



Helping ports to reduce their environmental impacts and deliver sustainable growth

The environmental impacts of shipping present considerable challenges to port owners around the world. As global trade expands, levels of shipping activity are forecast to rise significantly, leading to increasing environmental challenges and associated adverse health impacts at and around ports and coastal locations.

The environmental impacts of ports generally fall into three categories:

- Problems caused by general port activity.
- Problems caused by ships calling at a port.
- Environmental impacts associated with intermodal transport networks serving ports.

Impacts can be short-term, affecting day-to-day operations, and long-term, presenting significant barriers to the future development and growth of ports. Environmental regulators are recognising this and legislation is tightening around the world.

Ricardo has been working with port owners and operators for decades to help them understand their environmental impacts. Through our work, we have developed an in-depth understanding of the unique challenges that ports face and are ideally placed to help them manage these.

With a cross-disciplinary team of experts, our knowledge spans the full range of environmental issues including energy, water, resource efficiency, waste management, air quality, sustainable transport and chemical risk.

Our engineers, scientists, technology specialists and economists have extensive knowledge, understanding and experience of the environmental challenges faced by ports and the shipping industry. They provide deep insight into the environmental impacts of port operations and options for developing cost-effective mitigation plans that support more sustainable, competitive and profitable growth.

Our expertise includes:

- Port operations and their environmental impacts.
- Environmental and sustainability advice to maritime operations.
- Marine engine technologies.
- Development of environmental modelling and assessment of mitigation scenarios.
- Pollution measurements to help build the pollution evidence base and track the impact of mitigation measures.
- Utility usage modelling and optimisation of waste management to control costs.



Our services

Air quality

- Compiling air pollutant emission inventories to understand the sources of pollution, and target and assess the impact of improvement measures.
- Design, install, operate, manage and quality-assure air quality measurement solutions to support compliance reporting, and occupational and public exposure studies.
- Detailed dispersion modelling to assess current and future air quality, and the impact of improvement strategies.
- Best practice mitigation advice and an up-to-date knowledge of emerging technologies.
- Odour and dust assessment.

Sustainable transport

- Port vehicle fleet analysis, alternative fuels and electric vehicle options appraisal, refuelling/recharging infrastructure planning and support, and fleet replacement strategies to help fleet operators reduce their emissions and costs.
- Life-cycle greenhouse gas (GHG) and air pollutant emissions impacts, resource availability, using cost-benefit analysis to compare alternatives.

- Economic impacts assessments.
- Port fleet operator engagement forums to share information and encourage vehicle operators to adopt low-emission vehicles.

Energy management

- Energy strategies for ports to provide clear and coherent actions to cut energy costs, starting with the simplest and most cost-effective investments.
- Renewable energy options analysis to help reduce dependence on fossil fuels and mitigate the effects of energy price rises.

Low carbon operations

- Regulatory assistance (such as the UK's Energy Savings Opportunity Scheme (ESOS) and the CRC Energy Efficiency Scheme) to maximise opportunities from carbon reductions and support compliance.
- Compilation and analysis of GHG emissions inventories to identify the 'low-hanging fruit' where emissions reductions can be cost-effectively made.

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Port development, environmental impact assessment and regulatory support

- Environmental permit application and regulatory support including liaising with key regulatory stakeholders.
- Port environmental monitoring for environmental permit compliance.
- Port development and expansion support, including preparing Environmental Impact Assessment, and supporting port owners with planning applications and discharging planning conditions.

Management of chemical risk

- Providing around-the-clock chemical emergency advice to support port authorities when responding to incidents involving chemicals. Our chemical emergency response team supports material identification, and initial risk assessments and development. The team will also sense check a response plan.
- Our chemical hazards database, Chemdata®, contains information on over 61,000 substances and provides relevant, actionable and proportionate advice at an incident scene. It is available for use on desktop and mobile devices.
- Business continuity, incident notification and emergency response training, exercising and consultancy services.

Water

- Monitoring and assessing water discharges to support the achievement of regulatory compliance.
- Oil weathering and dispersant testing.
- Environmental permit application and regulatory support, including liaison with key regulatory authorities.
- Delivering in-house planning and Environmental Impact Assessment expertise to support port development and expansion.
- Conducting ballast water management and Strategic Environmental Assessments (SEA).
- Marine environmental baseline surveys to support ecological protection and port planning and development.

Resource efficiency and waste management

- Decision-making support through insightful supply chain audits that identify efficiency savings.
- Support in risk management and protection of organisational reputation through due diligence assessments.
- Identifying performance improvements and cost savings as part of waste management process reviews.
- Assessing and implementing circular economy business models.

