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a Kongsberg Wilhelmsen joint venture

Autonomy in shipping; opportunities and challenges

Per A. Brinchmann, Wilh. Wilhelmsen Holding ASA

- World leader in dynamic positioning and marine automation
- Frontrunner in digital development
- Leading in development of autonomy
- In front on cyber security

www.kongsberg.com

- In front on vessel operation and ship management
- Major logistics operator at sea and on land
- Owns and operates 20+ terminals
- A global network - 2 200 ports in 74 countries

www.wilhelmsen.com

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Our offering: Autonomous operations in the value chain

Logistics

Planning and full operation from factory to dealer

Terminals

Design, specification, project management and operation

Autonomy

All hardware and software for the vessel and the shore control center

Vessel

Turn key; design, specification, site management and approvals

Operation

Vessel operation from control center, ship management, all approvals etc.

Manning

Access to all maritime and technical competence as required

Insurance

Broking and facilitation

Financing

Facilitation and possible participation

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What shall we deliver?

Environmentally friendly logistics enabling the shift from road to sea

30% of all cargo that is transported by roads over 300km to be transported by waterways & rail within 2030 and 50% by 2050

European Commission, 2011

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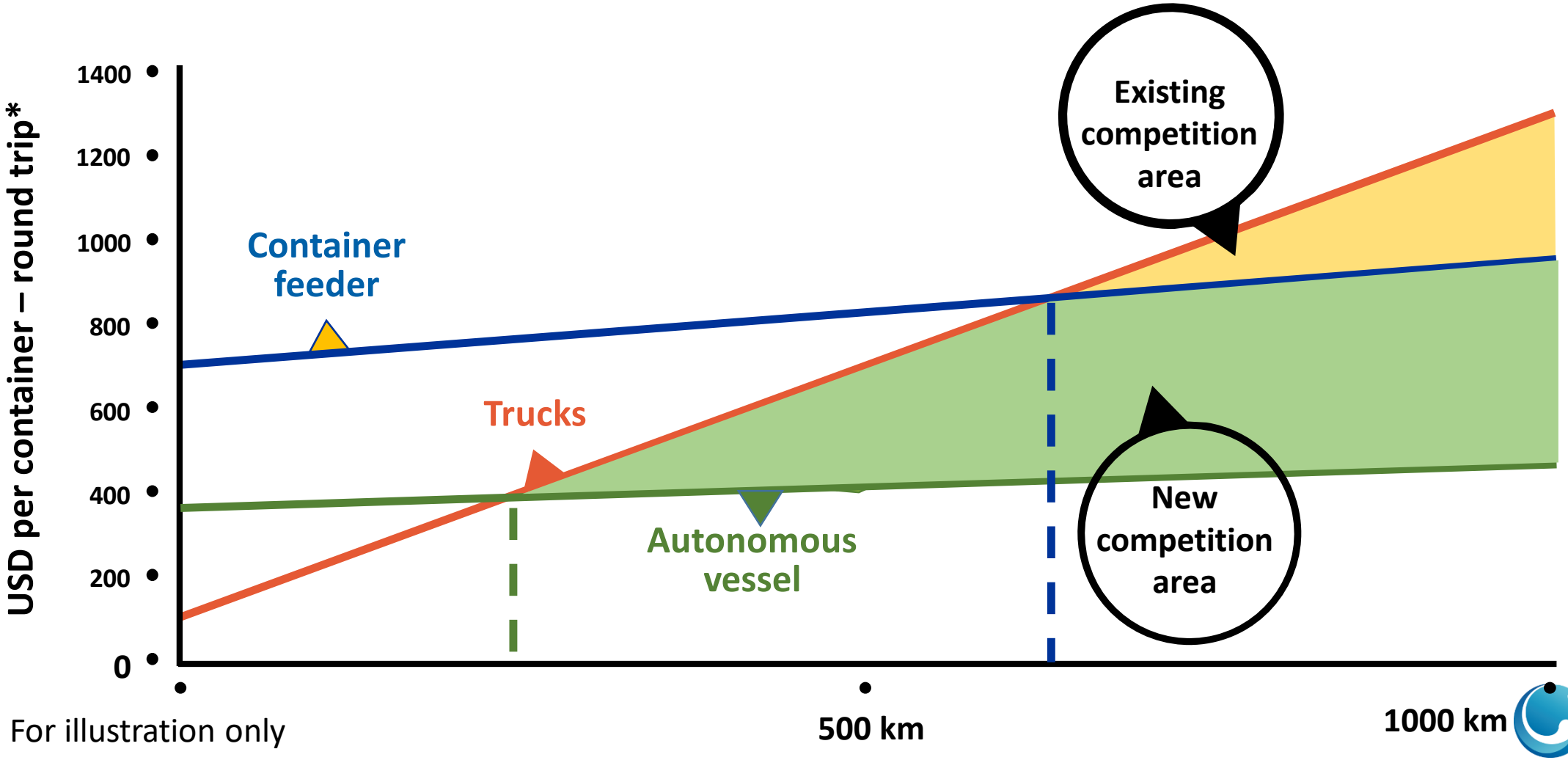
Autonomous feeder logistics will compete with road transport on significant shorter distances



