Sustainable ports in the green future

Ports are the arrival, transit and exit point for a large part of the world's trade and can as such be portrayed as economic growth engines. Port activities come with a cost to the environment and the surrounding cities, where our race towards zero carbon emission also affects the way in which ports will be operated in the future. The track record of ports is often centuries long, and their development has been underpinned by the activities in the hinterland as well as the activities of the players in the port.

Future port strategies must include sustainability to ensure a green future and viewed in the context of the lifetime of ports, this becomes increasingly necessary.

The big contributor to carbon emissions

The shipping industry is a big contributor to carbon emission. In its 2017 report on CO_2 emission from international shipping DTU, the Technical University of Denmark, stated that 90% of the world's trade is transported by ship, while 2.2% of all greenhouse gases are emitted by these ships.

There is an environmental argument for the shipping industry to progress towards a greener future, which is also recognized by the International Maritime Organization targeting a 50% reduction by 2050. However, when these ships call into ports close to cities, the need for curbing emissions becomes even more of a priority and results are required much earlier.

A common approach in ports is the provision of shore power, which obviously makes most sense if the power is from renewable resources. This situation juxtaposed with port operation, where various ships call at different quays at all times of the day, makes planning essential, but we know that shore power connection cannot be installed in every possible location in any port.

These are economic conditions for the ports and therefore also towards the shipping industry, where the cost of port calls must not be allowed to increase due to excessive investments in green port infrastructure. This dilemma is on the schedule of many port

administrations. This issue is also a preoccupation for the communities surrounding the ports.

In Port Esbjerg, on the west coast of Denmark, has been buying certified green energy from offshore wind parks for half a decade. The green power is used to supply small vessels, buildings and for fueling the port's fleet of electrical cars. However, this has only decreased the carbon emission by a fraction, when compared to the greenhouse gases from the 6,000 ships calling at the port each year.

To curb the emission, it was imperative to get an overview of the carbon footprint of the port at any one time and to understand where shore power systems could be deployed to maximize the environmental benefit. A live system presenting the carbon footprint of the port at any one given day. The possibility to connect vessels to shore power systems when possible or to deploy these where the largest impact can be assured is optimizing carbon reductions.

In the pursuit of managing this complexity, Port Esbjerg partnered with Honeywell to develop the Enacto Carbon and Energy Management System. They are working together, a global first for the maritime industry, to implement a climate co-operation designed to reduce carbon emissions at the Danish port.

The Port Esbjerg team has inaugurated nine green shore power connections, which enable large vessels to run on green electricity while docked, rather than use their onboard diesel generators, and this has the potential to reduce emission from the port by 20%.

The saying about 'you can't control what you don't measure' is true, and the reduction in carbon emissions in Port Esbjerg demonstrates that digitalization coupled with implementation will bring about a greener port. Naturally, sustainability also encompasses other operations.

Sustainable port operations

Sustainability in ports includes many of the 17 United Nations Sustainable Development Goals. Ports are generally ambassadors in their relationship with their many stakeholders, such as the residents in encroaching cities, and they contribute to economic prosperity and to securing decent working conditions, but the environmental focus will be the overarching goal during the next decades. However, the question remains about how much ports can impact through their role in the logistics networks, which they service, and how they go about making an impact.

