will be a significant landmark for the entire region – a design which was awarded the first prize for its high level of technical excellence and aesthetic appearance.



### FACTS

Location: Guangdong Province, China  
Year: 2015-ongoing  
Client: The Administration Center of the Shenzhong Link Project

### COWI SERVICES:

- › Concept design for the international design competition
- › Development of the winning concept into preliminary design
- › Technical consultancy and design review during development of preliminary design, detailed design and construction.

## ERIK: CREATING SOMETHING GREAT TOGETHER

Civil engineer Erik Severin is driven by the idea of creating. Currently he is the project manager on the project 'Posten'. Sitting in the project offices in Nordhavn with a stunning sea view, he and his team are determined to create something special.

"We work hard and passionately because we want something to emerge from the ground. Something we can be proud of. Sometimes the challenges seem insurmountable, but having been in this business for a long time, I know that what might seem very tough this week can be overcome next week."

Erik has been with COWI for 35 years and involved in many fascinating building and housing projects. With a father who was an architect and a brother who also works with buildings, he has always been drawn to large construction projects, feeling most at home when he gets to be close to the project at hand. This is also the reason he decided to become a project director for large construction projects and 'Posten' might turn out to be the most exciting one yet.

In total, it will span an area of 200,000 m<sup>2</sup>, consisting of offices, housing, shops, conference centre and underground parking beside the Copenhagen Central Station. It will include three office buildings up to 40 metres high, and four high-rise residential towers up to 115 metres high.

"A project like 'Posten' is special because it will play a vital role for many people's lives in the city. I think the creation of big projects draws people in, but it is also about solving complications and finishing something. Sometimes I take on projects where I really need to be the problem solver and it is always very satisfying to succeed. It is a great feeling when construction is complete and everybody is pleased."



# MAKING THE CITY MOVE

## THE COPENHAGEN METRO, DENMARK

Every hour, every day, people spend billions of hours waiting in traffic jams around the world. The problem is set to accelerate as cities are growing dramatically. By 2050, two out of three of the world's 9.8 billion people are expected to live in a city. At that time, the city of Copenhagen is predicted to reach 790,000 inhabitants – almost 200,000 more than today.

To prepare for the city's growth and kick-start the development of new urban areas, Danish authorities decided to build a metro in the capital of Copenhagen with a total number of 39 stations expected to carry more than 100 million passengers a year.

Building metro lines and stations 30-40 metres underground in between fragile Medieval buildings is not easy. To mitigate the risk of causing cracks and settlements in surrounding buildings and monuments, sensors and meticulous computers have been installed, ensuring trustworthy drilling and building.

In 2008 and 2010, the Copenhagen Metro (green and yellow lines) was named the World's Best Metro. The City Circle (blue and red lines), which is the largest construction project in Copenhagen in 400 years, opened in 2019 and adds another 17 metro stations to the network. Each of them the size of a handball court and designed in the image of the surrounding urban space and people using them.

### FACTS

Location: Copenhagen, Denmark

Year: 1994-2019

Client: Metroselskabet I/S. The company is a partnership, owned jointly by the City of Copenhagen, the Danish Government and the City of Frederiksberg.

### COWI SERVICES ON THE CITY CIRCLE LINES

- › Station design (civil works and architecture)
- › Areas and rights
- › Utility relocation
- › Alignment and tunnel design
- › Environmental aspects incl. environmental impact assessment (EIA)
- › Construction programming
- › Bill of quantities and cost estimates
- › Geotechnical, geological and hydrological surveys and investigations
- › Preparation and interpretation of seismic investigations
- › Requirements regarding operation and maintenance
- › Advice regarding authority approval, building registration, construction risk assessment.

Shaft: Ø50  
Tunnel ①  
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POWERING YOUR 360° SOLUTIONS

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