Report Summary

Sustainability and the role of ports

Sustainability is becoming an increasingly important objective for the entire production chain, including transport, a sector in which there are still substantial gains to be realised in reducing environmental impacts. In this 2016 study, Panteia were commissioned by the Port of Rotterdam Authority and Deltalinqs (Rotterdam Port and Industry association) to carry out an independent investigation into the role that can be played by seaports in stimulating higher levels of environmental efficiency. The study involved an interview programme with key players in the market, and a modelling exercise to analyse the environmental impacts of container transport between the Far East and Europe.

Commercial Factors are still decisive in transport

Transport is traditionally a sector in which commercial factors are decisive, but consumers increasingly value sustainability, and increasing pressure is being placed on consumer goods manufacturers to produce in a more sustainable way. From the interviews it emerged that measures to reduce CO_2 emissions are considered the most important. However, transport services are still chosen largely on the basis of cost and service quality. Therefore the most successful initiatives are likely to be those fostering lower costs and, simultaneously, lower emissions. Key drivers for achieving lower rates of emissions through fuel efficiency include :

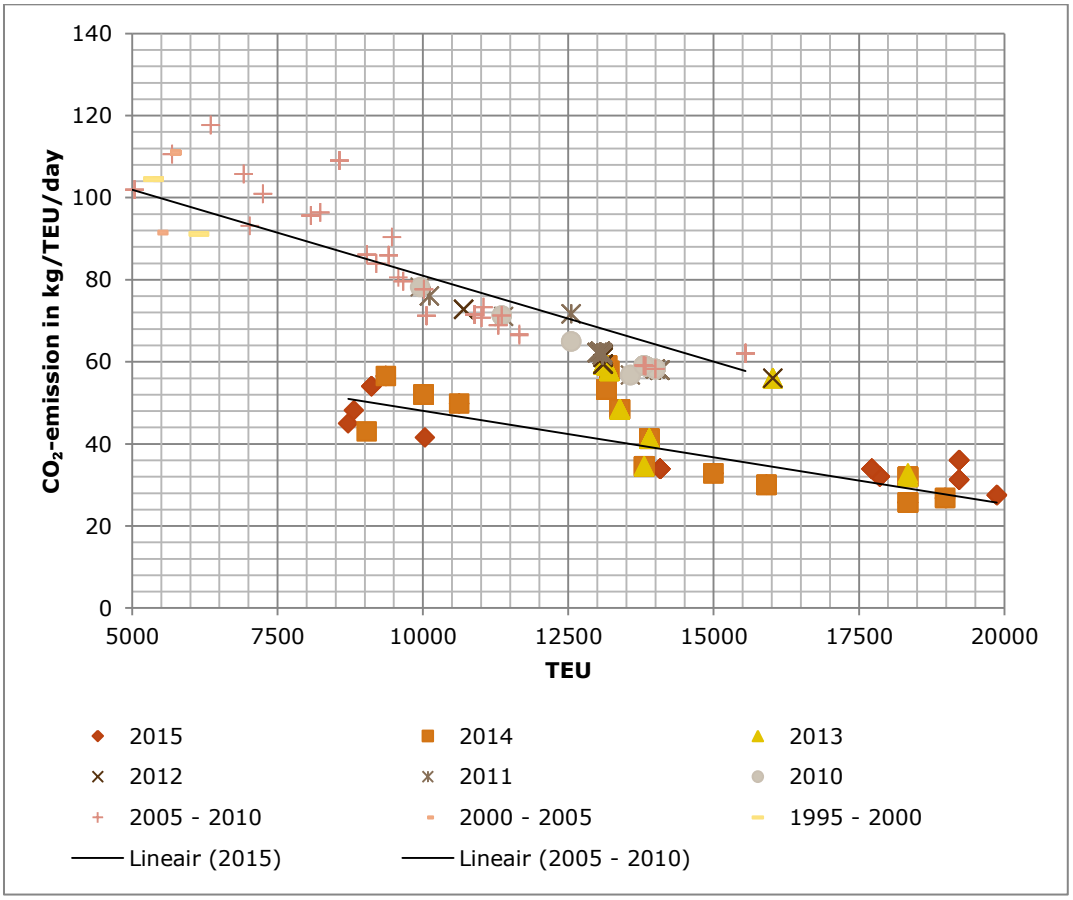
- Mode substitution
- Scale of transport
- Reduction of empty running and overcapacity
- Fleet modernisation

