# Seminar on multipurpose terminals in small ports

**Deliverable D10.5 - Version Final – 2023-05-31**

**Advanced, Efficient and Green Intermodal Systems**

**http://aegis.autonomous-ship.org/**

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# 1 Executive Summary

This document reports the seminar on “Multipurpose terminals in small ports” which was held on April 19th, 2023, in Vordingborg, Denmark.

The seminar was attended by 12 participants and summarized the general findings from the AEGIS logistical system and those related directly to WP10 and the Port of Vordingborg use case. The seminar was organised under the following agenda:

| | |
|---|---|
| ISE: | Presentation of vessel designs that are applicable to the Vordingborg Case |
| Port of Vordingborg: | Presentation Port of Vordingborg, introduction to interactive session. |
| Port of Vordingborg: | Guided tour on the Port of Vordingborg including the AEGIS pier |

It should be noted that this report only summarizes the seminar in Vordingborg. Therefore, more specific details concerning the presented findings and material should be found in the public deliverables, which can be found the at the project webpage: https://aegis.autonomous-ship.org/


This seminar was part of a two-days seminar series together with Port of Aalborg. The first day was arranged at Port of Aalborg and that seminar is described in the deliverable D10.6 *Seminar on Intermodal Autonomous Green Terminal in medium ports* [2].

# Definitions and abbreviations

**RoRo:** Roll on Roll off

**SSS:** Short-Sea Shipping

**PoV:** Port of Vordingborg

# 2 Seminar on multipurpose terminals in small ports

The seminar in Vordingborg on multipurpose terminals in small ports was held in two locations, hence Port of Vordingborg, Islandsvej 8, 4760 Vordingborg and at Johanneberg, Hjaletvej 51, 4760 Vordingborg in Denmark on April 19th, 2023. The seminar was organised as the second seminar in a two-day event, where the seminar D10.6 on Intermodal Autonomous Green Terminal in medium ports was held April 18th, 2023, in Aalborg, Denmark.

The seminar was organized and moderated by Jan-Jaap Cramer (CEO of Port of Vordingborg), with agenda as listed in Figure 1. The participants list can be found in Annex A Participants list.

**AGENDA**

**AEGIS SEMINAR**

**D10.5: Seminar on multipurpose terminals in small ports**

***Place:*** *Vordingborg*
***Time:*** *19th of April 2023*

| 19th April | |
|---|---|
| 09:00 - 09:10 | Welcome and introduction to guests |
| 09:10 - 09:25 | Presentation Vessel concept UC-C: SSS/IWW LoLo by Stefan Krause |
| 09:25 - 09:40 | Presentation Port of Vordingborg, introduction to interactive session. |
| 09:40 - 10:30 | Interactive session |
| 🚗 | *Transport to Port of Vordingborg (approx. 15 minutes)* |
| 11:00 – 12:30 | Guided tour on the Port of Vordingborg including the Aegis pier |
| 🚗 | *Transport back to Johanneberg* |
| 13:00-14:00 | Lunch |
| 14:00 | Wrap up |

*Figure 1 – Agenda*

**List of speakers:**

- Stefan Krause, ISE (Virtual, teams)
- Jan-Jaap Cramer, PoV

This document summarizes the most important points and arguments of each presentation and the interactive session held with the participants.

## 2.1 Design requirements

During the AEGIS project the main focus for Port of Vordingborg has been to set the design requirements for the multi pier (see Figure 2). The main driver for the study for investigating the feasibility to establish the multi pier was to provide new port infrastructure to move more cargo from road to sea by providing a facility where autonomous RoRo ships can handle cargo autonomously on remote port areas, where this designated remote port area would be leased on a time slot basis. On the pier, in a designated area, a "pop-up" RoRo terminal could be in operation on a weekly basis. Other weekdays, the area could be used by other port operators, also based on short lease terms.