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Case studies

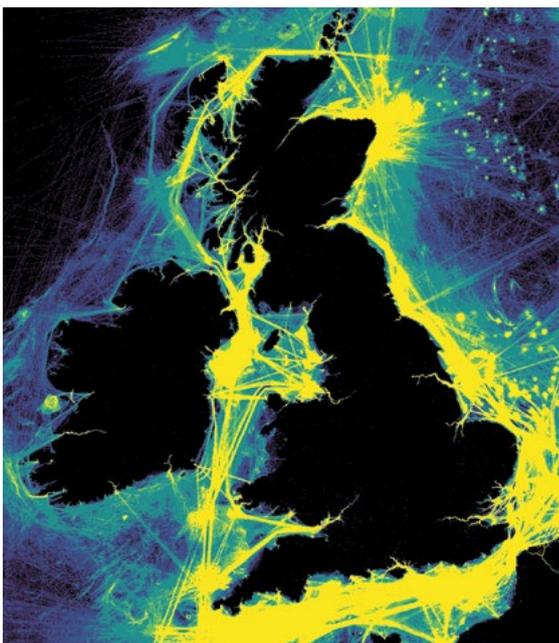
Developing and enhancing the UK Ship Emissions Inventory

As the UK is surrounded by some of the world's busiest shipping lanes, air quality pollutants and GHG emissions from shipping form a significant part of the UK's emissions.

Through innovative analysis, which included exploiting the use of shipping Automatic Identification System (AIS) data, Ricardo developed a new methodology and delivered significant improvements in accuracy and spatial resolution of the UK's understanding of shipping emissions:

- Emissions now reflect actual routes taken by ships with fine spatial scale down to detailed port level.
- Takes into consideration varying vessel speeds and loads.
- Includes more vessel types, such as fishing vessels, offshore fleet and service vessels within emission estimates.
- Cross-references to a database providing detailed information on the engines and performance characteristics of vessels.

The exceptionally high spatial resolution of the data supports improved emission inventories. This makes it much more useful for studying air quality effects at a local level and providing a valuable technical resource from a future planning perspective.



Design of low cost, low emission marine propulsion systems

Ricardo marine propulsion experts used state-of-the-art computer aided engineering (CAE) software to evaluate the environmental and commercial performance of different marine propulsion system architectures under a range of different usage scenarios.

The work focused on the requirements of a typical harbour tugboat operating in a medium-sized European port. The general characteristics of the vessel were assumed to be a length of 35m, beam of 14m and draft of 5m, with a bollard pull of some 50 tonnes. Two alternative propulsion system configurations were considered for this vessel:

- A high-efficiency conventional mechanical architecture, comprising two diesel engines powering respectively a port and starboard propeller by direct drive via a gearbox.
- A hybrid electrical propulsion system based on two natural gas engine generator sets providing power to battery banks, with separate electric motors driving each propeller.

The study demonstrated the value of applying CAE simulation tools at the very earliest stages of vessel design or of repowering. From assessing the likely usage profile, the CAE tools allowed for the early assessment of detailed considerations of environmental performance, capital and operational expenditure requirements, and likely return on investment.

Volatile organic compounds and odour from bunkering operations at sea

Ricardo assessed the potential for local health impacts from volatile organic compounds (VOCs) and odour emissions from shipping activities, and investigated the nuisance potential of fuel bunkering activities in the Port of Gibraltar. The study:

- Involved a detailed investigation of vapour emissions from fuel bunkering at different refineries, which identified concentrations of potentially harmful VOCs arising from operations.
- Identified the characteristics of the bunker fuel responsible for the greatest air emissions.
- Revealed that the odour released during bunkering operations would be detected in Gibraltar Town.
- Made recommendations for suitable operational procedures necessary to minimise impacts from bunkering.

Low emission strategy support

The link between air pollution and negative health outcomes for inhabitants of towns and cities around the world is now universally accepted. The problem is driven by growing populations, urbanisation, and the expansion of industry and transportation as economies grow. City leaders are acting to mitigate impacts through the introduction of low emission strategies.



Ricardo's air quality experts have unrivalled expertise in delivering high-quality air pollution evidence. This expertise includes measurements, emissions inventories and modelling – including the use of Ricardo's city-scale air pollution and decision support tool, RapidAir®, which provides highly spatially resolved air pollution evidence across large urban domains for city decision makers. We provide data-driven insights and accessible policy development tools to deliver informed, evidence-based, low emissions strategies at city, regional and national scales across Europe, China and the Middle East.

