


IPIC 2023

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Physical Internet Conference

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Athens, Greece

Small and medium automated ports - the future of intermodal logistics and the AEGIS project

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Scope

- Introduce the AEGIS H2020 project
- Report some results
- Focus on work by DTU

EU policy: Shift cargoes from road to greener modes (sea, inland navigation, rail)

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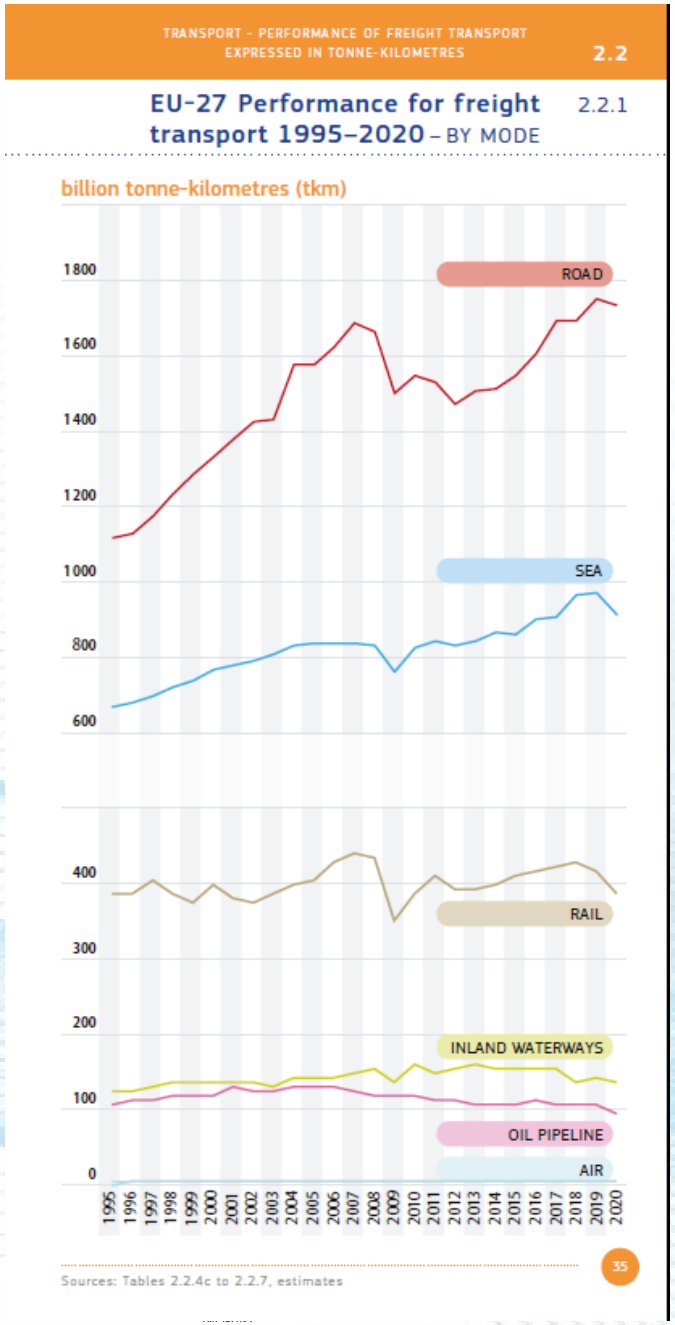

Intra EU-27 freight by transport mode: disturbing trends

- Source: EU statistical pocketbook 2022

GROWTH 1995-2020

ROAD 54.8%
SEA 36.6%
RAIL 0.7%
INLAND NAV. 14.6%
AIR 45.4% !