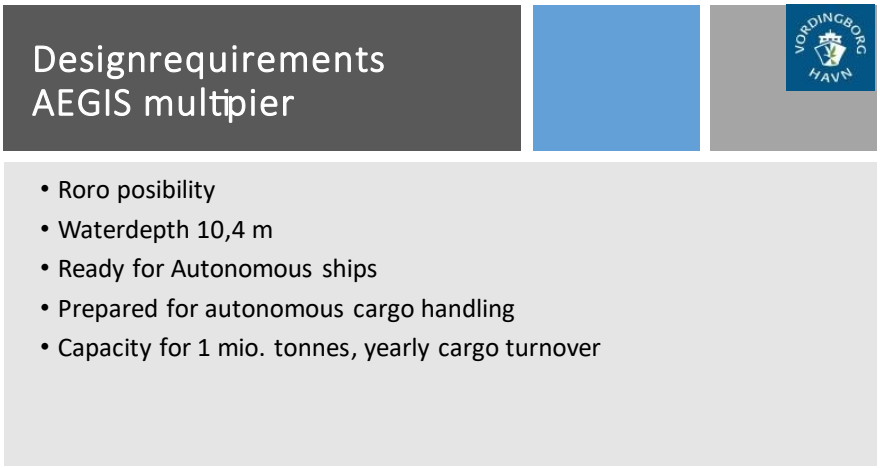


*Figure 2 – Design requirements for Aegis multi pier*

Based on the expected potential cargo volumes, a weekly call from a RoRo vessel with a capacity of 50 units would be feasible, and the first design (Figure 3) was developed with this requirement. To make the business case more feasible, the pier should also be capable of handling other commodities simultaneously with ships up to 200 meter in length.

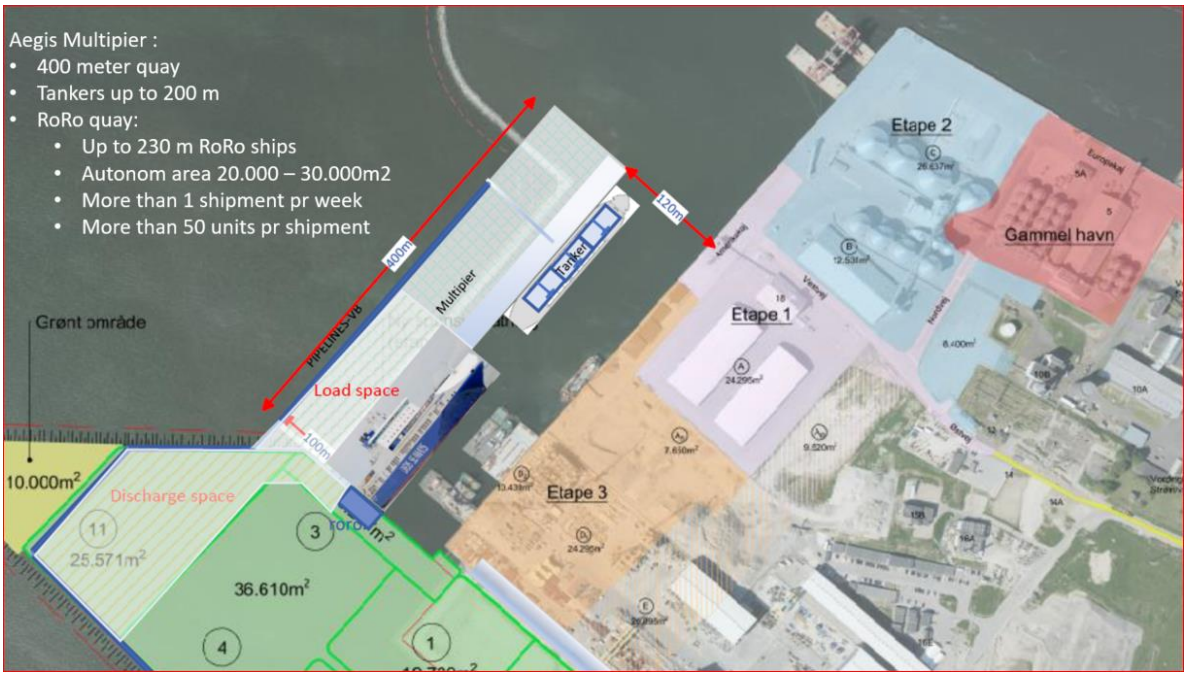


*Figure 3 – First design AEGIS multi pier*

In the design studies a yearly cargo turnover of 1 million tons on the AEGIS multi-pier was set as minimum. In the final design the below requirements for cargo turn-over have been applied (Figure 4):