* For illustration only

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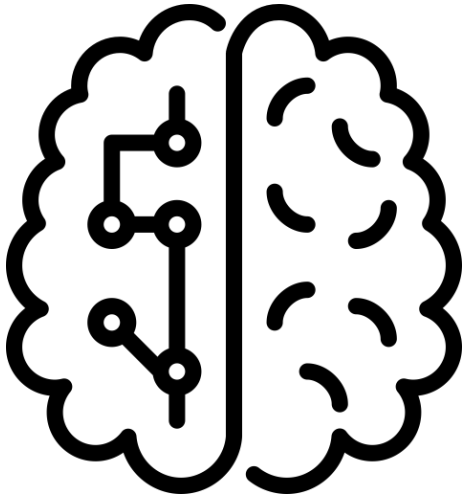
Autonomy* is the means, not the target



Autonomy will, over time, contribute to:

- Simpler vessels; lower investment cost
- Lower operational cost
- Acceptance of lower speed; less environmental impact
- Enhanced safety in sea and port operation
- More effective and safe cargo handling
- Safer and more cost effective conventional vessels

*Autonomous; Self regulating and self sailing, monitored from a shore center

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The technical enablers for vessel autonomy

1. Situational awareness
   Radars, AIS, GPS and new sensors; cameras, infrared cameras and LIDARs
   Sensor fusion creating a complete picture of the ship in surroundings in an awareness module

2. Autonomous Navigation
   Auto pilot, collision avoidance, maneuvering system, dynamic positioning

3. Machinery control
   Simplified by partly or fully electric propulsion solution

4. Communication Ship - Shore control module
   MBR (Mobile Broad Band), 4G, 5G, VSAT, Cyber security and control

5. Shore Control Center (SCC)
   A task oriented human operator environment ensuring short time to decision

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The technical enablers for vessel autonomy; what's new?

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The Shore Control Centre (SCC)
- a costly showcase or a value adding service?

	Personnel required	
Open hours	2 persons on watch	3 persons on watch
8/5	3	4
15/5	5	7
24/5	7	10
8/7	4	6
16/7	8	12
24/7	12	18

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The Shore Control Centre (SCC)
- now under construction in our Lysaker office

- Up to 24/7 manned monitoring and control
- Remote control capabilities (no maneuvering)
- Digital twin and full simulator available
- Redundant and secure communication
- Part of emergency response team of ship manager

- Will also serve conventional vessels, i.e.;
  - Performance monitoring and assistance
  - B0/PUB: Periodically unmanned bridge
  - Extended E0; “Chief on shore”
  - Cargo handling control
  - ……

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Maritime Autonomous Surface Ships (MASS)
- as defined by IMO:

1. **Ship with automated processes and decision support:**
   Seafarers are on board to operate and control shipboard systems and functions.
   Some operations may be automated. (Like most of today's vessels)

2. **Remotely controlled ship with seafarers on board:**
   The ship is, partly or fully, controlled and operated from another location, but seafarers are on board

3. **Remotely controlled ship without seafarers on board:**
   The ship is controlled and operated from another location. There are no seafarers on board.

4. **Fully autonomous ship:**
   The operating system of the ship makes decisions and determine actions by itself without external control

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The regulatory landscape; a showstopper?

"Maritime Autonomous Surface Ship (MASS)" is defined as a sh… to a varying degree, can operate independently of hum… …ion.

- IMO has started a scoping exercise. Timeline to regul… …rs ++
- National or regional regulatory bodies are free t… …e introduction of novel technologies and operational concepts wi… …rritorial waters.