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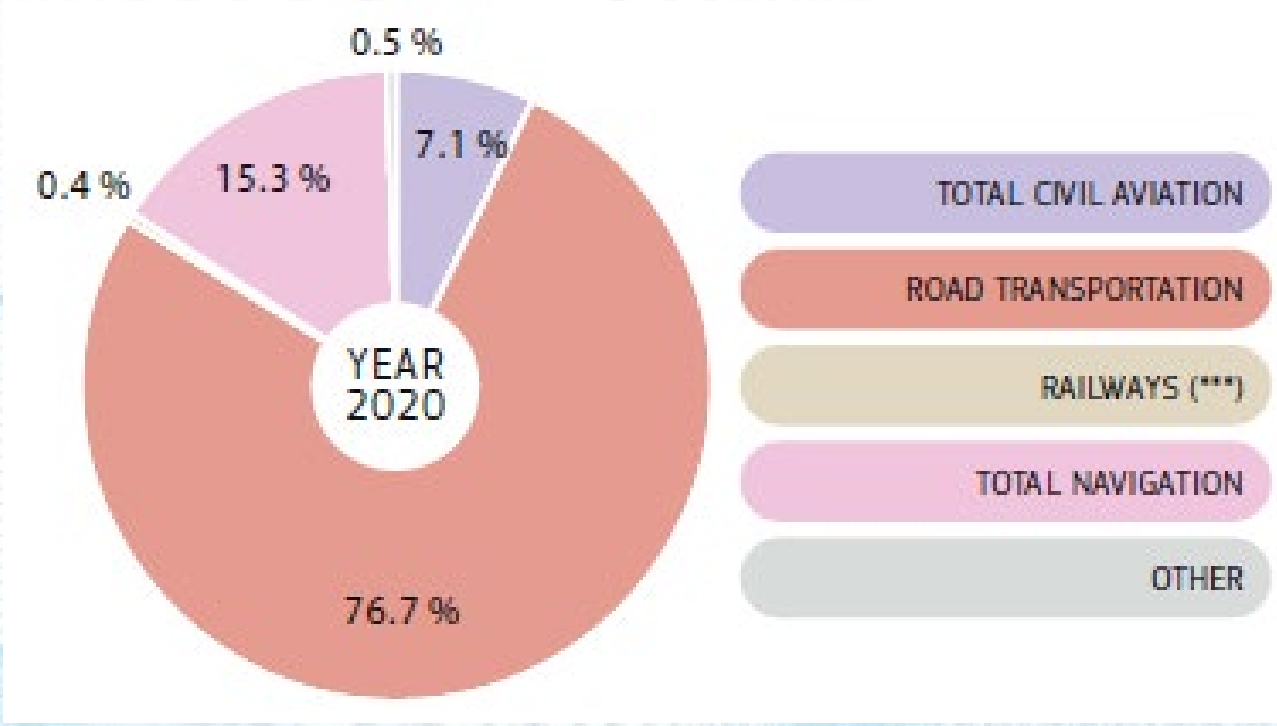
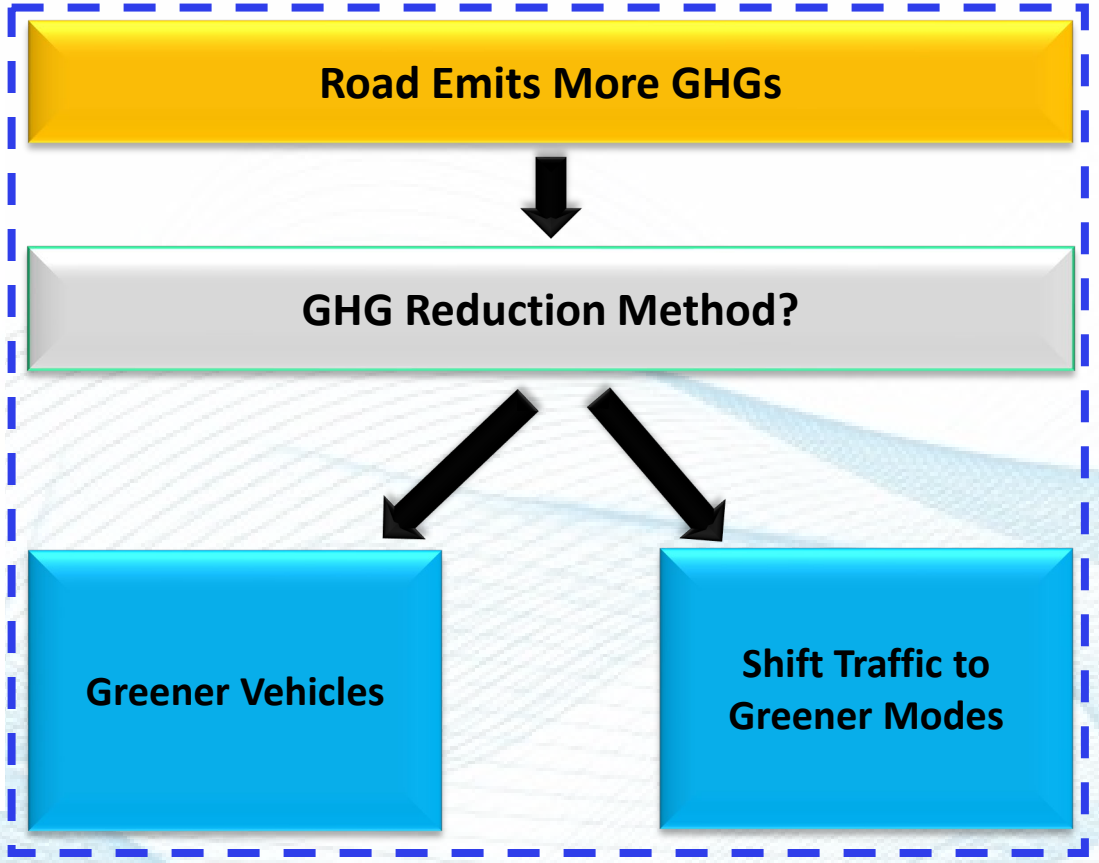
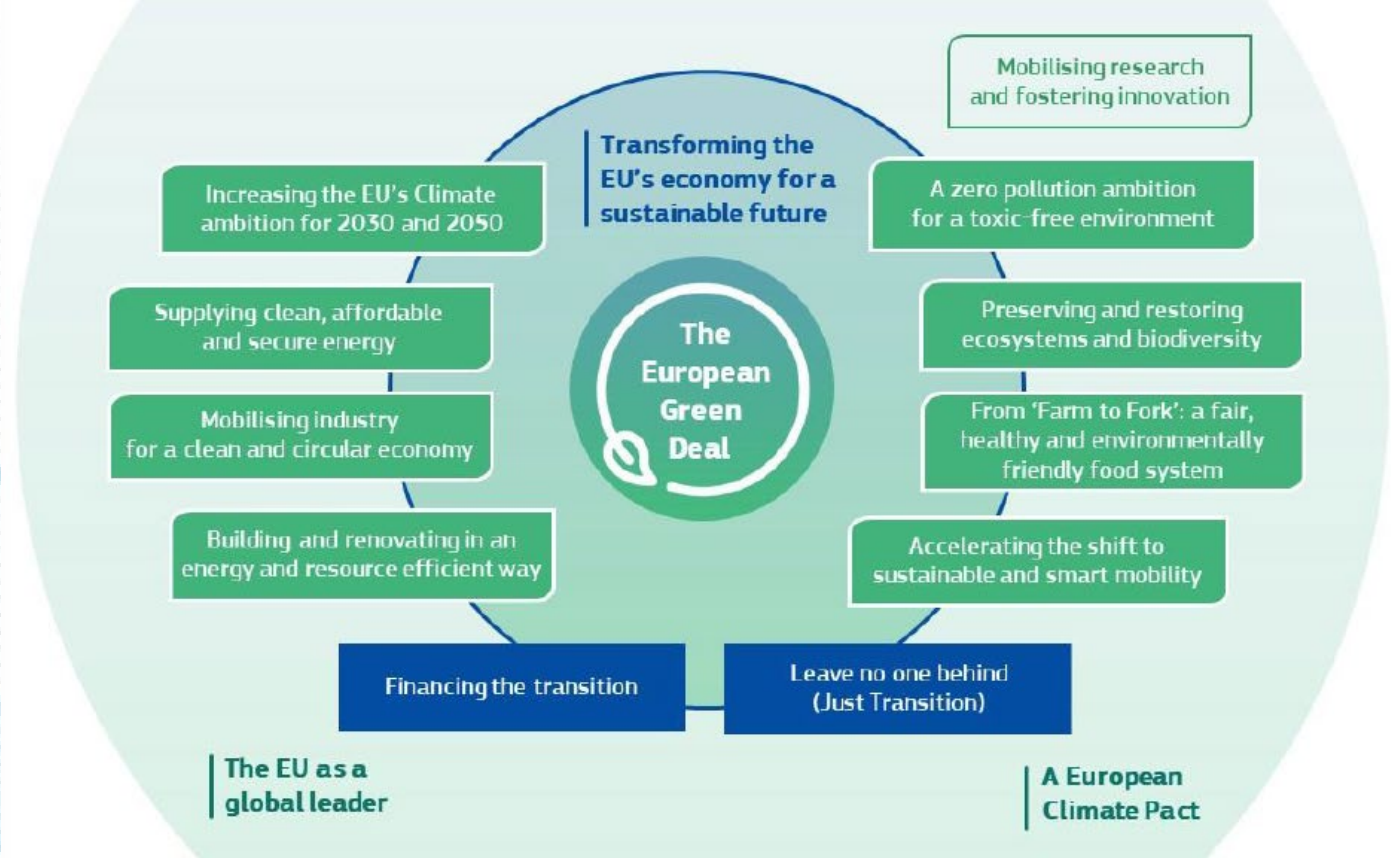
Road pollutes more

- Source: EU statistical pocketbook 2022





The European Green Deal



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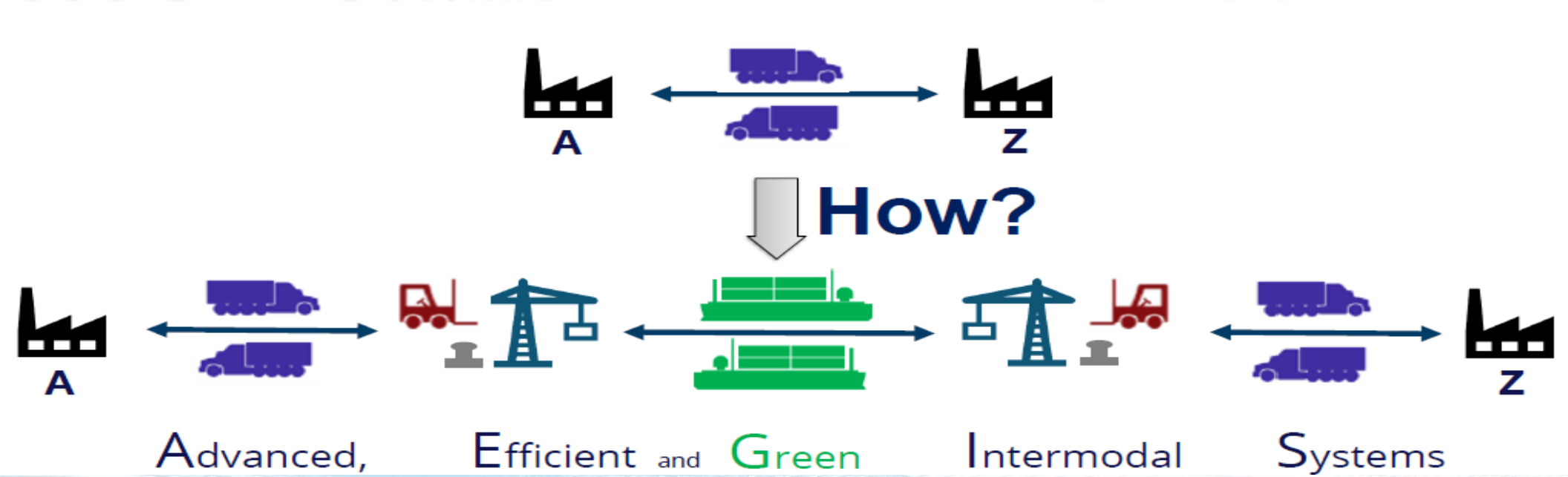
Central Pillar of the European Green Deal

How to tackle the logistical challenge?