Maritime transport is a green mode of transport, but more can be done

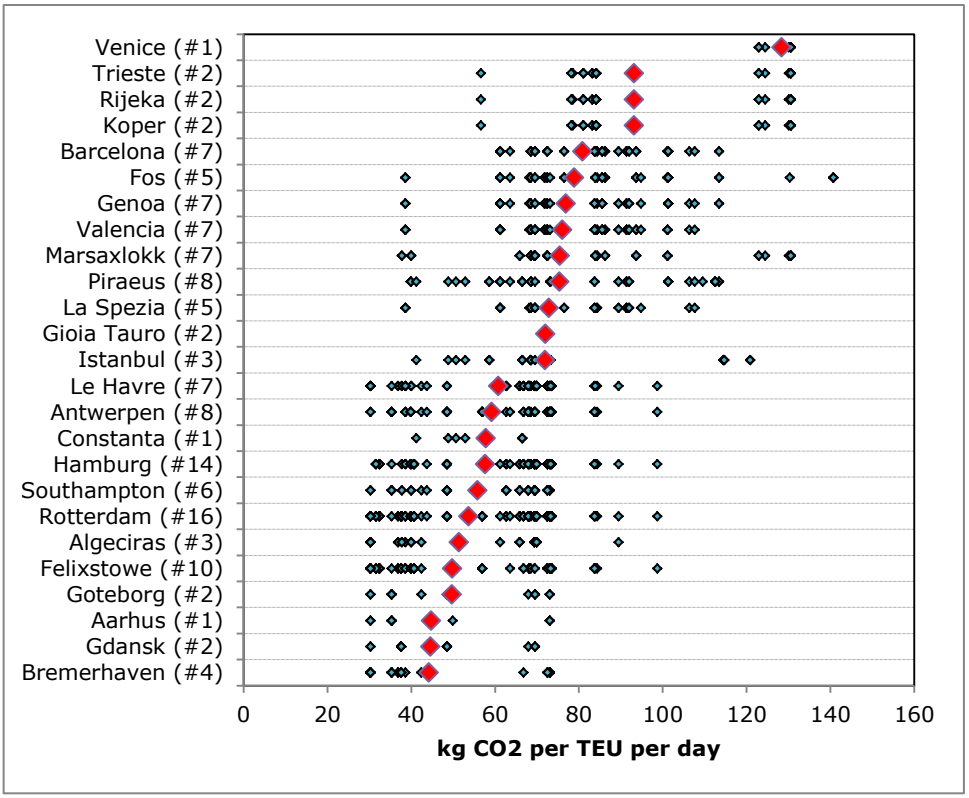
Numerous studies agree that rates of greenhouse gas emissions per tonne-kilometre are substantially lower for maritime transport than for land transport. Our models show that CO_2 emissions in 2016 for a large container vessel on the Europe-Far East trade lane are around ten times lower per tonne-km than road transport. In recent years this gap has increased due to the use of larger ships with more modern engines. However, the rate of increase in CO_2 efficiency is slowing down, and gains are being eroded by overcapacity in the maritime sector. So, while maritime transport remains the greenest transport mode, more can be done to reduce the high absolute levels of emissions arising from intercontinental transport.

Levels of emissions on Europe-Far East services vary significantly

By analysing ship deployment across a range of Far East - Europe container services it is possible to see that levels of emissions (kg of CO_2 per TEU per day) differ greatly depending upon the size and age of the vessel. The figure below shows that the use of larger vessels with more modern engines has decreased and will decrease the CO_2 emissions.



The most efficient vessels may achieve levels of CO_2 emission close to 30 kg per TEU per day given high load factors, whereas at the other end of the scale, levels of over 120 kg per TEU per day are found. For a 30 day voyage, these differences result in substantianlly differing levels of environmental impact per unit shipped. It is noticeable that the majority of European gateway ports can now receive vessels capable of achieving levels of emissions close to the best available. Severe commercial pressures to reduce fuel costs through economies of scale have stimulated rapid progress in this area. For a number of large seaports in Europe the level of CO_2 emission for ships calling, is shown in the figure below.



