

CONTAMINATED SITES: FROM MAPPING AND INVESTIGATION TO REDEVELOPMENT OF BROWNFIELD SITES





COWI RESOURCES AND CONTAMINATED SITE MANAGEMENT

Contaminated soil and groundwater can pose a risk to human health and nature and represent important financial liabilities. A systematic approach to managing the risks and liabilities related to contaminated sites is therefore of utmost importance. For more than 35 years, we have worked on all aspects of contaminated soil and groundwater to ensure quality sustainable cost-effective solutions. We have a staff of more than 200 specialists in contaminated site management in our offices in Denmark, Norway, Sweden, Central and Eastern Europe, China and the Arabian Gulf. In addition, we have a number of trusted local partners around the world.

The scope of what we do covers a whole range of services including inventorying and mapping of contaminated sites, intrusive investigation with sampling and analysis, assessment of potential environmental risks and liabilities

of real estate, development of conceptual models, detailed design of remediation, tendering, works supervision and monitoring. We have extensive experience with remediation including advanced in situ remediation techniques such as air-sparging and vacuum extraction, thermal remediation with steam, enhanced reductive dechlorination and chemical oxidation. Finally, we have experience with handling contaminated soil and groundwater for brownfield developments and new infrastructure projects and implementing mitigated measures for risk reduction at industrial sites.

We work for private and public entities including ministries, regional and local authorities, multinational industries and project developers. We have an extensive and comprehensive list of field equipment, including a mobile soil gas laboratory and a Geoprobe MIP unit.



INVENTORIES

MAPPING AND RISK RANKING

Site inventories based on historical information provide an overview of potentially contaminated sites within a geographical area and make it possible to map and rank the sites according to the assessed risk for each site.

COWI has carried out several inventories of contaminated sites for the authorities and industrial clients using new information retrieval tools, data processing and map production techniques.

We have assisted the authorities in Denmark, Ukraine, Spain and India in mapping potentially contaminated sites, ranking the sites according to risk and developing a national plan for contaminated sites. We have also assisted private companies in assessing potential contaminated sites in the estate portfolio and advising on the environmental consequences.

SERVICES

- › Inventorying and mapping of potentially contaminated sites
- › Environmental screening
- › Historical site review
- › Risk ranking of contaminated sites
- › Environmental database and GIS management system



INVENTORY FOR CONTAMINATED SITES IN INDIA

COWI developed the first national inventory of potentially contaminated sites in India by collecting information at the state level, and identifying and assessing contaminated sites. COWI delivered a database with a GIS (GeoEnviron) for data management and soil and groundwater analysis for a selected number of sites. The sites were ranked according to the risk they pose to human health and the environment. ▾

CUSTOMER:
WB

COUNTRY:
India

NATIONAL PLAN FOR MANAGEMENT OF CONTAMINATED SITES IN UKRAINE

COWI assisted the environmental authorities in Ukraine in developing a national plan for the management of contaminated sites in the country. The contaminated sites were ranked according to the risks posed to human health and to the environment. The inventory data were incorporated in an electronic national register of contaminated sites developed as an interactive decision-making tool for site remediation planning. ▾

CUSTOMER:
DANCEE

COUNTRY:
Ukraine

NATIONAL IT MANAGEMENT SYSTEM REQUIRED FOR DANISH SOIL CONTAMINATION LAW

COWI developed an IT system to support the Danish regions' administration of legislation on contaminated soil. Compilation of the data required the retrieval of information from both internal and external data sources in the form of database registrations, journalised documents, GIS data as well as analogue data – such as old cadastre maps and road directories. ▽

CUSTOMER:
Danish Regions

COUNTRY:
Denmark



CONTAMINATED RAILWAYS IN POLAND

COWI identified, examined and carried out environmental risk assessments of more than 70 sites belonging to the Polish State Railways. The three most affected and vulnerable sites were selected and prioritised, and subsequently remediated. ▽

CUSTOMER:
Polish State Railways

COUNTRY:
Poland



INVESTIGATIONS

SOIL, GROUNDWATER AND SOIL AIR INVESTIGATION

The scope of our services includes investigation of soil, groundwater and soil air. We plan our investigations carefully for the specific purpose, whether screening during mapping, intrusive investigations for risk assessment, delineation of contamination for liability issues or as a tool for defining the design parameters for redevelopment of brown sites. We have an extensive and comprehensive list of field equipment for intrusive investigations with sampling and analysis including a mobile soil gas laboratory, field gas chromatograph with GC/MS detector and Geoprobe equipment for pore air and water measurement, e.g. MIP, HPT and MIHPT. We are also capable of taking intact soil core samples and sampling of level-specific water with Geoprobe equipment.