- Enter the AEGIS concept!



Project Info

- **EU Horizon 2020 call:**
  MG-2-6-2019: Moving freight by Water:
  Sustainable Infrastructure and Innovative Vessels
- **Budget: EUR 7.5 Million**
- **Start: June 1st 2020**
- **End: Nov. 30 2023 (42 months)**
- ***Web site:*** **http://aegis.autonomous-ship.org/**

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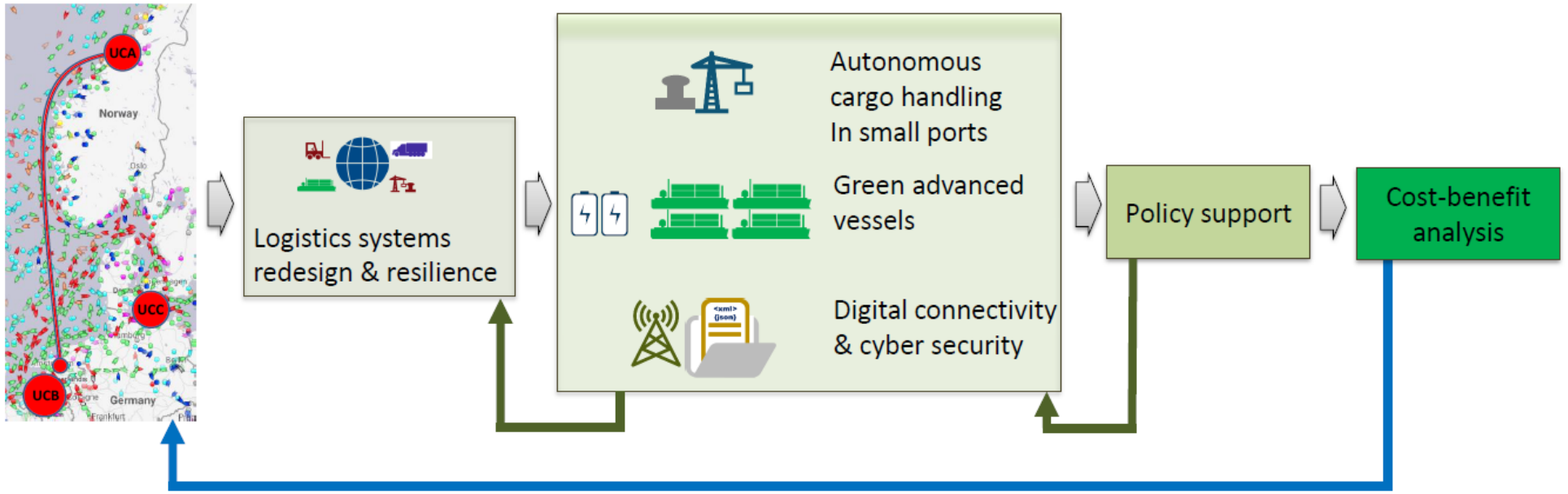
Partners

- Leader: SINTEF Ocean

The project

- A cross-disciplinary approach



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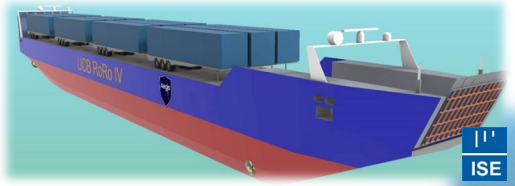
AEGIS: *The next generation sustainable waterborne transport system*

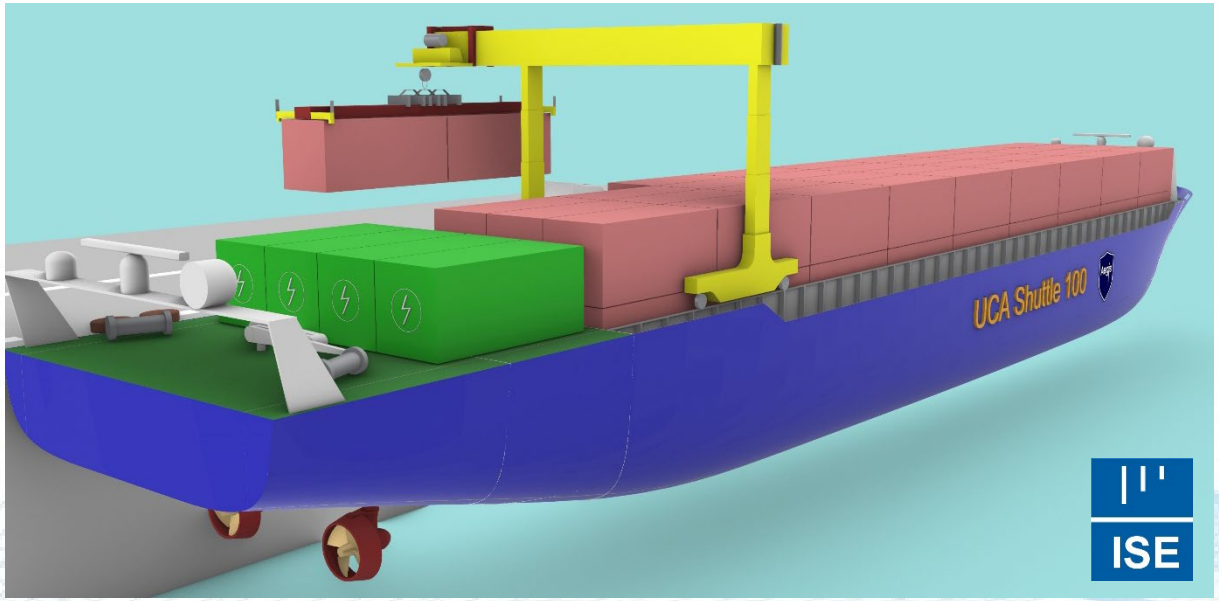
1. Small and flexible ships
2. Autonomous cranes
3. Autonomous terminals
   - Higher utilization of small/medium ports
4. Digitalization and
5. Communication
6. Autonomy
7. New energy sources



The project has received funding from the European Union's Horizon 2020 Research and innovation program under Grant Agreement N°859992.