These figures depend upon the shipping lines achieving high load factors, so smaller vessels, with higher rates of CO_2 emissions per TEU per day, may still be optimal for specific trades.

Sustainability needs to be tackled by analysing whole transport chains.

Maritime and inland transport are often regarded as completely separate distribution systems, but to be able to manage environmental impacts effectively it is necessary to analyse whole transport chains. Port choices made by shipping lines dictate the entry and exit points into the hinterland networks. Often these choices are linked to agreements and relationships between shipping lines and container terminals, and they are not necessarily optimised to minimise overall transport distances. The model analysis shows that a typical TEU imported from the Far East to Central Europe on a modern, large containership will generate 800-1,000 kg of CO_2 emissions on the maritime leg, around 25 kg in the port itself, and up to 700 kg in the hinterland, depending on the inland distance and the choice of inland mode. Some margin of savings are possible at the European end of the maritime leg, but the hinterland portion can be reduced substantially by landing the container close to point of final consumption at a port with short-sea, rail and/or inland waterway connections. Port choice is therefore the crucial factor in optimising transport chains.

Ports are the link between maritime and inland transport legs

Emissions of greenhouse gases arising from port activity are minimal in comparison with those arising from transport operations (around 1-3% for Europe- Fareast container transport). However, interviewees identified a key role for ports as facilitators and stimulators for initiatives which have broader environmental impacts. Such initiatives include providing multimodal connections, application of ICT, platooning, and developing pilot projects for sustainable fuels. By playing a pro-

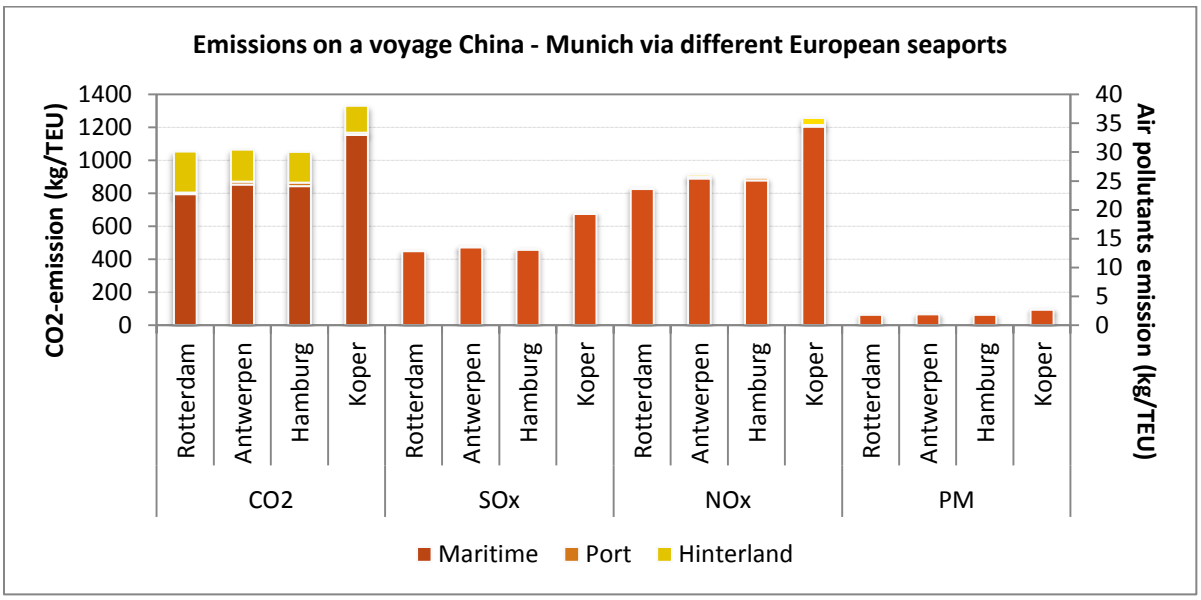
active role, ports can bring cargo owners, transport companies, and other service providers together to develop innovative solutions.