SERVICES

- › Intrusive soil and groundwater investigation
- › Environmental site assessment
- › Topographical survey
- › Geoprobe equipment for pore air and water measurement, e.g. MIP, HPT and MIHPT
- › Intact soil core sampling and sampling of level-specific water with Geoprobe equipment
- › Field gas chromatograph, e.g. GC/MS detector

INVESTIGATION USING FIELD LABORATORY AND GEOPROBE

COWI has developed a mobile field laboratory using a Geoprobe® system for sampling soil, groundwater and soil gas. It has various analytical equipment including a GC/MS gas chromatograph and a gas monitor for analysing contaminants. The field laboratory makes it possible to conduct in situ measuring of contamination both horizontally and vertically and to assess the extent of contamination in the field. The soil layers and contamination are continuously recorded from the time the probe hits the ground to a depth of 30-40 m or more. The system is flexible and can also be used for taking out intact and level-specific soil, groundwater and soil air samples. It is a quick and inexpensive way of mapping contamination in both the saturated and unsaturated zones and enables an investigation to be optimised. ▽

CUSTOMER:

Various clients

COUNTRY:

Various countries



INVESTIGATION AND REMEDIATION OF A MERCURY-CONTAMINATED CARBIDE FACTORY SITE.

COWI investigated the contamination from a former carbide chemical factory in the Nura River valley, Kazakhstan. The study including investigation of ash dumpsites, neutralisation ponds, wastewater collectors, wastewater treatment facilities, sludge lagoons and surrounding areas. The knowledge we had gained from our international experience in cleaning up contaminated sites and designing and operating hazardous waste landfill sites was conveyed to local stakeholders. ▾