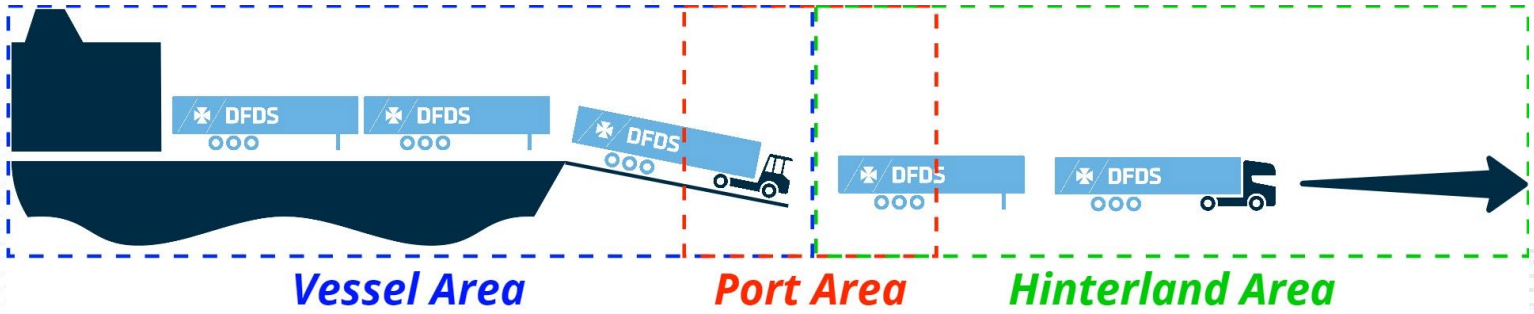
Next generation vessels

- Autonomous securing of cargo
- Autonomous crane
- Autonomous navigation
- No superstructure
- Autonomous mooring
- Battery propulsion - containerized

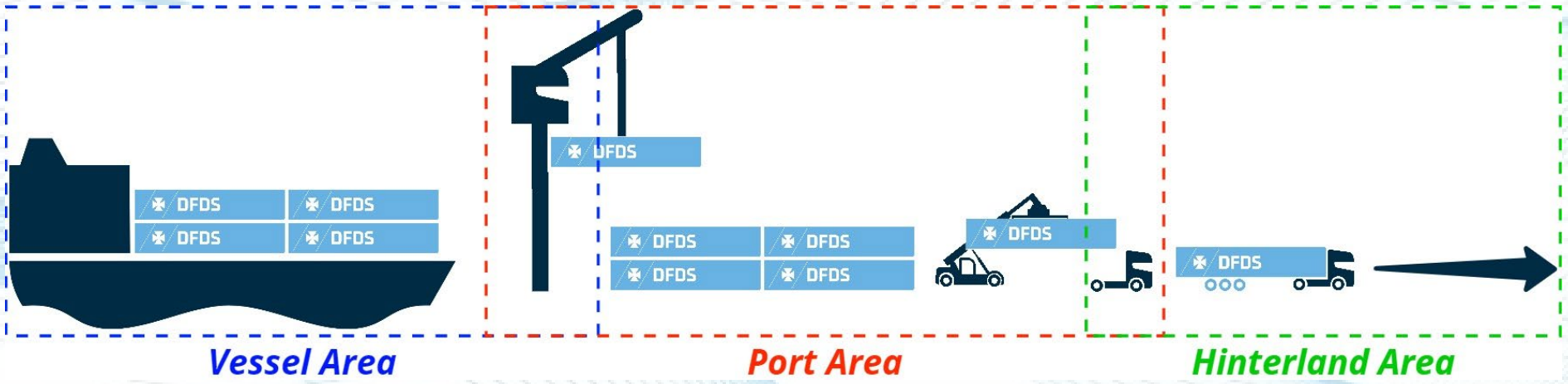


The project has received funding from the European Union's Horizon 2020 Research and innovation program under Grant Agreement N°859992.

RoRo vs LoLo concepts



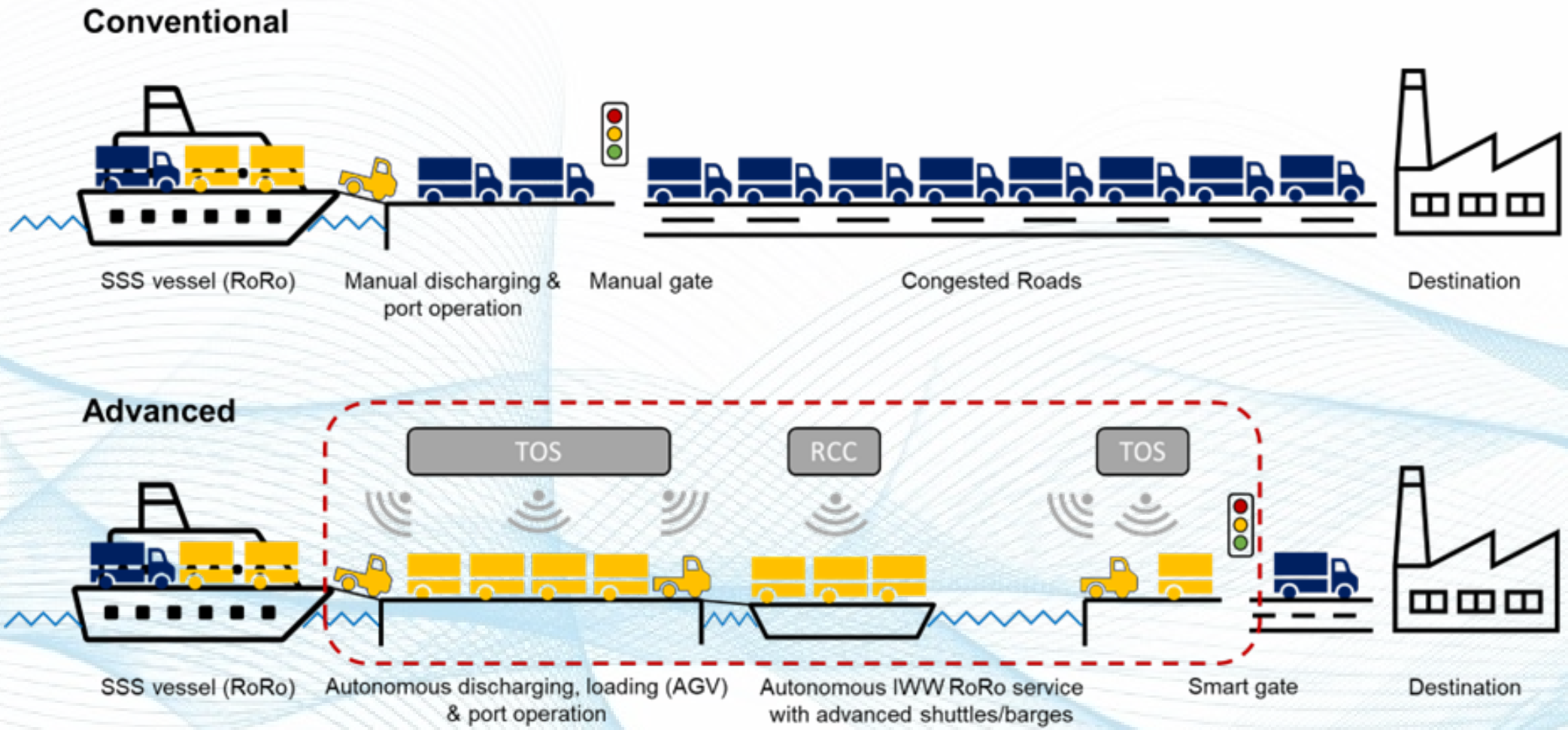
RoRo Barge
Cargo Operations



LoLo Barge
Cargo Operations

The project has received funding from the European Union's Horizon 2020 Research and innovation program under Grant Agreement N°859992.