**Design requirements**
**cargo turnover:**

Biomass 500.000 tons
Aggregrates 400.000 tons
Metanol 200.000 tons
eKerosine 90.000 tons
Nafta mv 10.000 tons

*Figure 4 – Design requirements cargo turnover for Aegis multi pier*

Developing a commercial port rather close to the city and residential areas brings in "social" requirements to the design. It is a challenge to make a feasible and sustainable business case for port infrastructure and at the same time comprise the design of the infrastructure to minimize nuisance from developing, building, and operating a commercial port facility. In the design process, Port of Vordingborg worked closely with the local zone-planning authorities to investigate possibilities within a new zone-planning area. Among other things, this has resulted in no buildings being built on the pier and the harbour expansion to the west being limited.

In the final design, which has been approved by the Port of Vordingborg board of directors, all the design requirements are met (Figure 5).


*Figure 5 – Final Design AEGIS multi pier*

Although the final and approved design is almost similar to the initial design, minor but important changes have occurred in the design. Below is a summary of the main changes.

**Readiness for autonomous ships:**

To provide better and safer solutions for autonomous ships, the turning basin is widened. This enables ships to operate autonomously in a bigger area and allows more simultaneous ship movements also when the port is congested. Furthermore, possibilities for accommodating RoRo ships are approved in the final design.

**Social Requirement:**

The project has been moved about 30 meters to the East to minimize “horizon pollution” for nearby residential areas. The added benefit of this move is that the dredging work associated with the construction of the AEGIS pier will be significantly smaller and will therefore reduce costs and environmental impacts.

**Sustainability:**

The social demand that resulted in moving the project east allowed us to maximize port space, resulting in a better long-term business case. At the same time, the scale-up of the project allows us to find better and more sustainable ways to build the pier, as the larger volume creates opportunities for the recovery of excessive soil and residues instead of using natural means.

**Layout of the pier:**

The AEGIS pier is designed with an area for a long-term (25 years) lease. The reason for this is that a potential RoRo operator had no interest in operating from the port and no replacement operator could be found. Therefore, the idea of the “pop-up" RoRo-terminal for autonomous RoRo ships was cancelled. Instead, we worked with the idea to have the possibility to accommodate and handle small autonomous bulk carriers. Import of bulk commodities is a growing market, especially import of aggregates.

## 2.2 Purpose built ships

The design of the concept vessel has been adapted and chosen to meet the expectations of handling new cargo goods with coaster-sized, autonomous cargo ships, see design requirements in Figure 6. The ship must have a very shallow draught and a shallow air draught, which allows the ship to sail in smaller ports with limited water depth and to destinations on the larger rivers and canals in Northern Europe, where there is both draught and height limitations. These could be destinations in the German Ruhr area, for example in Duisburg and Düsseldorf. Because of the navigation in shallow waters in smaller ports and fairways the designed ship has a high manoeuvrability.

Specifically, the size of the ship allows to sail to new destinations in the Port of Elblag, in Poland with very shallow waters. This destination, in the north of Poland is interesting in terms of the possible trade of biomass on a regular basis.

- Design requirements on the vessel concepts:
  - combined SSS-IWW multi-purpose vessel of CEMT class VI with low draught
  - capacity of approx. 3,500 tons dry bulk with options for container and project cargo
  - (Re)-moveable bulkheads for different types of cargo (bulk, containers)
  - Removable hatch covers
  - An on-board crane to open and store the hatch covers
  - A low-emission propulsion system based on (bio)-methanol
  - An evolving autonomy level, starting with 1–2 and adjustable to 3–4
- Designs adaptations for:
  - weather conditions, water depth, port facilities, cargo type, cargo volume

*Figure 6 – Design requirements for vessel concepts*

Based on the design requirements in Figure 6 ISE has developed a concept for a low-emission autonomous shallow water coaster, suitable for this AEGIS use case, see Figure 8. In the Port of Vordingborg use case, the following routes are being considered (as shown in Figure 7):

- Vordingborg - Ruhr area, Germany
- Vordingborg – Elblag, Poland


*Figure 7 – Considered routes from Vordingborg to northern Europe*

The ship is designed to transport bulk cargo but has also the right dimensions to sail with containerized cargo. A combination of the two different cargo types on a single voyage will also be possible. The size of the ship and the cargo capacity allows for "one day" cargo operations. That means that the ship either can load or discharge in normal working hours, even in smaller commercial ports. This is a big advantage for ship owners where “time is money”. (Cargo loads above (about) 3.500 tons for loading or discharging, requires more than one working day in an average port).