CUSTOMER:
EBRD

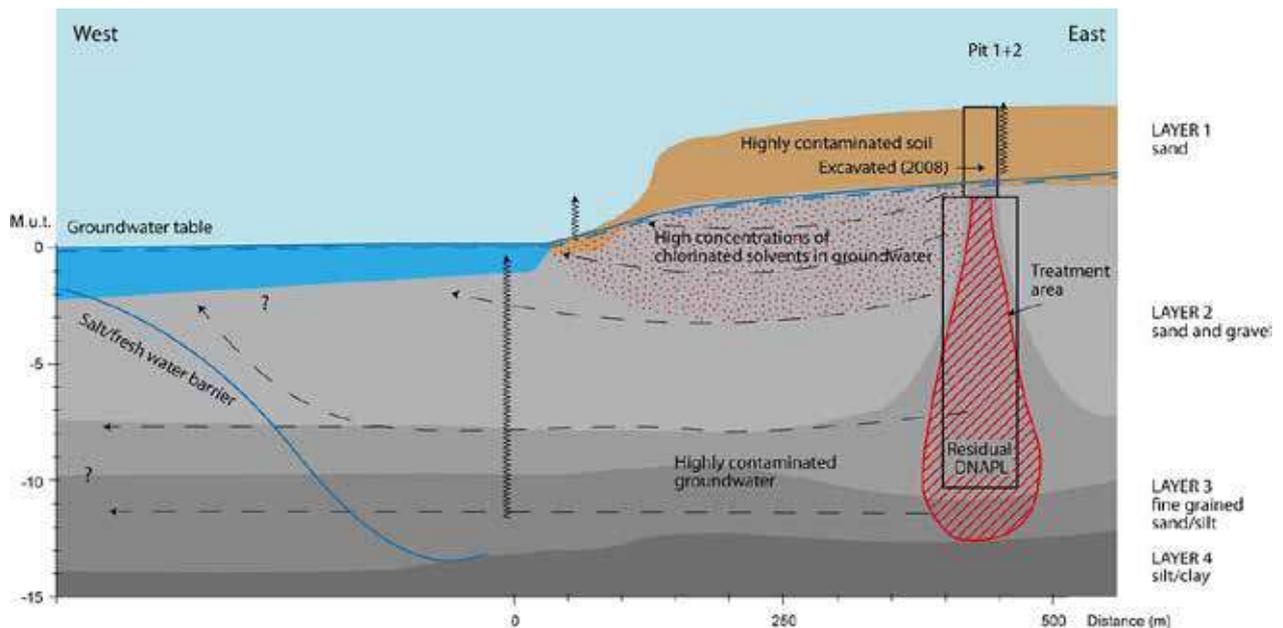
COUNTRY:
Kazakhstan

TBILISI RAIL: INVESTIGATION OF SOIL CONTAMINATION FOR URBAN DEVELOPMENT IN TBILISI

COWI conducted an intrusive investigation including an extensive drilling campaign of a 74 ha railway area in Tbilisi, which is planned to be redeveloped for urban use. The investigation included assessments of soil and groundwater contamination, and checking for contaminants and hazardous substances in the construction materials of buildings and in installations. Based on the results, COWI prepared a remediation strategy and action plan for the area. ▾

CUSTOMER:
EBRD/Georgian
Railway

COUNTRY:
Georgia



WUXI COKING PLANT PHASE I INVESTIGATION

The phase I investigation included describing potentially polluting activities, a field environmental screening and a proposal for a phase II investigation. The project was conducted following the relevant Chinese guidelines and the best international standards. Documents, such as a project proposal, HASP paper and project execution plan, were evaluated for assessing contamination and planning the screening investigation. ▾

CUSTOMER:
Wuxi Taihu Lake
Management
Company

COUNTRY:
China

REMEDIATION

MITIGATION MEASURES AND ELIMINATION OF ENVIRONMENTAL RISKS

COWI has developed a systematic approach by which remediation alternatives can be identified, developed and evaluated for selecting the most feasible and cost-effective remedial action for soil and/or ground-water contamination.

Soil excavation and reuse of soil material are commonly used as a simple and fast method for reducing risk and ensuring a safe environment; however, removal of contaminants from the soil without excavation can sometimes be an attractive alternative. For many years, COWI has used different types of advanced in situ techniques.

We employ single methods or combinations of methods. Depending on the conditions at the specific contaminated site, the methods may include soil ventilation such as vacuum extraction, bio-ventilation, steam injection, chemical oxidation, air-sparging and bio-sparging.

SERVICES

- › Identification of remediation objectives
- › Feasibility studies
- › Cost-benefit analyses and selection of most cost-effective remediation solution
- › Preparation of tender documents and procurement expertise
- › Supervision and monitoring
- › Soil excavation and reuse
- › In situ remediation, such as air-sparging and vacuum extraction
- › Advance remediation technologies, such as thermal remediation with steam, enhanced reductive dechlorination and chemical oxidation



DEVELOPMENT OF DOCUMENTATION FOR REMEDIATION OF THE HIGHLY POLLUTED WASTE PIT ('HOT SPOT') SOVJAK, NEAR RIJEKA IN CROATIA

The waste pit contained more than 150,000 m³ of hazardous oil products, tars and solvents. COWI prepared the remediation programme including technology proposals, technical and financial assessments, and a feasibility study with a cost-benefit and financing plan. COWI also prepared the conceptual design, the project application for submission to the European Commission and tender dossiers for works (Yellow FIDIC book) and works supervision. ▴

CUSTOMER:
Environmental
Protection and Energy
Efficiency Fund

COUNTRY:
Croatia

GROYNE 42: IN SITU PILOT PROJECT FOR ONE OF DENMARK'S LARGEST CHEMICAL DUMP SITES

The objective of the pilot project was testing of in situ alkaline hydrolysis for remediating a large and complex contaminated site polluted with large amounts of the insecticide parathion and other chemicals. In situ alkaline hydrolysis works with sodium hydroxide. It converts the contaminants into more water soluble and less toxic substances, which are then treated in a water treatment plant. ▴