Smart and autonomous



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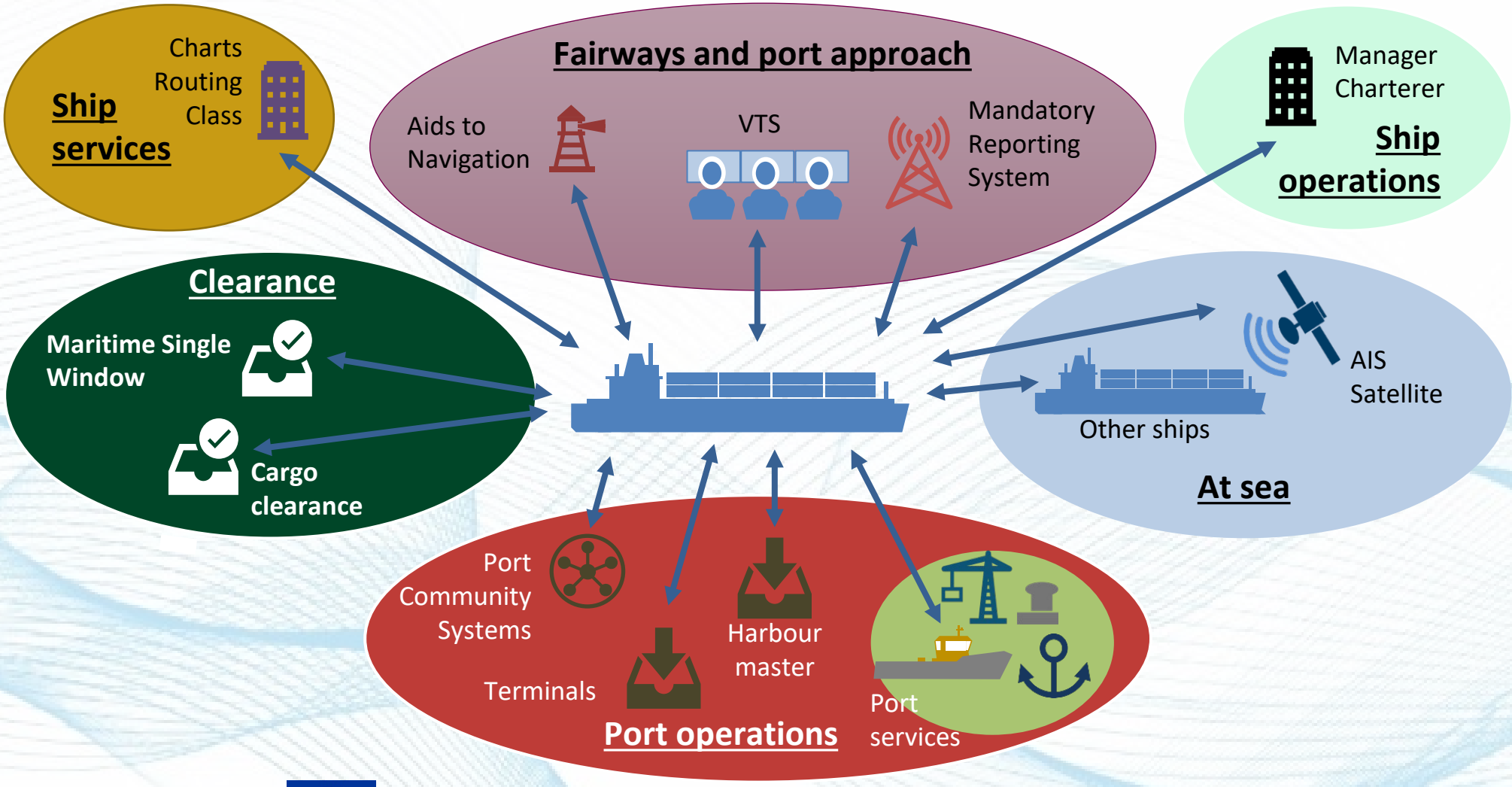
Digital exchange between ship and shore



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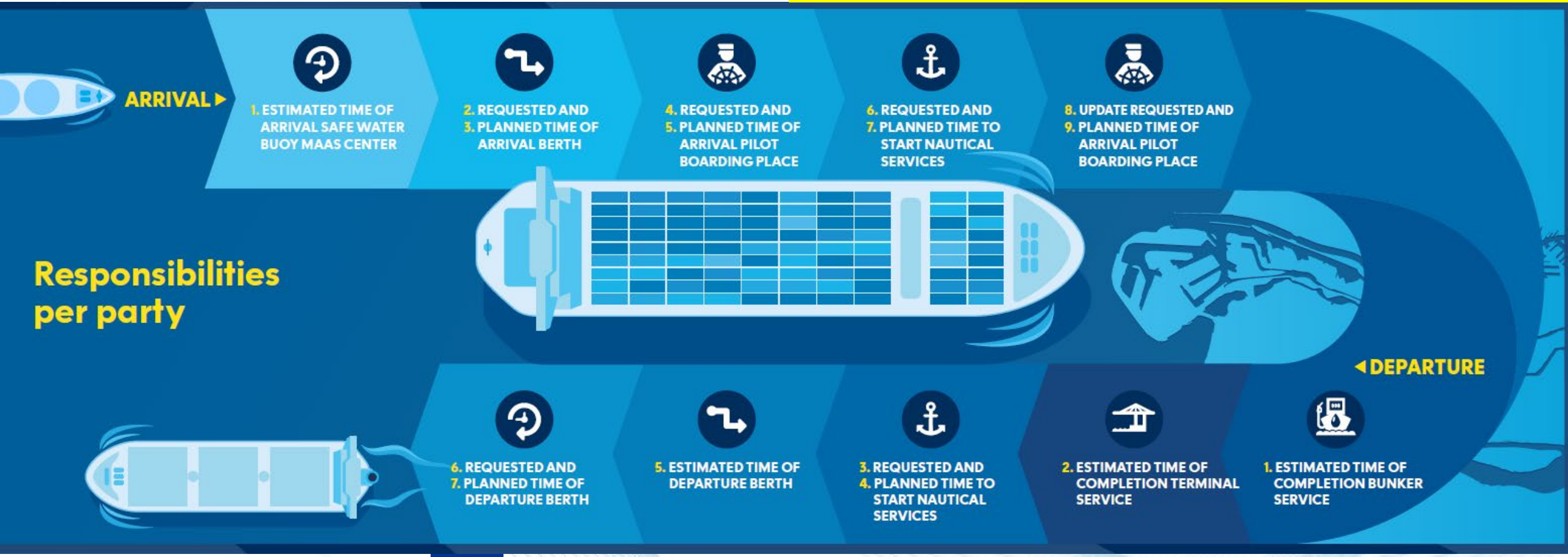
Just-In-Time Arrival/Departure

- JIT Data set included in IMO Reference Model
- Test implementation in 2023/2024 in the Rotterdam-Singapore digital corridor
- Presentation of results to FAL 48 in March 2024