The propulsion system is based on two independent (bio)-methanol-electric power supplies to two independent 360 degrees propellers (Figure 9). This guarantees a sustainable transport and high manoeuvrability and allows navigation in shallow waters.

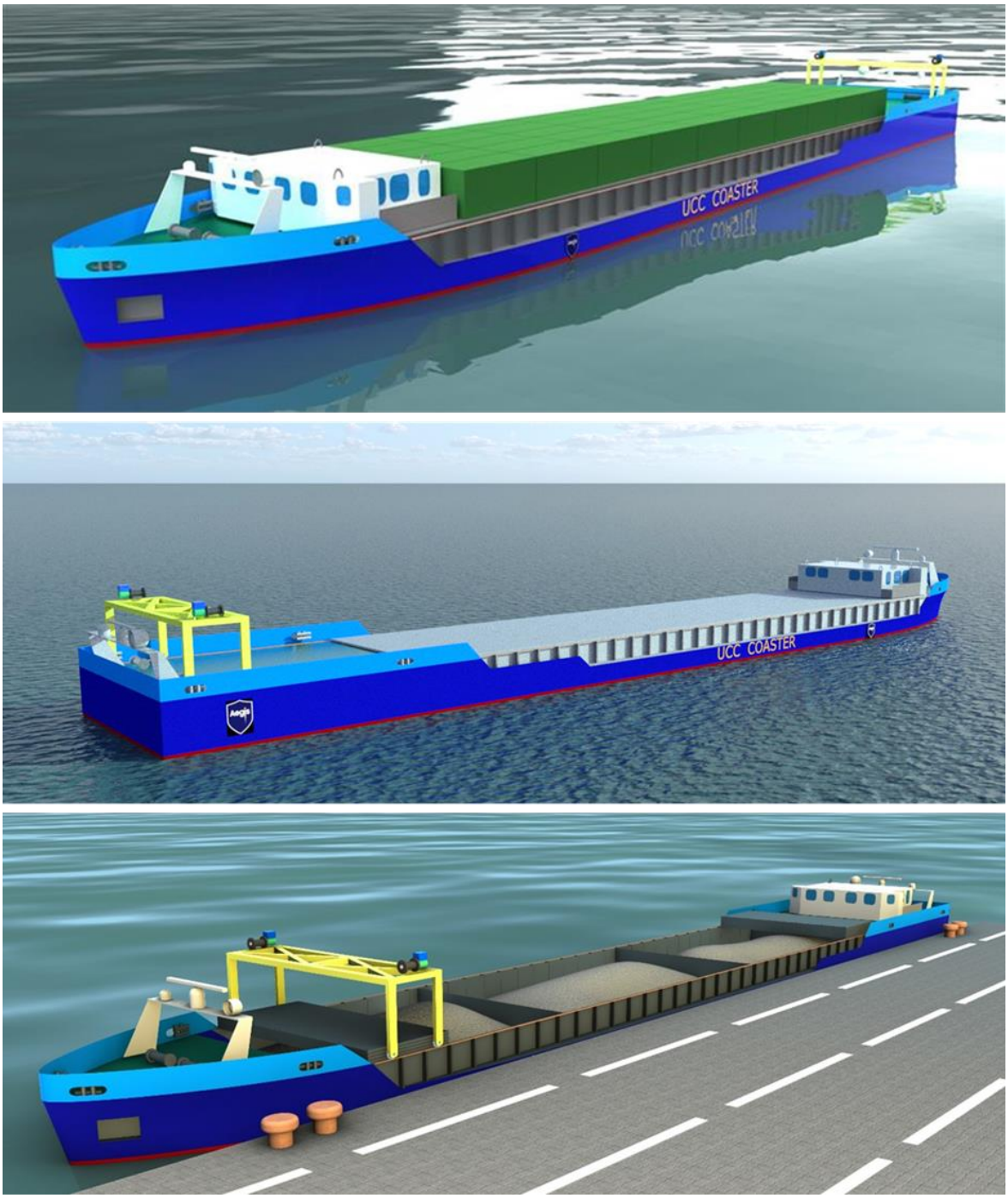


*Figure 8 - ISE concept for a low-emission autonomous shallow water coaster*

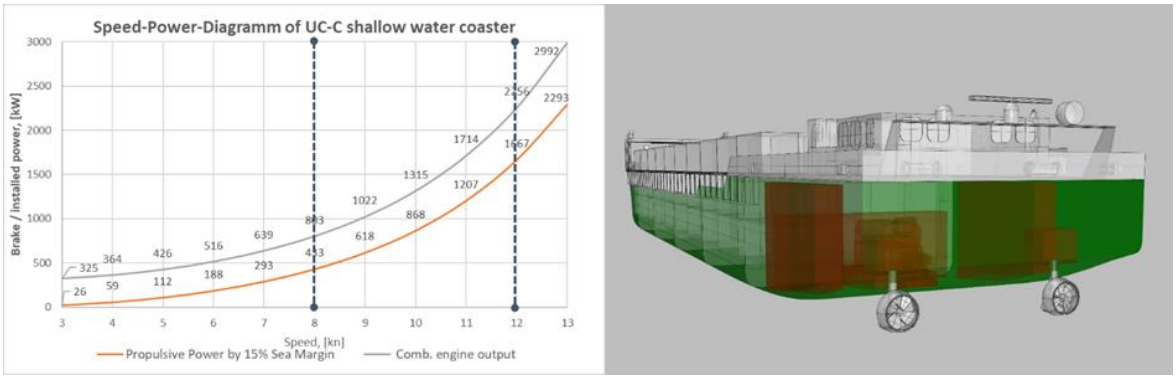


*Figure 9 - Propulsion system*

## 2.3 Results so far

The Port of Vordingborg has undergone a significant growth in recent years and four port expansion projects have already been realized since 2015. In the coming years, a further growth is expected. In the beginning of the AEGIS project, the goal was to actively work with the green transition and move cargo from road to sea by facilitating new port infrastructure and redeem potential existing cargo volumes.

These potential cargo volumes should be carried on regular basis on a liner service by smaller autonomous ships in RoRo units and containers. During the last years it seems, however, that the Port of Vordingborg can also play another important role in the green transition of waterborne transport by providing port area and port infrastructure to producers of new green fossil free fuels for the shipping industry. In 2022, Port of Vordingborg signed lease contracts with two new companies who within a near future will produce eFuels. At the same time, it seems not to be feasible with a regular RoRo service or other liner service.