Tech… …ualification as per MSC.1/Circular 1455 in SOLAS: Demon… …l of safety equivalent or better compared to conventional vessels

Another opportunity for the Norwegian Maritime Cluster

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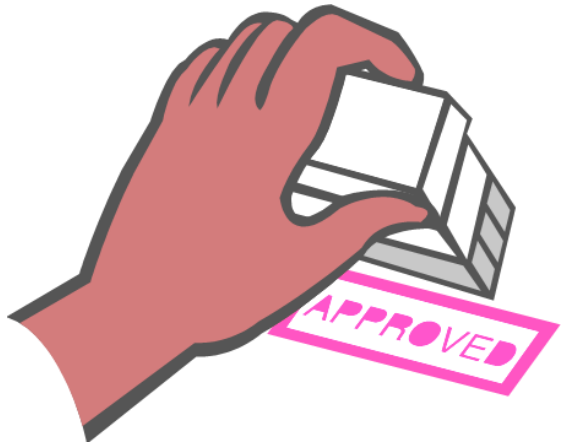
We are clearing the road towards autonomous logistics

…by collaborating closely with authorities and stakeholders



- Captain’s role
- Manning and competence in Shore Control Centre
- Acceptance criteria for autonomous sailing
- Compliance with SOLAS
- Compliance with the ISM Code
- Compliance with the ISPS Code
- Local rules and sailing permits
- Flag state regulations
- Legal aspects in general
- Insurance
- Ethics

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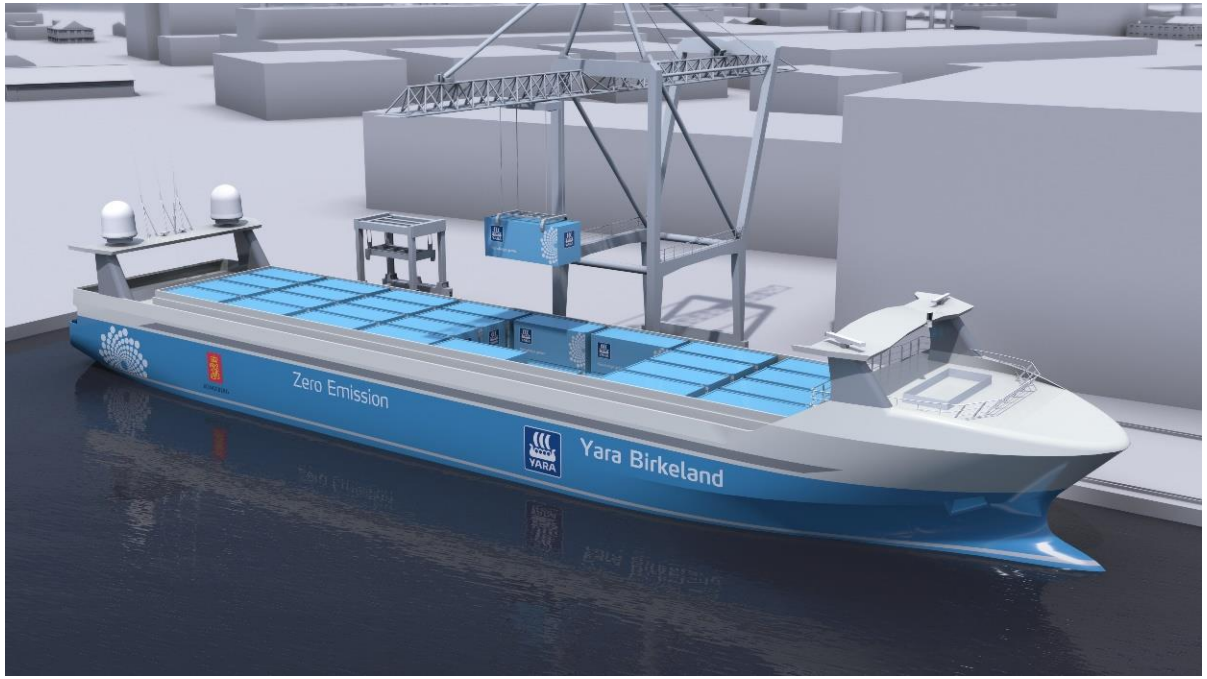
The Yara Birkeland project;
- a fully electric, autonomous 120 teu feeder vessel



- Sailing between 3 Norwegian ports
- Replacing 25,000 truck-loads/year

- Length: 80 m
- Width: 15 m
- Service speed: 8 knots
- Battery capacity: 6 MWh
- Ordered for delivery Q1, 2020
- Fully autonomous sailing in 2021