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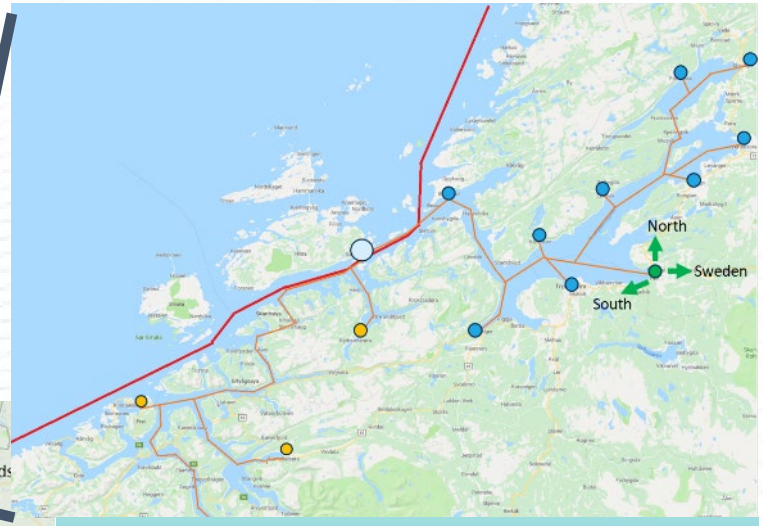
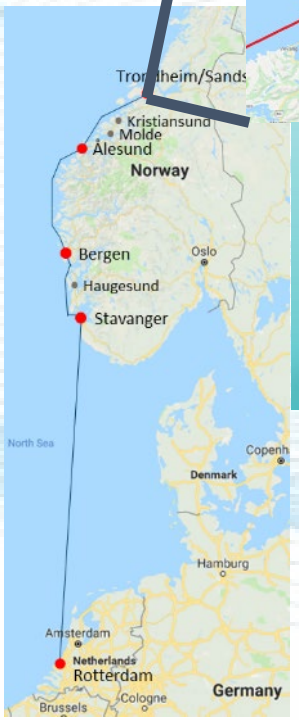
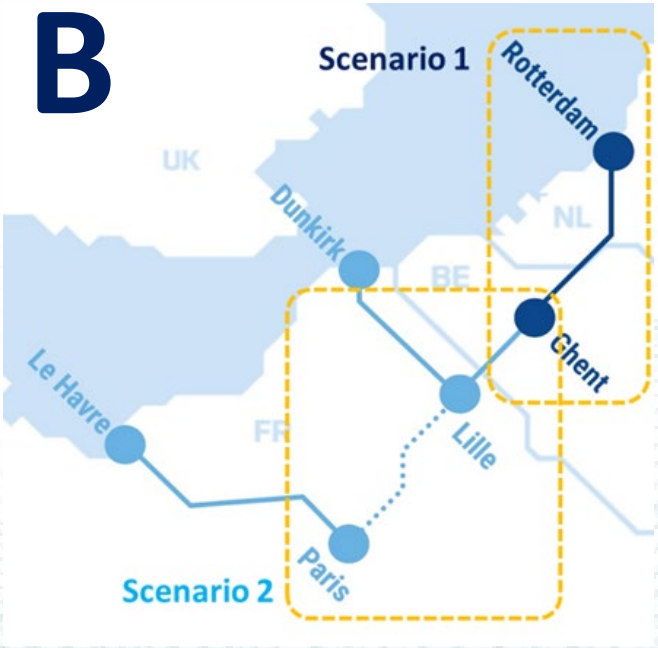
Three use-cases

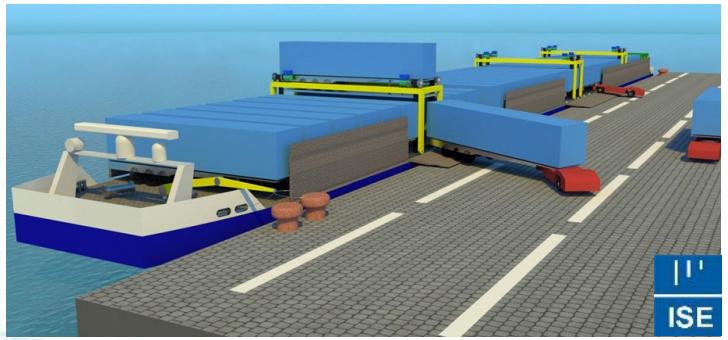
A

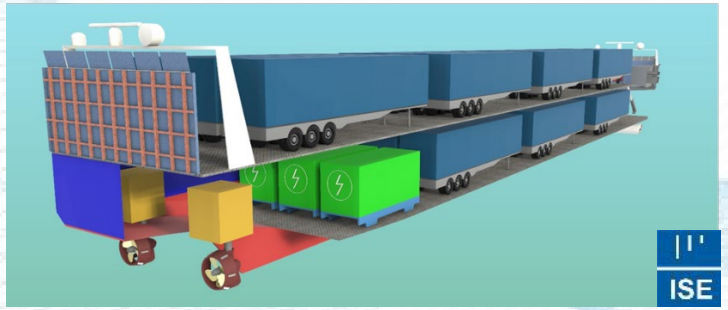




B

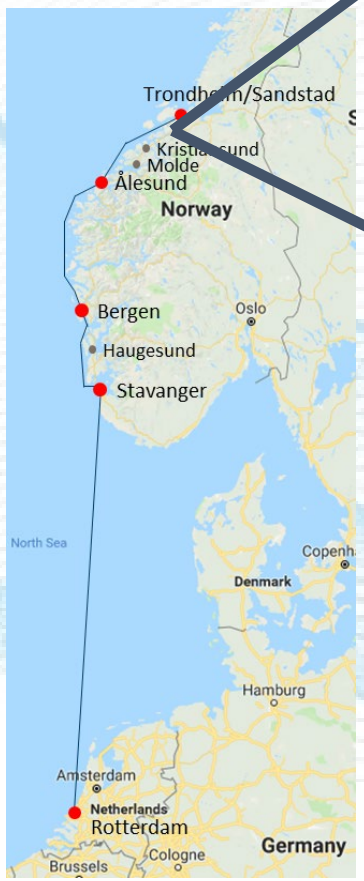






C

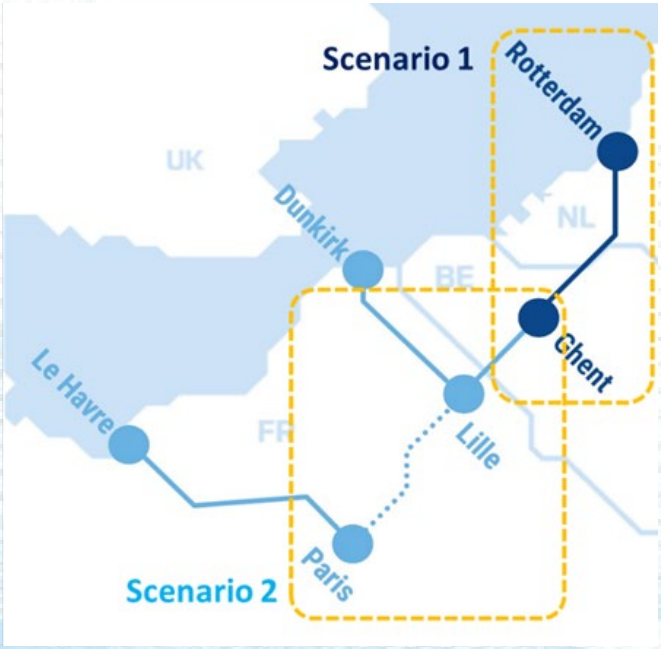
Use-case A: Short sea terminals in Norway