The pier and the ship concepts are therefore redesigned and adjusted to the new potential cargo types. One of the two new companies to be established in connection to the multi pier expects to import between 200.000 and 400.000 tons of biomass yearly. This biomass, straw in briquettes, is available in the bigger agriculture areas as we see in, for example, the north of Poland. For that reason, the autonomous ship is designed and designated as a very suitable trader between smaller ports in the north of Poland and the Port of Vordingborg. At the same time Port of Vordingborg sees a potential significant growth in the transport and import of aggregates, since natural resources are becoming scarce in Denmark.

The ship design has an excellent layout to transport aggregates between the smaller ports in general and the quarries in Sweden and Norway. For this reason, a hatchless, self-discharging version could be a possibility. With the signed lease agreements, the expected yearly cargo turnover rates on the AEGIS multi pier will be around 1 million tons in 2027.

## 2.4 Interactive sessions

Port of Vordingborg organised three interactive sessions with the participants to see how Port of Vordingborg could benefit from the potential of the ship design, the design of the AEGIS multi pier and the potential cargo as described in the AEGIS WP 10 - D10.3 *Potential for calling the two Danish ports by DFDS* [1]. The participants were divided in three groups with the following topics:

- Potential cargo
- Ships concept
- Port infra structure

## 2.5 Potential cargo

During the session the participants had to discuss and answer (see Figure 10):

1. How can AEGIS, society, short sea shipping, commercial ports, and others benefit from the report and collected data?
2. How can the report be combined with the vessel concept?