CUSTOMER: Danish EPA
COUNTRY: Denmark

KAERGAARD DUNES: A EUROPEAN MEGA-SITE

Kaergaard Dunes is one of the largest and most complex contaminated sites in Denmark due to discharges from the production of vitamins and medicine. COWI carried out tests for groundwater remediation in cooperation with Region South, Danish EPA and other specialist companies. The assignment comprised three pilot tests starting with field tests where two different kinds of chemicals are added to the groundwater. ▾

CUSTOMER:

Region South and Danish EPA

COUNTRY:

Denmark

BOHUS WHARF: INVESTIGATIONS, REMEDIAL ACTIONS AND ENVIRONMENTAL CONTROL, SWEDEN

Bohus Wharf is heavily contaminated with heavy metals, oil residues and other contaminants. COWI's services included planning and execution of the investigation programme and subsequently planning and implementation of the remedial action. COWI carried out environmental supervision during the remediation stages, including establishing control programmes as well as the actual sampling of soil and water. ▾

CUSTOMER:

Ale Municipality

COUNTRY:

Sweden



IN SITU REMEDIATION OF DE-ICING AGENTS IN OSLO AIRPORT

The use of de-icing agents is increasing in many airports; however, the de-icing agents have a negative impact on groundwater quality and need to be remediated. COWI is completing a number of bioremediation in situ pilot tests on the Oslo airport runways to reduce the impact from the contaminants on an important groundwater aquifer below the airport. ▾

CUSTOMER:

Oslo Lufthavn AS

COUNTRY:

Norway

DEVELOPMENT OF BROWNFIELD SITES

PROMOTING FUTURE LAND USE FOR URBAN DEVELOPMENT AND ENSURING SUSTAINABLE REUSE OF SOIL MATERIAL

Abandoned contaminated industrial properties, harbour areas and other brownfield sites have huge potential for redevelopment into land for new housing and commercial use due to their prime locations near the waterfront or proximity to existing urban areas. From the early stages of a brownfield project, project developers, architects, town planners and soil contamination specialists cooperate closely to provide the most cost-effective solutions. We work on all soil and groundwater issues related to the development of the sites, including investigation and remediation, such as soil excavation and reuse and in situ remediation. We also cooperate closely with other departments in COWI to provide a range of services, e.g. sustainable urban development, reuse of building materials, traffic planning, noise monitoring etc. e.g. sustainable urban development, reuse of building material, traffic planning, noise monitoring etc.

SERVICES

- › Development of contaminated sites during urban development of harbour areas, industrial sites and dumpsites
- › Soil classification and advanced soil excavation and soil logistics
- › Supervision of contractors
- › Dialogue with environmental authorities
- › Demolition of contaminated buildings and installations



SLUSEHOLMEN: RESIDENTIAL DEVELOPMENT IN COPENHAGEN HARBOUR

COWI is managing the remediation of a 100,000 m² industrial harbour area in Copenhagen. The area is being developed into an attractive neighbourhood with recreational, commercial and residential buildings consisting of eight artificial islands with 1,000 new dwellings. The environmental services included an historical review, intrusive environmental investigations, risk assessments and remediation, including excavation, disposal and various in situ methods. ▾

CUSTOMER: Private developers
COUNTRY: Denmark

AL KHOUDH LANDFILL IN OMAN

COWI carried out an investigation and risk assessment of the 350,000 m² uncontrolled dumpsite located on the outskirts of Muscat. COWI developed a conceptual model for the landfill and its surroundings to assess the risks and to design the remedial actions required in line with the municipal plans for urban development of the area. Subsequently, COWI prepared the tender dossier for the remediation required. ▾

CUSTOMER: Muscat Municipality
COUNTRY: Oman



PROJECT KULTURHAVN KRONBORG

Kulturhavn Kronborg is an ambitious project to develop an old industrial area into an attractive urban area with a museum, library and other cultural institutions. COWI was responsible for the environmental issues related to the reconstruction, including investigation and supervision during the handling of more than 100,000 m³ of soil. A sustainable approach to the soil handling resulted in approximately 90 per cent reuse of the soil material. ▲