Poole Harbour macroalgal harvest – pilot study design

Ricardo was commissioned by the Environment Agency to evaluate the detrimental growth of *Ulva* spp. in Poole Harbour as a result of excessive nutrient input from the harbour catchment.



The study aimed to appraise candidate macroalgal harvest techniques for use in Poole Harbour, assessing the feasibility of techniques against the likely impact on the benthos (i.e. those invertebrates such as crustaceans that live on or in the surface sediment (the benthic zone)) and bird communities, and the associated cost of implementation.

Ricardo undertook a detailed desk study to determine an ecological baseline and likely impacts of all scoped harvesting technologies.

Based on data available and expert knowledge, outline costs were provided for different options. On the basis of cost, feasibility and ecological assessment, a pilot study area was proposed to support the Environment Agency in assessing the feasibility and ecological impact of three top-ranked harvest methods.





Shipping emissions and renewable energy in ports

A study, commissioned by Schneider Electric, used an innovative modelling system based on real-world shipping movements to determine the emissions from auxiliary engines of vessels at berth in the UK.

The study indicated that connecting vessels to electric shore power when at berth could reduce carbon dioxide (CO₂) emissions by up to 0.83Mt and oxides of nitrogen (NO_x) by up to 11.4kt – the equivalent of removing approximately 1.2 million diesel cars from the road.

Ricardo's air quality and energy teams are working with major transport hubs across the UK to understand the impact of vehicle emissions and develop energy strategies that reduce their environmental impact and deliver commercial value.

Ricardo is supporting a range of clients on projects at the leading edge of renewable energy generation and distribution, focusing on the development of profitable solutions to provide electricity directly to users or concessionaries.

Impact of marine emissions regulation

A marine industry association wanted an independent, impartial assessment of the impacts new emissions regulation would have on its sector.

Ricardo formed a multidisciplinary team to carry out an in-depth analysis of available emissions reduction technologies, the global effect on emissions and the socio-economic impact of new regulation. As part of the assessment process, Ricardo:

- Consulted a wide variety of stakeholders, through interviews and questionnaires, to understand their issues and gather data.
- Reviewed the emissions control technology required to meet the new regulation and the implications of installing this technology on vessels.
- Conducted an emissions inventory of the impact the emissions regulations would have on air quality – globally and regionally.
- Modelled the socio-economic implication of the legislation.

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At the end of the project, the client received a comprehensive report covering the environmental benefits and the marine sector impacts of the new legislation. The report included:

- An environmental impact assessment.
- A socio-economic impact assessment.
- A technology review.
- A review of industry perceptions.

Chemical incident support

Ricardo's chemical emergency response practice, the National Chemical Emergency Centre (NCEC), has been working with a major European port to improve its response in the event a chemical incident occurs. The port has challenges with the volume of bulk chemicals that are moved through the port on a daily basis and the ongoing issue with undeclared goods.



For the former issue, NCEC provides its ChemData database. This means that, if there is a release of one of these hazardous materials, first responders can quickly access critical safety and response information from their mobile device, which enables them to plan a response. Employees at this port also have access to NCEC's emergency response telephone numbers, so if they need additional advice on their response or support with identifying an undeclared material, they can access this from our qualified chemical emergency responders, 24/7.

Chemical safety is critical to the port operator, and investing in these tools and services to protect staff and safeguard operations is a key part of its sustainability strategy.

Baseline monitoring for London Gateway Port and Logistics Park

Ricardo has assisted DP World London Gateway in implementing an air quality monitoring programme, with the aim of assessing pollutant concentrations around the port and logistic park.

Ricardo staff undertake monthly visits, deploying a network of passive nitrogen dioxide (NO₂) diffusion tubes at nine locations in and around the port and logistic park. These are Department for Environment, Food and Rural Affairs (Defra) approved and this is a nationally recognised monitoring technique that is adequate for assessing concentrations.

The network is set up to assess air quality at DP World London Gateway and to identify if there are any trends in the air quality data as the development grows. Ricardo air quality data produced at London Gateway Port and Logistics Park will feed into similar monitoring exercises being conducted elsewhere.

Delivering Excellence Through
Innovation & Technology



For more information on how we can help your port to reduce environmental impacts and deliver sustainable growth, please contact one of our experts at **enquiry-ee@ricardo.com** or **+44 (0) 1235 753000**

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