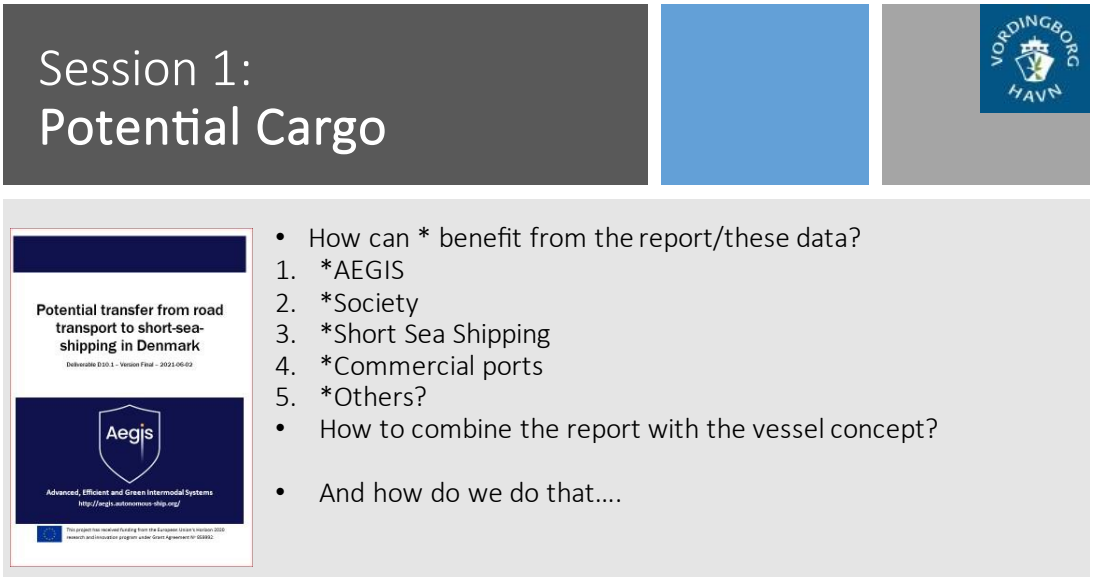


*Figure 10 – Potential cargo*

Table 1 summarizes the input from the interactive session on potential cargo.

*Table 1 – Summarized input from interactive session on potential cargo*

| | |
|---|---|
| **AEGIS** | RoRo potential – greater bulk business/perspective |
| **Society** | - Smaller and more flexible vessels with automation and climate-friendly fuel move traffic from road networks (= less pollution and congestion) – cheaper operation – less dependence on personnel.<br>- Logistics can become dependent on smaller hubs/ports to create a web (network of ports).<br>- Being informed of the vision of the port and what can change in terms of navigation around the area.<br>- Less air pollution because of alternative propulsion types.<br>- Smaller vessels are better for visual pollution/noise (especially for residents in the waterfront).<br>- Increased economic activity in the region can benefit local industries associated with transport and energy.<br>- Local industries may have facilitated access to new markets because of the proposed new routes.<br>- Potential for new job types in the region (namely in the energy industry).<br>- Autonomous terminals may link well with other such terminals (e.g., Aalborg) and create new industrial partnerships to develop isolated regions in DK.<br>- Having ports who are first movers in new tech forces public authorities to regulate and create new policy and this opens the field for other ports. |
| **Commercial ports** | Port network – flexibility – new logistics systems |
| **Other** | - Point to point is replaced by web<br>- Fish exports<br>- Seasonal freight/cargo/port -> port<br>- Biomass exports<br>- Competition on price, environment, and smooth transition<br>- Interesting for cargo owners<br>- Distribution (DH, shipping companies, freight forwarders) |

The general conclusion on this session is that “Society” can benefit most according to the participants. It seems that there should be a further potential to move more cargo from road to sea.