CUSTOMER: Elsinore Municipality
COUNTRY: Denmark

ENGHAVE BRYGGE: RESIDENTIAL DEVELOPMENT IN COPENHAGEN HARBOUR

Enghave Brygge is an urban development of an 180,000 m² industrial site. COWI's services include mitigation measures to allow future land use as a residential area with green areas and canals. COWI carried out environmental investigations and prepared environmental management plans for handling of contaminated soil and polluted groundwater. It conducted supervision and monitoring and submitted the environmental reports and environmental applications. ▲

CUSTOMER: JM Danmark
COUNTRY: Denmark

IKEA SHOPPING CENTRE ON LANDFILL

The Ikea shopping centre in Gentofte was constructed on an abandoned landfill site with potential production of landfill gas. COWI carried out the investigation and risk assessment and prepared the design for the mitigation measures. The buildings were constructed with active and passive ventilation of landfill gas, alarm systems and controls, and regulation and monitoring of gas concentrations in the active ventilation system. ▲

CUSTOMER: Ikea Denmark
COUNTRY: Denmark

TRØRØD RESIDENTIAL AREA WITH APPROXIMATELY 50 PRIVATE VILLAS

An investigation revealed there was considerable production of landfill gas and potential risk for several of the approximately 50 single houses constructed on the abandoned Trørød landfill site. COWI designed remediation for each house to ensure there was a safe indoor climate. Subsequently, COWI carried out monitoring and adjusted the remediation strategy to optimise the mitigation measures and obtain the best cost-benefit methodology. ▲

CUSTOMER: Capital region
COUNTRY: Denmark

INFRASTRUCTURE PROJECTS

Infrastructure projects, such as ports, airports, railways and roads, can have a significant impact on soil and groundwater. COWI has considerable experience in the management of contaminated soil and groundwater for various types of infrastructure.



ENVIRONMENTAL INVESTIGATION AND REMEDIATION FOR THE CONSTRUCTION OF THE COPENHAGEN METRO, DENMARK

COWI was a consultant to the client in the design and construction of the Copenhagen metro, the first phase comprising 22 km of metro line and the second phase being a circular line of 16 km. COWI carried out environmental investigations and supervised soil and groundwater remediation, and also handled negotiations and approvals with the authorities. ▴

CUSTOMER:
Metroselskabet I/S

COUNTRY:
Denmark

NEW DOHA PORT – SOIL AND GROUNDWATER INVESTIGATION, QATAR

New Doha Port was constructed as an inland port covering an area of nearly 25 km² and required considerable soil handling. The soil and groundwater part of the environmental impact assessment focused on impacts from the excavation of the port basin area and the onshore part of the access channel, and it included an investigation and assessment of soil and groundwater quality. ▴

SERVICES

- › Historical review of and locating potential sources of contamination in project areas and along alignments
- › Investigation and pre-classification of soil quality
- › Ports, airports, road, railways and urban infrastructure projects
- › Environmental impact assessments
- › Supervision of contractors
- › Monitoring

FERRY TERMINAL CONSTRUCTION PROJECT IN KALININGRAD, RUSSIA

COWI carried out an assessment of the ferry project including intrusive investigation of soil and groundwater. The area was heavily contaminated with oil products through more than 60 years of operation. The project identified the volume of contaminated soil and proposed a sound approach for handling it during excavation of the harbour basin. ▴

CUSTOMER:
EBRD

COUNTRY:
Russia

CUSTOMER:
The Government of the State of Qatar

COUNTRY:
Qatar

INDUSTRIAL SITES

RISK ASSESSMENTS, REMEDIATION DURING ONGOING INDUSTRIAL OR COMMERCIAL ACTIVITIES, SITE CLOSURES AND INFRASTRUCTURE PROJECTS

Contamination from industrial activities usually represents liabilities, which may materialise if the authorities issue enforcement notices or if the property is sold or requires mitigation measures to ensure continued industrial operation.

The widespread use of oil products for transportation, heating and production has resulted in many spills to the environment, especially to the soil, groundwater and surface water. COWI is highly experienced in mapping, investigating and remediating sites contaminated by oil. We have worked for most major oil companies, like Shell, Q8, BP, Texaco and Statoil, as well as for other entities with oil installations like the Norwegian and the Danish national defence forces.