- Autonomous cargo handling

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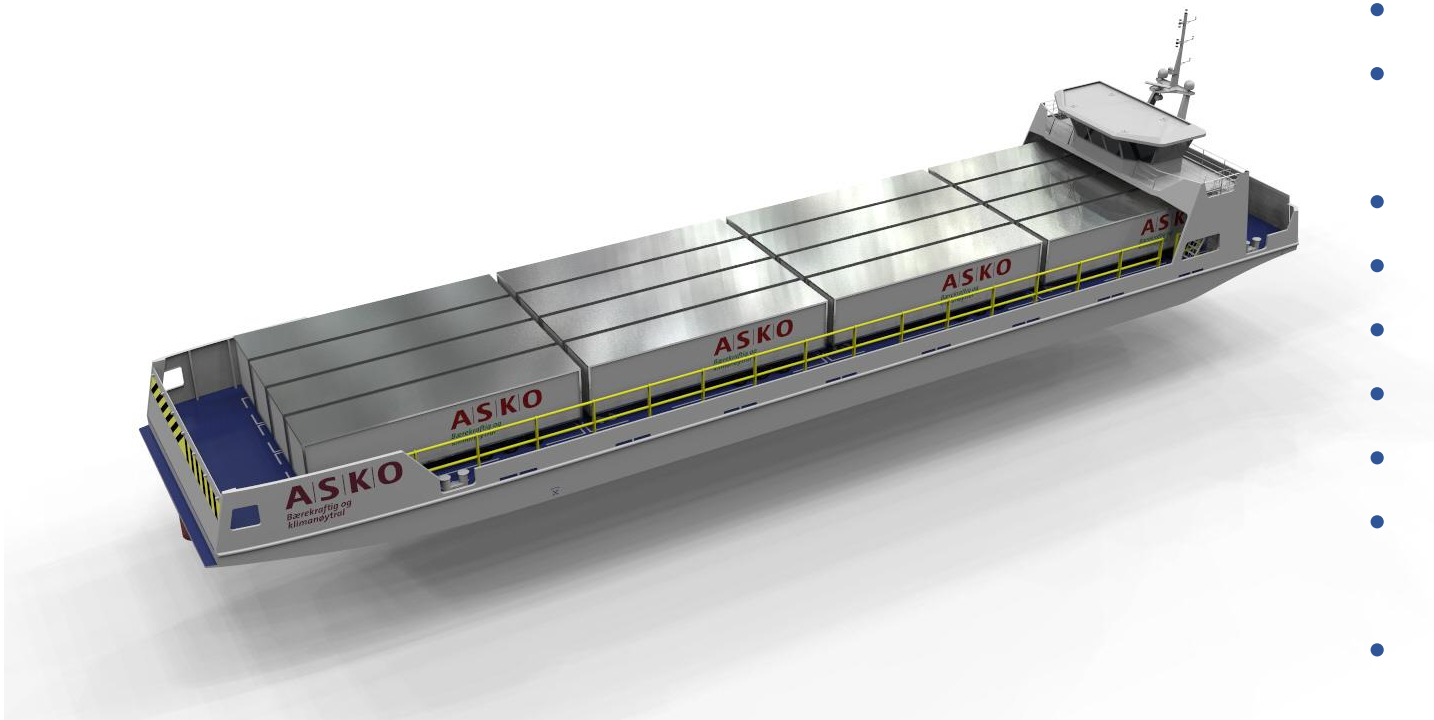
The ASKO project:

- fully electric autonomous RoRo feeders for 16 trailers



- Crossing the Oslo fjord
- Replacing 1 million truck-kms/year

- Length: 66 m
- Width: 15 m
- Service speed: 8 knots
- Battery capacity: 1,1 MWh
- Target delivery: Q4, 2020
- Fully autonomous sailing in 2021