## 2.6 Ship concept

During the session the participants had to discuss and answer (Figure 11):

1. How can the vessel concept be commercialized?
2. How can the report be combined with the vessel concept?

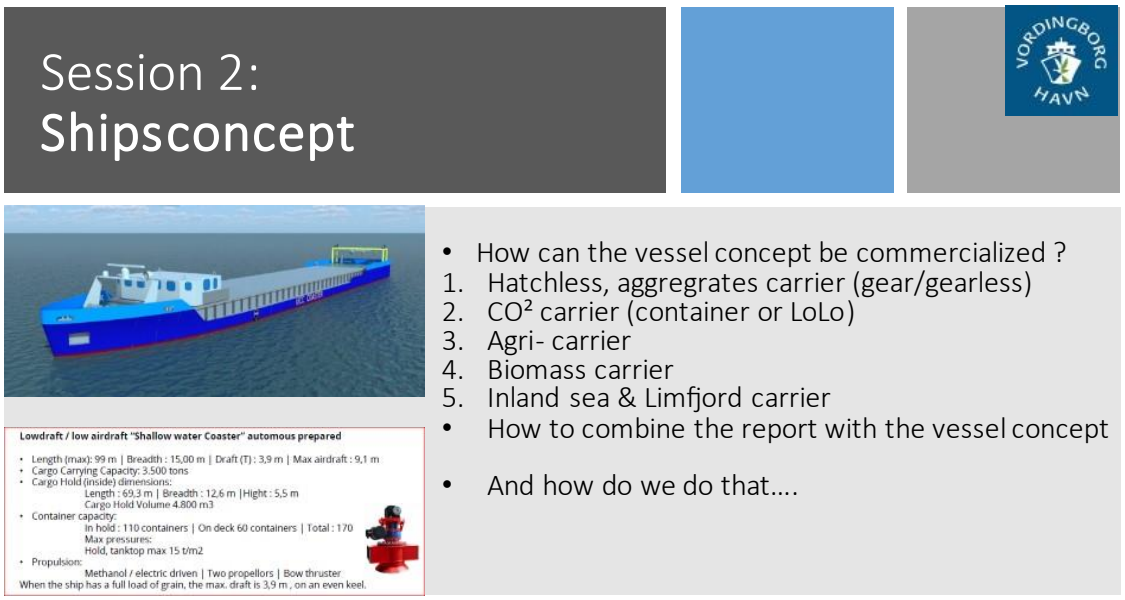


*Figure 11 – Ship concept*

Table 2 summarizes the input from the interactive session on ship concepts.

*Table 2 – Summarized input from interactive session on ship concepts*

| | |
|---|---|
| **Innovation** | Port of the future |
| **Digital port** | Objects must be digitized |
| **Cargo** | Cargo shuttle service from port |
| **Environment port** | Bio – hydrogen |
| **Dues** | Dues to move the shipowner to green operations |
| **ROR** | Port infrastructure must be able to be carried on an autonomous ship |
| **LOR** | ROC > docked |
| **Sustainability versus economy** | Shipowner, shipyard, shipping, port. Can investment be remunerated sensibly? |
| **CO2-carrier** | Can be a transition solution without piping. In addition, it is possible for non-piped geographies to ship CO2, hydrogen, etc. |
| **Agri-carrier, biomass carrier** | - More items that are standardized can make it attractive for shipping companies to call at smaller ports. |

| | |
|---|---|
| | - Requires network/facilities to exploit the potential. DSV on water.<br>- Limfjord carrier has potential |
| **Other** | Ship/engine maintenance – TEAMS on board |

The general conclusion on this session is that the ship has a good potential to be commercialized. The Port of Vordingborg will consider further studies with the aim to realize construction and operation of the ships concept.

## 2.7 Port infrastructure

During the session the participants had to discuss and answer (Figure 12)

1. What role should the Port of Vordingborg have so society can benefit from the port and the vessel concept design and why?