SERVICES

- › Historical review of and locating potential sources of contamination
- › Investigation of industrial sites and service stations
- › Evaluation of risk of spills from storage and handling of chemicals and from production activities
- › Remediation and emergency response during ongoing industrial or commercial activities
- › Site closures

FORMER PETROL RETAIL STATIONS IN DENMARK

COWI has managed investigations and remediation projects at a total of 1,200 former petrol stations or 90–100 sites annually under the national Danish Oil Industry’s Remediation Fund (OM). The work comprises planning, investigations, risk assessments, monitoring and remediation. The remediation includes several different remediation technologies, including excavation, pump and treat, and in situ approaches. ▾

CUSTOMER:

The Danish Oil Industry’s Remediation Fund (OM)

COUNTRY:

Denmark



INVESTIGATION OF CONTAMINATION BY A CHLORINATED COMPOUND IN GERMANY

In the divestment of an industrial site, COWI was assigned to investigate major contamination by VOCs and oil of soil and groundwater. The investigation included intrusive investigations with standard drilling equipment as well as sampling and analysis of soil water and pore air. Based on the investigation, a conceptual model and a proposal for further action were elaborated. ▾

CUSTOMER:

Danfoss

COUNTRY:

Germany

ENVIRONMENTAL DUE DILIGENCE, INDUSTRIAL EMISSIONS DIRECTIVE AND ENVIRONMENTAL IMPACT ASSESSMENTS

LIABILITY MANAGEMENT, ESTABLISHING AN ENVIRONMENTAL BASELINE FOR EXISTING ACTIVITIES AND ASSESSING THE IMPACT OF FUTURE ACTIVITIES

For environmental due diligence, COWI documents the potential environmental liabilities and obligations related to the transaction. Our assessments are tailor-made to the individual transaction and to the compliance situation relative to national and regional regulations.

COWI is part owner of the CAT Alliance Ltd, a joint venture company established in 2001 to provide global risk and liability management as well as capital asset and transaction services. With offices all over the world, COWI and CAT Alliance Ltd offer consultancy services and plan projects using our extensive knowledge of local markets while drawing on the international experience of our entire organisation.

COWI also offers services related to the EU Industrial Emissions Directive, which imposed new challenges for assessing the baseline of soil and groundwater contamination. Another service offered is an environmental impact assessment. These often require a substantial input related to soil and groundwater as well as close cooperation with other specialists for noise, air quality, waste and social economic issues.

INVESTIGATION OF INDUSTRIAL CONTAMINATED SITES IN THE USA, BULGARIA, RUSSIA, UKRAINE, KAZAKHSTAN AND CHINA

COWI has performed environmental due diligence for site acquisitions, divestitures and the development of production facilities on potentially contaminated sites for different multinational customers. These have included investigations, topographical surveys and intrusive site investigations to assess contamination and for geotechnical purposes. The objectives of the investigations have been liability assessments and compliance with national regulatory requirements for construction permits. ▾

CUSTOMER:
Various International Investors

COUNTRY:
Various countries

SERVICES

- › Due diligence scoping
- › Phase I and II environmental due diligence assessments and environmental compliance reviews
- › Hazard risk and safety engineering evaluations
- › Environmental liability valuations and cost opinions
- › Environmental impact assessments
- › ESIA according to WB, IFC or Equator principles
- › Environmental feasibility studies
- › Environmental management and monitoring plans
- › Baseline studies and reports
- › EU Industrial Emissions Directive



ENVIRONMENTAL IMPACT ASSESSMENT OF REMEDIATION OF SOLID WASTE DUMPSITE AT KAP IN MONTENEGRO

COWI carried out environmental assessments for the remediation of the five most contaminated sites in Montenegro. The contaminated sites were a dumpsite with 7.5 million tonnes of sludge, a waste disposal site with 8 million tonnes of waste, a shipyard with nearly 60,000 tonnes of contaminated soil, a steelyard with 2.5 million tonnes of waste and a dumpsite with 3.9 million tonnes of waste from an old zinc/lead mine. ▾