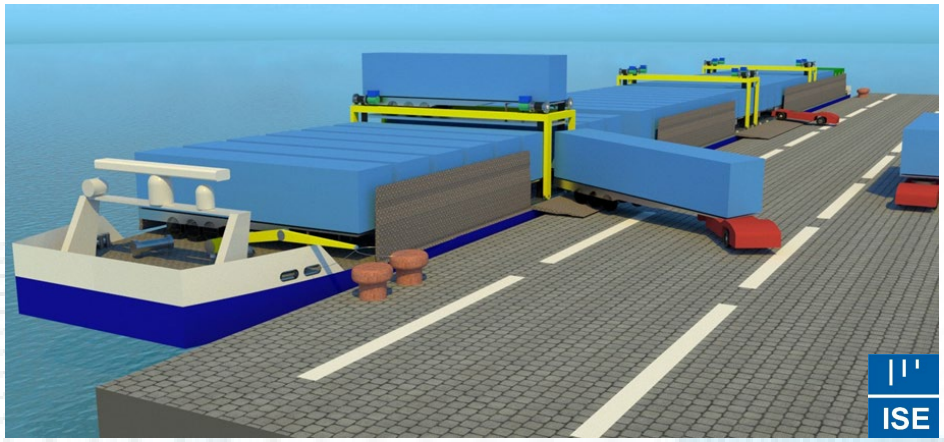


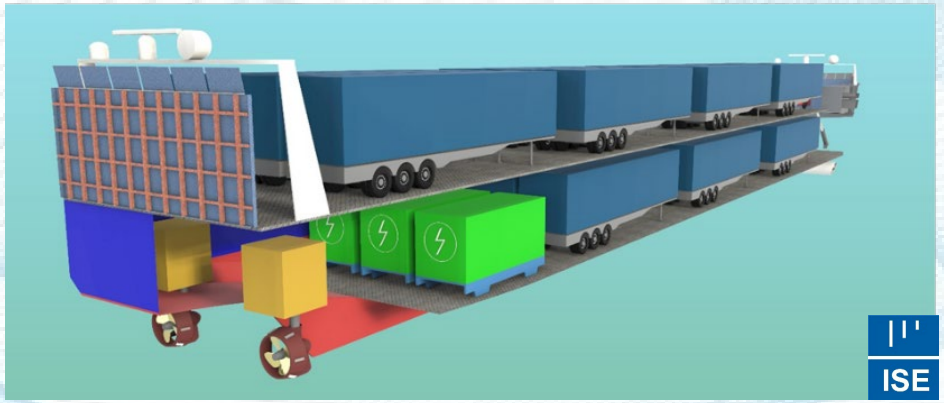
Transhipment hub: Hitra Kysthavn

Source: Hitra Kommune

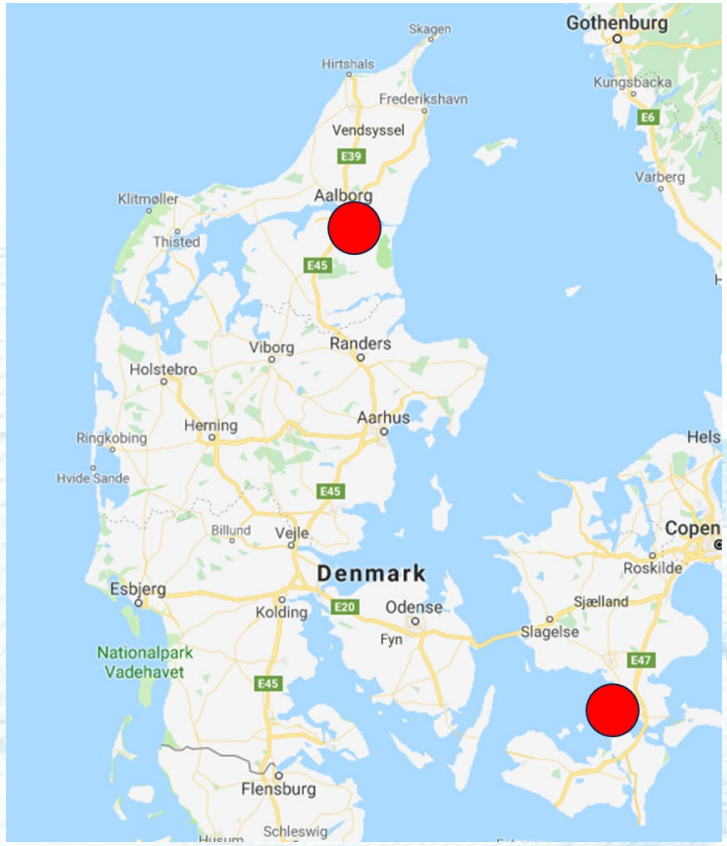
Use-case B: RORO Short sea and inland shipping in Belgium and Netherlands







Use-case C: Revitalizing regional ports and city center terminals; Aalborg and Vordingborg



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AEGIS work packages

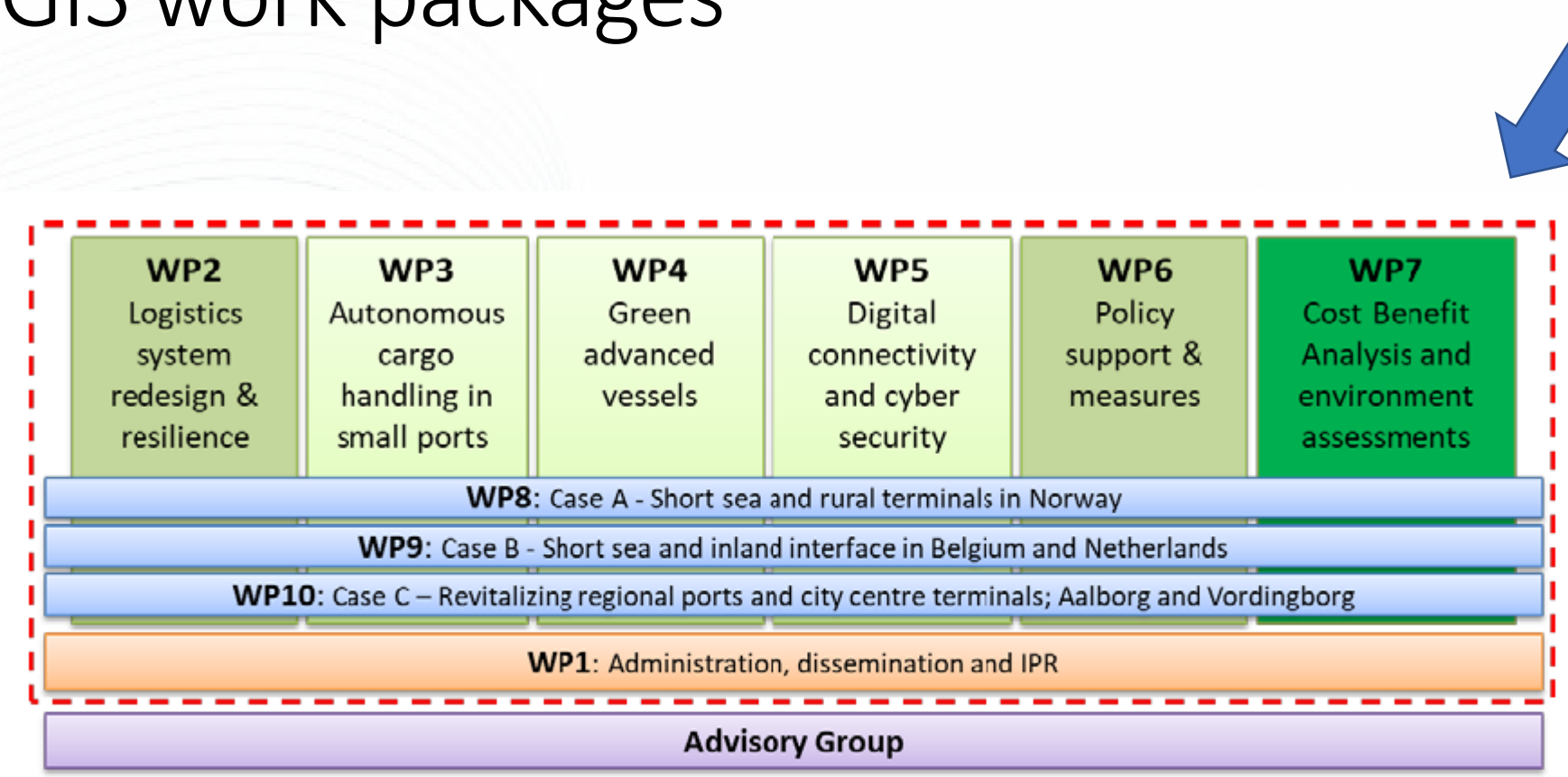
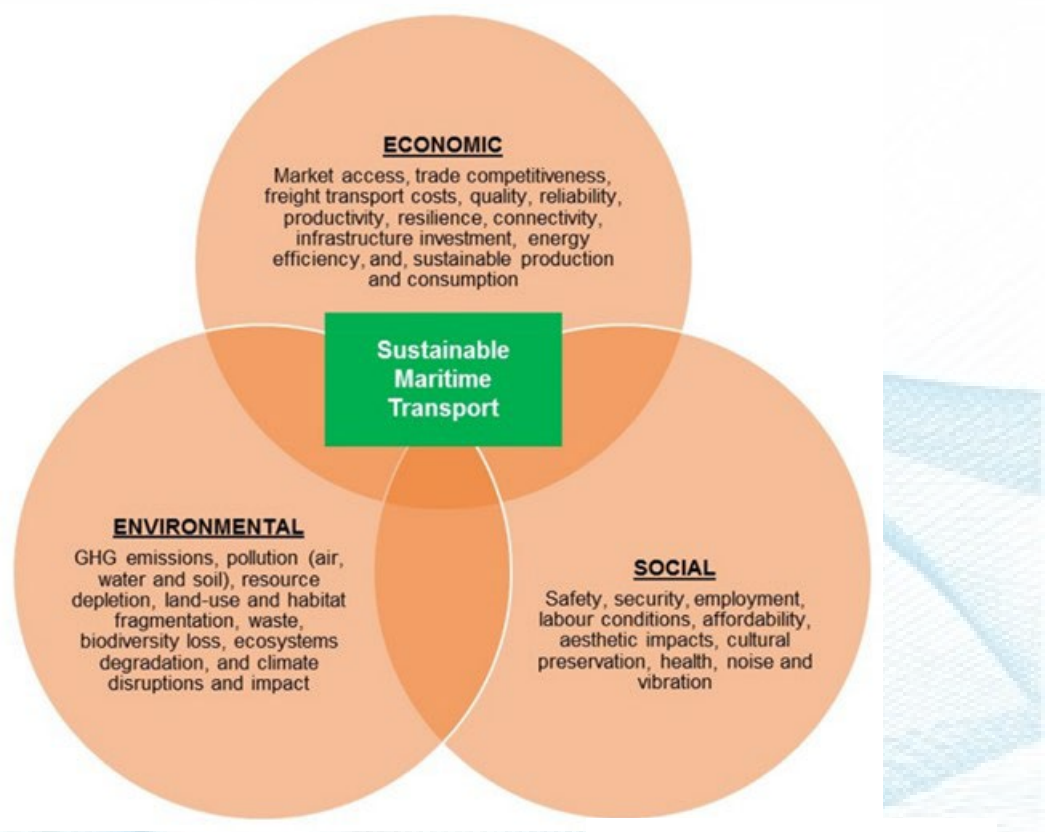