Optimised Transport Chains – Europe Far East

A model was constructed to analyse the routeing of containers on the Fareast Europe trade lane from the perspective of internal and external costs, including CO_2, SO_2, NOx, and particulate matter (PM). This trade lane was selected because it accounts for 54% of total laden containers imported to or exported from Europe. The aim was to use the model to select routes which minimise internal and external costs for all European NUTS3 regions. Thus, it selects a maritime service, a main port, a feeder port (if required) and a sequence of inland modes in optimal combination. The analysis was based upon current ship deployment and current inland freight services (short-sea, road, rail, and inland waterway) available at specific European seaports.

Hinterland versus maritime costs

A typical container from China to central Europe travels around 15,000 to 18,000 kms by sea and up to 900 kms by land, a ratio of approximately 20 to 1. However, because of the efficiency of modern container vessels, the ratio of maritime to inland external costs is approximately 70:30. Examples of these ratios for a selection of routeings involving different port choices, across a range of different emissions is shown below.

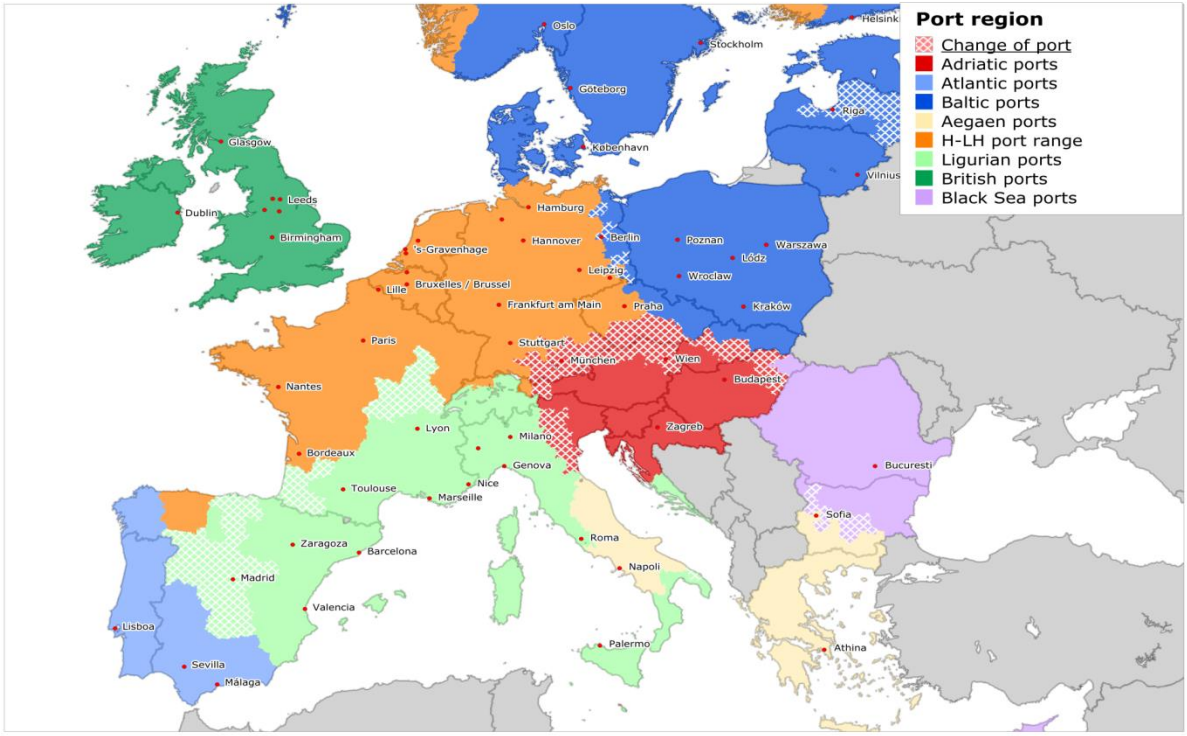


Port choice determines:

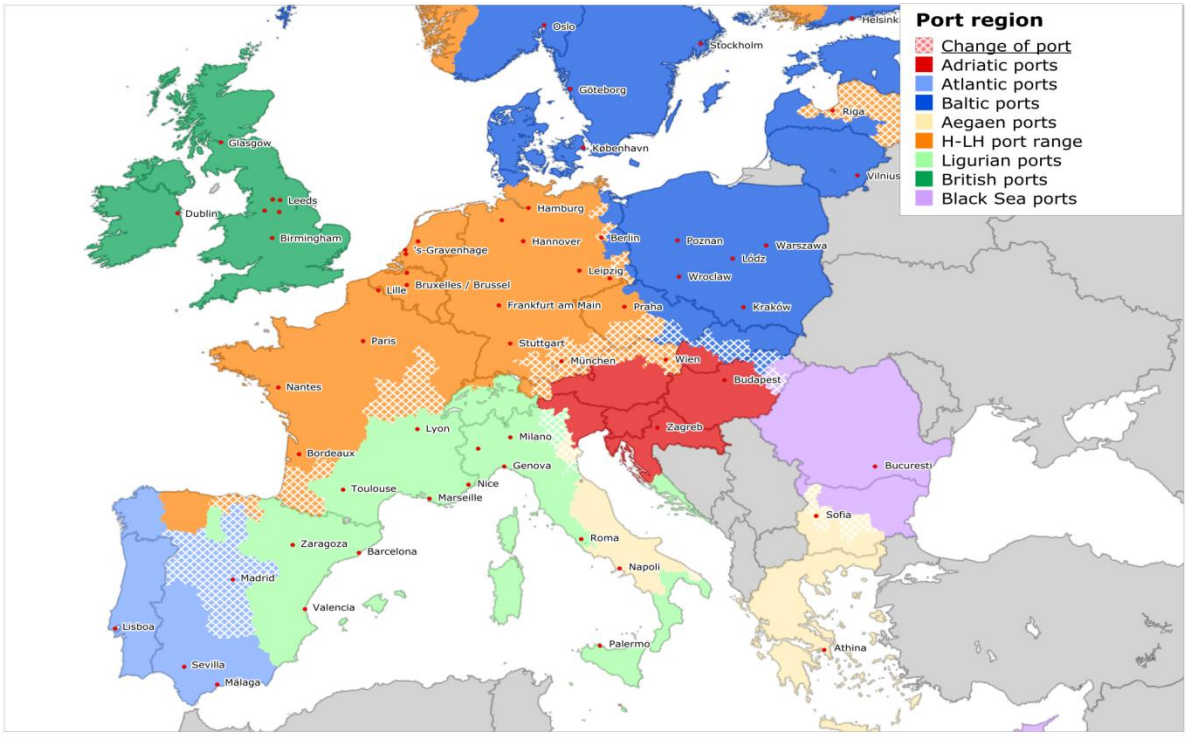
- the maximum size of intercontinental vessel that can be used for the Asia to Europe leg, and therefore the rate of emissions at sea.
- The distance to the hinterland, and the range and attractiveness of inland modes which can be used for the hinterland leg.

The model calculates the most efficient routeing, using (1) internal costs only, and (2) a combination of internal and external costs. The shades areas show the effect of internalising external costs.