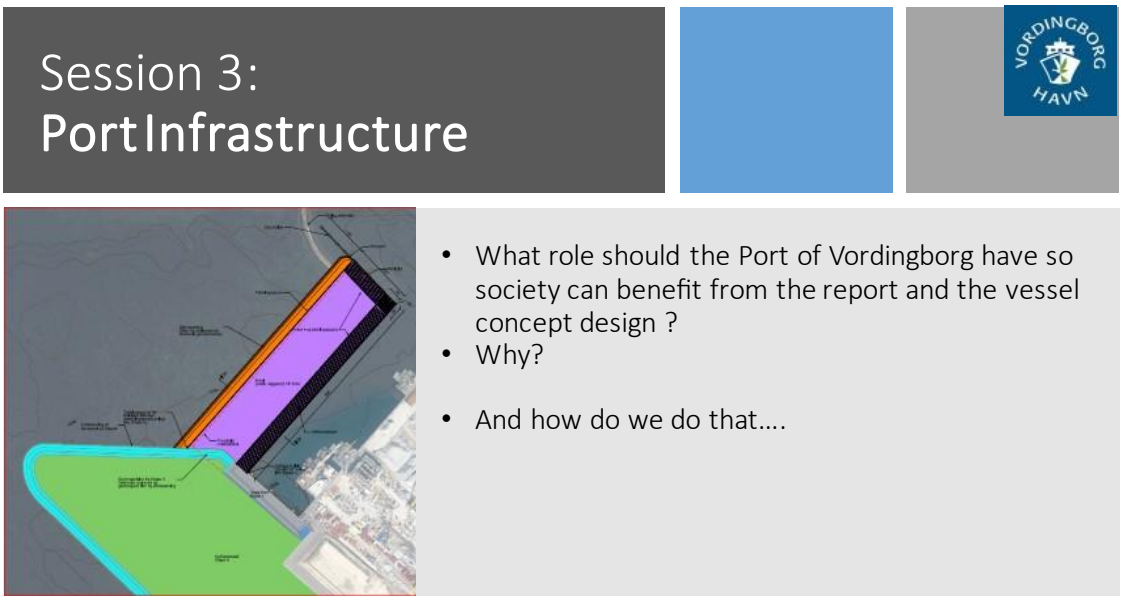


*Figure 12 – Port infrastructure*

The main take-aways from the discussions:

- Port of Vordingborg must take on the role of facilitator/integrator that makes things happen that Port of Vordingborg cannot do alone.
- Port of Vordingborg already uses the power of being an example
- Think in attractive investment sources - Who will invest in green long-term infrastructure?

The general conclusion from this session is that the Port of Vordingborg has an important role in facilitating port infrastructure, and therefore must have an innovative and pro-active approach. However, Port of Vordingborg cannot stand alone in this role, but will need collaboration with business partners, authorities, and EU-project partners.

# 3 Conclusion

Multipurpose terminals in small ports have a great potential to attract new cargo volumes when providing a capacity of port infrastructure where industries can be developed.

Port of Vordingborg is pursuing the findings from AEGIS. The design of the AEGIS pier helps to facilitate the green transition of waterborne transport and allows the Port of Vordingborg to continue pursuing the aim to move more cargo from road to sea.

In the coming years, after the construction of the AEGIS-multi pier, new cargo flows in the Port of Vordingborg will be realized, of which a great part has potential to be shipped autonomously and handled autonomously at the port.

Cargo to be handled at the Port of Vordingborg is suitable for semi- or fully autonomous handling, both for loading and unloading. The ship design can be a tool for creating liner shipping between the smaller commercial ports in Northern Europe and thus move more cargo from road to sea.

# References

[1] AEGIS 859992 D10.3 Potential for calling the two Danish ports by DFDS, November 2021

[2] AEGIS 859992 D10.6 Seminar on Intermodal Autonomous Green Terminal in medium ports, May 2023

# Annex A Participants list

List of participants of the D10.5 seminar:

| **Participant** | **Company/Organization** |
|---|---|
| Jan-Jaap Cramer | PoV |
| Daniel Irvold | PoV |
| Camilla Rosenhagen | Danske Havne |
| Kenneth Johansson | NCL |
| Bjarke Møller | PoA |
| Jesper Raakjær | PoA |
| Kay Fjortoft | Sintef |
| Odd Erik Mørkrid | Sintef |
| Stefan Krause (online participant) | ISE |
| Espen Tangstad | Sintef |
| Jesper Kraft Andersen | PoV |
| Christina Mayland | PoV |