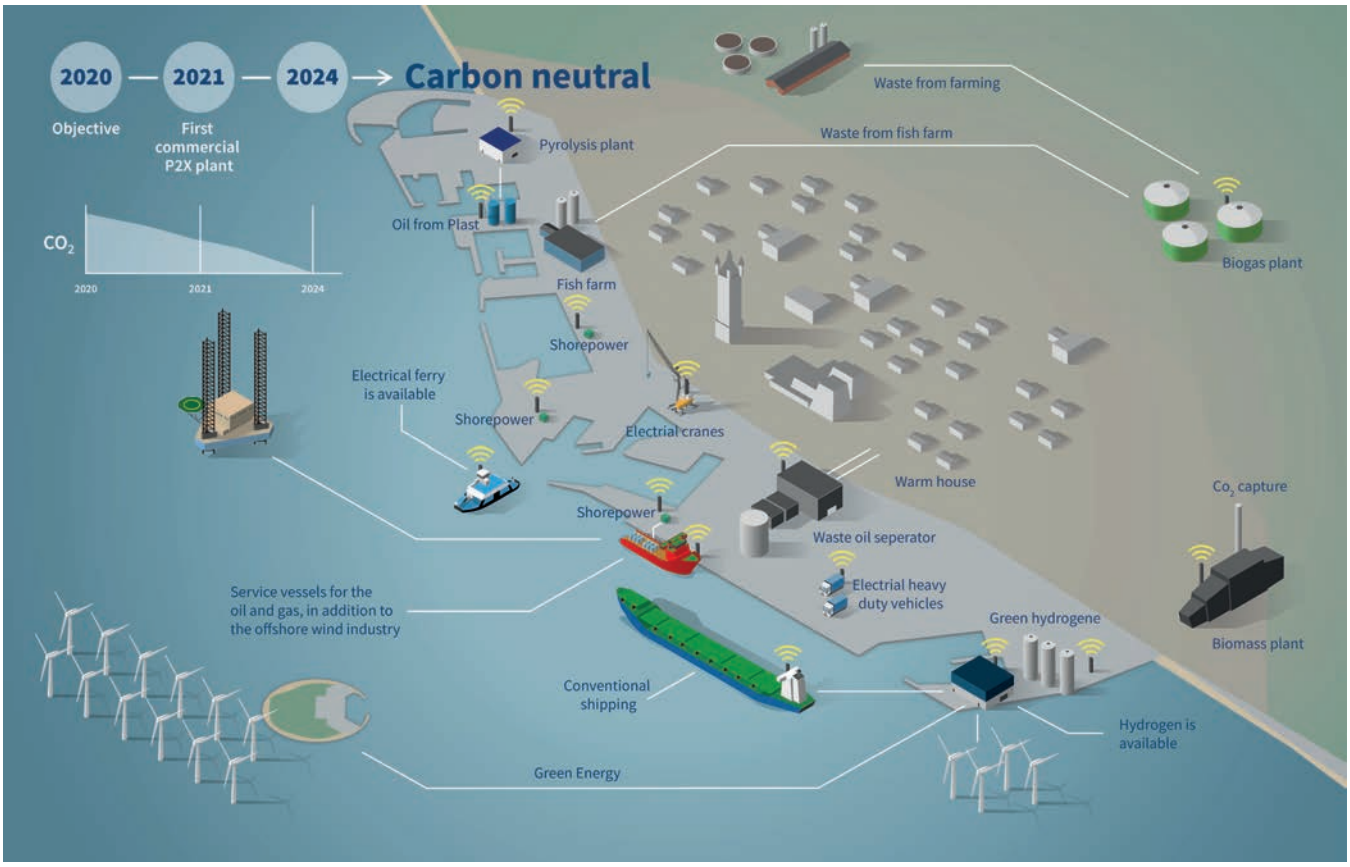
The emission from ports is caused by ships and equipment, but the incineration of ship waste is also a contributing factor. The same applies to the lack efficiency of roads into ports and availability of quays, which both increase congestion and contribute to carbon emissions. In contrast, today many ports are able to accommodate rail freight and are advocating the push from road to rail due to the environmental advantages. The optimization of port operations and logistic networks may therefore be first on the route to carbon neutrality.

Conversely, the technological advantages of the green transition may entail electrical trucks and the arrival of fuel cells and the hydrogen economy, while future ships may also require various e-fuels such as green methanol, or ammonia.

The support of the green transition and change to the logistic networks may therefore be best influenced by making green power and fuels available within the ports. The difference between advocating change by doing thing differently, or making current port activities greener requires ports to engage with the industrial eco-systems. This reflection has also been performed by Port Esbjerg, which has planned its path to carbon neutrality by engaging with industrial ecosystems.

Engaging with industrial ecosystems

In Port Esbjerg, the industrial ecosystem means that multiple energy systems can be evaluated. This requires adequate port infrastructure, but when assessing the common direction for shipping biomass and



'... one of the most significant industries for Port Esbjerg is offshore wind with its huge expansion plans for Europe.'

biogas, it also includes sustainable fuels. The biogas produced outside Port Esbjerg gets its feedstock partly from fish farm waste, but to actively merge the circular economy into the industrial ecosystem the ships servicing the offshore fish farms could operate on biogas.

However, one of the most significant industries for Port Esbjerg is offshore wind with its huge expansion plans for Europe. This growth requires an increase in the production of offshore wind turbines and many more ships will need to be deployed to cater for the industry's future demands. Port Esbjerg engages fully in this. It's plans for offshore wind production is driven by power from offshore wind. Of course, the technological gap for the green transition of ships needs a careful strategic approach.

The electrification of ships is already used for ferries and is a hybrid solution for service operation vessels serving the offshore wind industry, but turbine installation vessels and the fast crew transfer vessels throw up other challenges.

The future e-fuels for the ships may be methanol, ammonia, or hydrogen. The industrial ecosystem will catapult these possibilities. The ongoing shift towards sustainable heating in the City of Esbjerg allows for sector coupling, where waste heat from production can be sold and used in the municipality's central heating systems, thereby providing cost benefit for the companies operating within the spatial cluster of Port Esbjerg.

This provides an advantage for establishing power: for power-to-x systems for production of e-fuels. Renewable energy is used to produce these fuels, and it may therefore be argued that swift installation of offshore wind farms is essential. Epitomized in the drive for green transition in ports and onboard ships, the access to a vast amount of renewable energy is imperative, and this again demonstrates the position of Port Esbjerg as one of the epicenters for offshore wind, where future expansion plans define future possibilities.

Sustainable infrastructure and sector coupling

Expansion projects in Port Esbjerg are conducted by using the sand dredged from the channel, and the addition of the next 50 hectares is about to commence. For Port Esbjerg this means a continuing important role in the offshore renewable industry. To progress towards the complete power-to-x sector coupling hub, the industrial ecosystem and other activities in the nearby surroundings are included in the port's expansion plans. Port Esbjerg considers this to be an integral part of being a sustainable energy port.

www.portesbjerg.dk