- Autonomous cargo handlling

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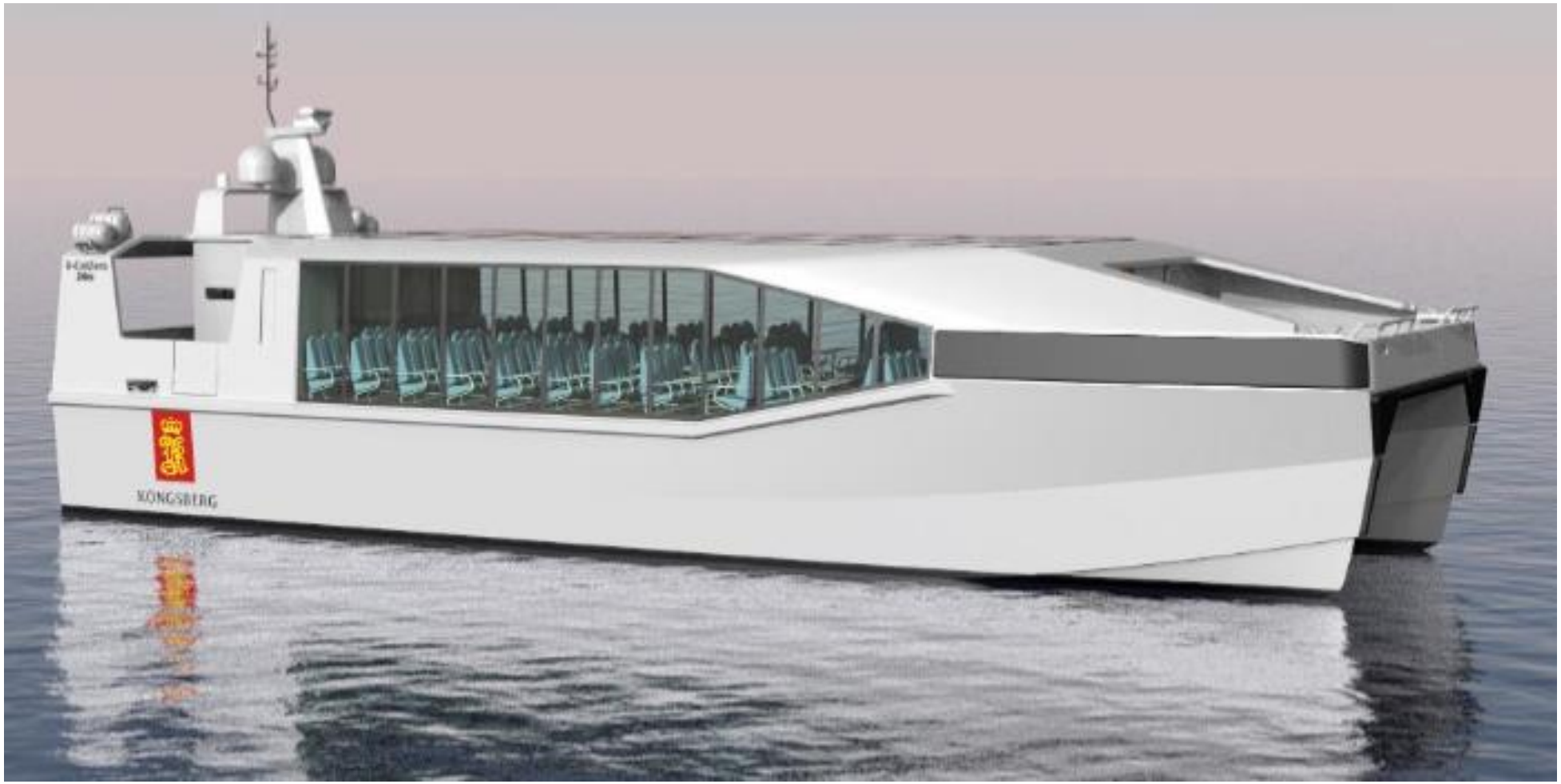
Seashuttle Project:

- semi-autonomous container vessel with hydrogen/fuel cells
- trading between Oslo, Gothenburg, Malmo and Poland

- Awarded € 6 Million in support from Norwegian government (PILOT-E program)

- Project owner: Samskip
- Partners : Massterly
  Kongsberg
  HYON
  Kalmar
  FlowChange

Concept; autonomous passenger vessel
- autonomous sailing, but with a safety crew for passengers



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The different levels of autonomy and manning

Degree of unmanned

Unmanned vessel

Reduced crew

Full crew

Cost-effective logistics,
moving goods by sea rather than truck

"Next Generation Shipping"
OPEX reduction
(fuel, crew, maintenance)

Auto docking,
Collision avoidance

Conventional vessel

Autonomous functionality / remote control

Fully autonomous

Degree of autonomy

Our autonomy in the interest of the society

- New, compatible logistics solutions
- Zero/low emission vessels only
- Improved safety at sea and in port
- Removes road traffic
- Speeds up development of new regulations
- Improved safety and efficiency of conventional vessels

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