Internalisation of external costs Hinterland lost by port clusters



Internalisation of external costs Hinterland won by port clusters

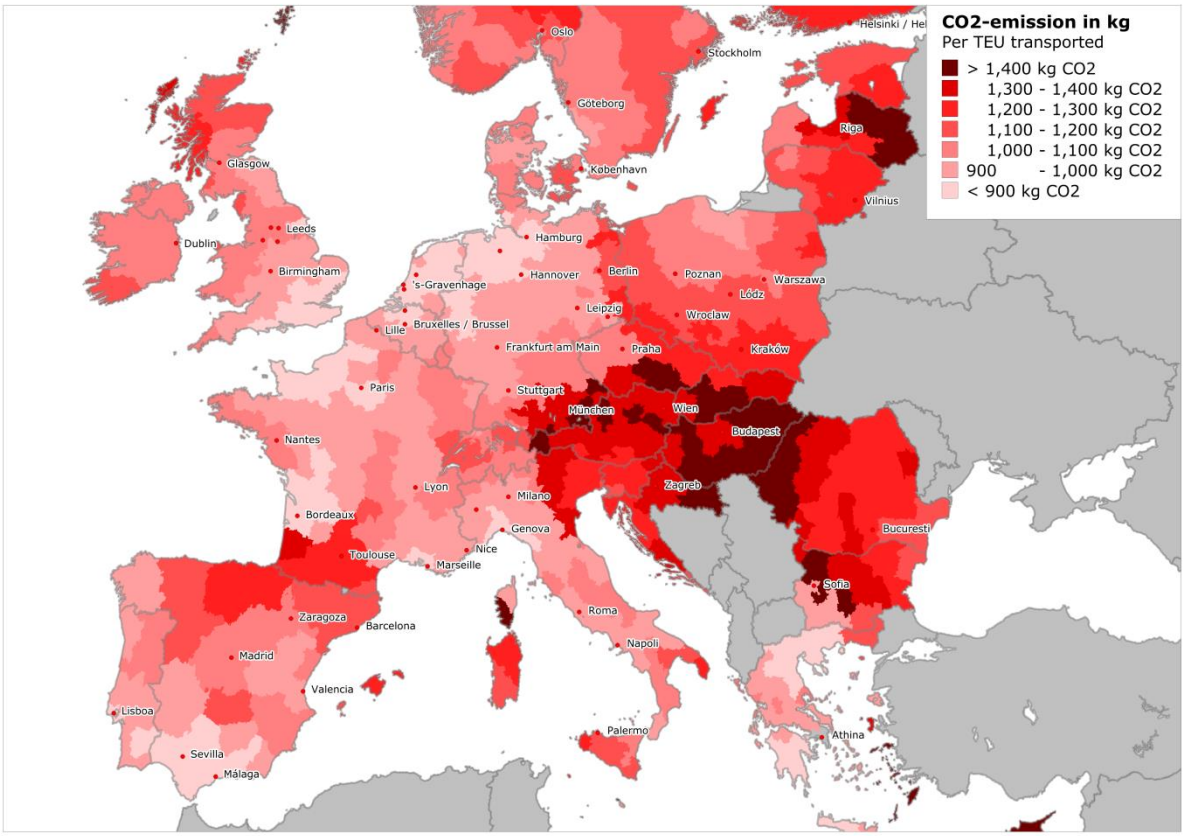


The maps show that internalising external costs across the whole chain makes relatively little difference to port choice. In general the optimal route choice is the one which lands the containers close to their final point of consumption, for all European regions. This is explained by the fact that the high volumes, the deployment of large vessels and the presence of sulphur emission control areas help to compensate the routes involving more distant ports (e.g. North Sea and Baltic) for the extra few days sailing around the coastline. Therefore the hinterland costs which are significantly higher per unit per kilometre than maritime costs are still the decisive factor, for determining the optimum port choice for each region.