CUSTOMER:
WB

COUNTRY:
Montenegro

INDUSTRIAL EMISSIONS DIRECTIVE BASELINE REPORT FOR MAABJERG VÆRKET

A baseline report was prepared in relation to the EU Industrial Emissions Directive. The study included a list of potential hazardous chemicals and the risk of spills to soil and groundwater based on a review of raw materials, storage facilities, production types and lines etc. A field investigation was conducted to assess the existing soil and groundwater environmental baseline. ▾

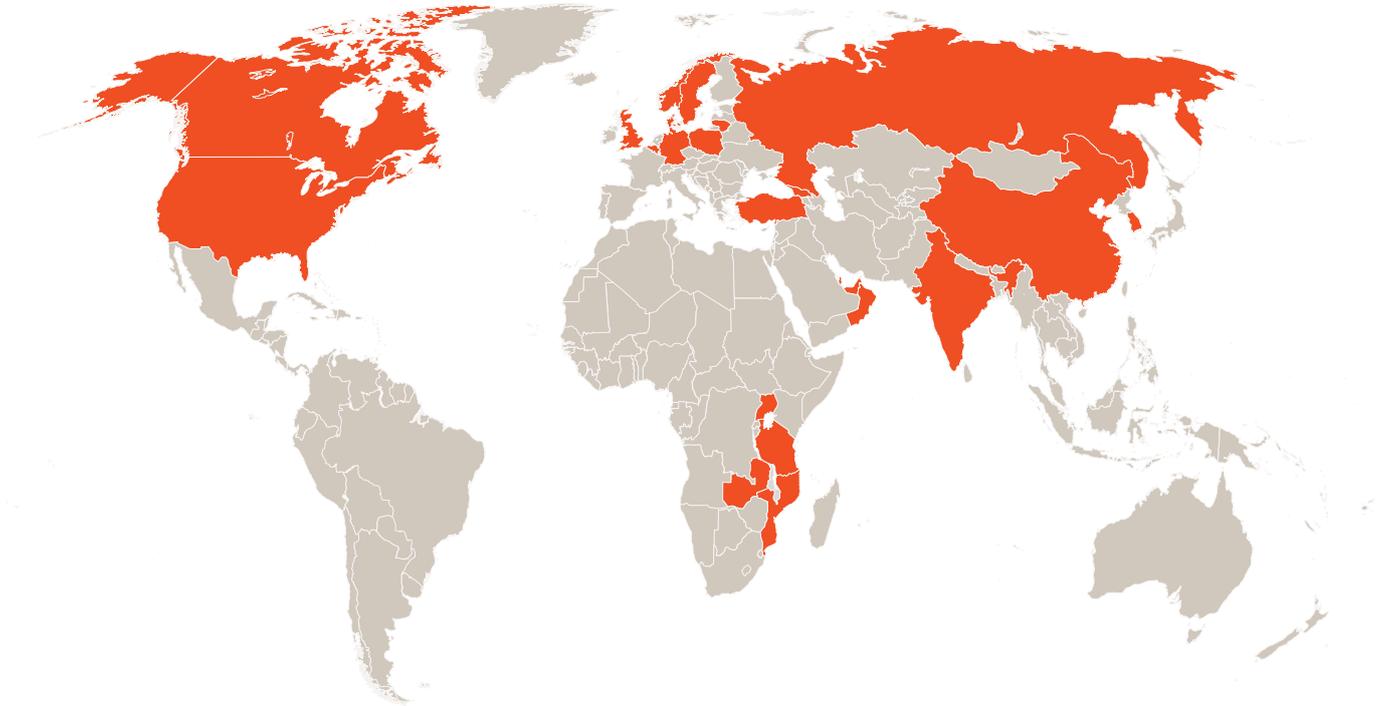
CUSTOMER:
Maabjerg Energy
Concept

COUNTRY:
Denmark



WORLD-CLASS KNOWLEDGE COMBINED WITH WORLDWIDE PRESENCES

With more than 6,200 employees and offices in more than 20 countries worldwide, we have executed projects from the suburbs of St Petersburg to the top of the Mount Everest. At any given time, we are involved in more than 17,000 projects all over the world.



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POWERING YOUR 360° SOLUTIONS

COWI is a leading consulting group that creates value for customers, people and society through our 360° approach. We tackle challenges from many vantage points to create coherent solutions for our customers.

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