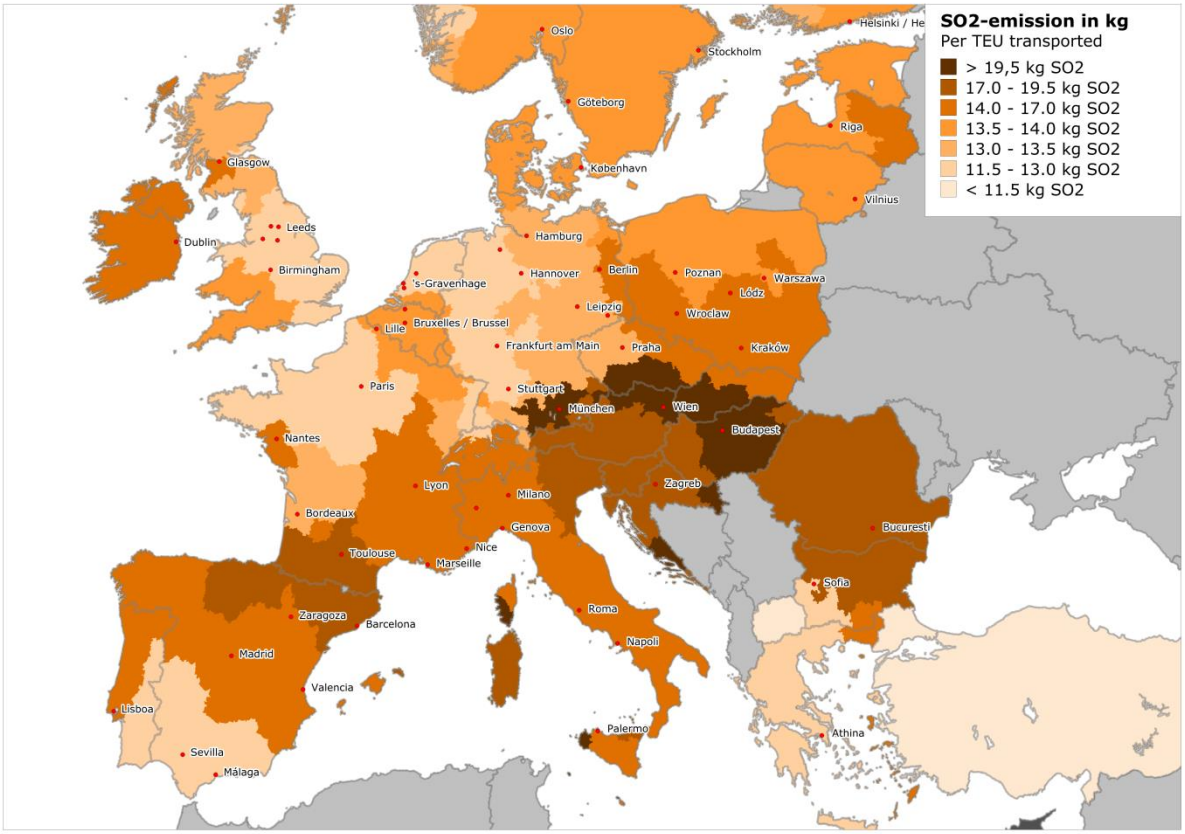
CO_2 and SO_2 emissions

The maps below indicate the sum of maritime and hinterland emissions (CO_2 and SO_2) for a container imported from China to every EU NUTS3 region, based on optimised routeings.

CO_2 emission of the entire transport chain, mapped onto destination-regions



SO_2 emission of the entire transport chain, mapped onto destination-regions



Lowest emissions are generally found in regions close to the ports where the most fuel efficient vessels are calling. Greece, southern Italy, southern Spain, southeast England and the northern coastline of continental Europe are good examples. Where there are dense networks of inland waterway and rail services attached to the gateway ports e.g. Belgium, Netherlands and Germany, the emission levels for inland regions may also be below average. Highest emission levels are found for shipments to land-locked regions or otherwise less accessible regions such as Hungary, the Baltic States, northern Spain and Scotland. An optimal routeing to Hungary would involve the use of an Adriatic service and inland transport by road. The challenges faced differ by geographical region. In southeast Europe, large gains can be realised within the maritime leg of the chain, and by developing intermodal inland transport to a greater extent. Regions like Scotland, northern Spain, Ireland and the Baltic States which are more distant from the main intercontinental hubs can benefit by the use of greener short-sea services to avoid long overland hauls. Regions such as Benelux, northern France and northern Germany, which already enjoy access to efficient maritime services and multimodal inland connections, can benefit most from elimination of empty running, greater operational efficiency through digitalisation, and measures to introduce cleaner fuels.

Conclusions

Interviewees indicated that they face renewed pressure to improve the sustainability of their operations. Profitability demands sustainability. It is apparent that by 2016, many quick-wins have been deployed, so in future it will be necessary for industry to tackle more complex areas, including logistics, where cargo-owners have less direct control and where end-consumers and policy-makers have less market or regulatory leverage. Complexity arises due to the need to optimise the performance of long-distance multimodal chains, and because open, global markets, such as inter-continental shipping, operate according to commercial logic. Ports have a key role to play as facilitators through the provision of infrastructure to enable the operation of efficient deep-sea, short-sea and hinterland transport services. Now, this role also extends to the deployment of ICT, alternative fuels such as LNG and biofuels, and other forms of technical innovation.