Figure 16 – Work package structure

WP7 objectives

- Define Key Performance Indicators (KPIs) to do a quantitative cost-benefit analysis (CBA)
- Do analysis of economic, environmental and societal effects of AEGIS proposals
- Combine to overall CBA, covering all three factors, compare with today's solutions
- Identify "win-win" solutions that give the best overall benefits at lowest possible cost

Source: UNCTAD



Identification of KPIs

- KPIs represent the criteria under which the set of solutions developed under AEGIS will be evaluated. They include criteria grouped under the following classes:
  - Economic KPIs
  - Environmental KPIs
  - Social KPIs

KPI Level	KPI Sublevel	KPI Name	KPI Measurement	Score Partners	Score AG
Economic	Cost	CAPEX	€	🟢 ○ ○	🟢 ○ ○
Economic	Cost	OPEX	€	🟢 ○ ○	🟢 ○ ○
Economic	Cost	Maintenance costs	€	○ ○ 🔴	🟢 ○ ○
Economic	Cost	Trade competitiveness factor	€	○ 🟡 🔴	○ ○ 🔴
Economic	Cost	Port charges	€	🟢 ○ 🔴	○ ○ ○
Economic	Cost	Waterway dues	€/NM	○ ○ 🔴	○ 🟡 ○
Economic	Cost	Fuel cost	€/NM	○ ○ 🔴	🟢 🟡 ○
Economic	Cost	Wages	€	○ ○ 🔴	🟢 ○ ○
Economic	Cost	Infrastructure development	€	○ 🟡 ○	○ 🟡 ○
Economic	Cost	Cargo unit cost	OPEX/TEUs	🟢 ○ ○	🟢 🟡 🔴

KPI Level	KPI Sublevel	KPI Name	KPI Measurement	Score Partners	Score AG
Economic	Time	Loading time	h	🟢 ○ ○	🟢 ○ ○
Economic	Time	Sailing time	h	🟢 ○ ○	🟢 ○ ○
Economic	Time	Unloading time	h	🟢 ○ ○	🟢 ○ ○
Economic	Time	Waiting time	h	🟢 ○ ○	🟢 ○ ○
Economic	Time	Drive time	h	🟢 ○ ○	○ ○ 🔴
Economic	Time	Punctuality rate	% of port calls	🟢 ○ ○	○ 🟡 ○
Economic	Time	Recovery time	h	🟢 ○ ○	○ 🟡 ○
Economic	Time	Salvage time	h	○ ○ 🔴	○ ○ 🔴
Economic	Time	Certificate handling	h	○ 🟡 🔴	○ 🟡 🔴
Economic	Time	Cargo handling time	TEUs/h	🟢 ○ 🔴	🟢 ○ ○

KPI Level	KPI Sublevel	KPI Name	KPI Measurement	Score Partners	Score AG
Economic	Others	Energy consumption	KWh	🟢 ○ ○	🟢 ○ ○
Economic	Others	Cargo carried	TEUs/ship	🟢 ○ ○	🟢 ○ ○
Economic	Others	% of load	Cargo car/max cap.	🟢 ○ ○	🟢 ○ ○
Economic	Others	Cargo damaged	% total cargo	○ 🟡 ○	○ 🟡 ○
Economic	Others	Cargo lost	% total cargo	○ 🟡 ○	🟢 🟡 🔴
Economic	Others	Cyber-attacks	#	○ ○ 🔴	🟢 🟡 🔴
Economic	Others	Autonomy level	levels	🟢 ○ ○	○ 🟡 ○
Economic	Others	Frequency of service	Shipments/week	🟢 ○ ○	🟢 ○ ○
Economic	Others	Energy efficiency	%	🟢 ○ ○	🟢 ○ ○
Economic	Others	Number of container moves	#TEU/route	🟢 🟡 🔴	🟢 ○ ○
Economic	Others	Road going transport impact	?	○ 🟡 ○	○ 🟡 ○

KPI Level	KPI Sublevel	KPI Name	KPI Measurement	Score Partners	Score AG
Environmental	Emissions	CO2	Kg of CO2/tkm	🟢 ○ ○	🟢 ○ ○
Environmental	Emissions	NOx	Kg of NOx/tkm	🟢 ○ ○	🟢 ○ ○
Environmental	Emissions	SOx	Kg of SOx/tkm	🟢 ○ ○	🟢 ○ ○
Environmental	Emissions	Particulate matter	Kg of PM10/tkm	🟢 ○ ○	🟢 ○ ○
Environmental	Emissions	Waste emissions	Kg	○ 🟡 ○	○ 🟡 ○
Environmental	Emissions	Acoustic emissions - Noise	dB	🟢 ○ ○	○ 🟡 ○
Environmental	Emissions	Light pollution	Lumens/shipment	○ ○ 🔴	○ ○ 🔴
Environmental	Others	Terminal area per cargo unit	m^2/cargo unit	○ 🟡 ○	○ ○ 🔴
Environmental	Others	Use of renewable energy sources	%	🟢 ○ ○	○ 🟡 ○
Environmental	Others	Sustainability factor	?	○ ○ 🔴	○ 🟡 ○

KPI Level	KPI Sublevel	KPI Name	KPI Measurement	Score Partners	Score AG
Social	Security/Safety	Accident rate	#	🟢 ○ ○	🟢 ○ ○
Social	Security/Safety	Fatality rate	#	🟢 ○ ○	🟢 ○ ○
Social	Security/Safety	Fire incidents	#	🟢 ○ ○	🟢 ○ ○
Social	Security/Safety	Crime	#	○ 🟡 ○	○ 🟡 ○
Social	Work-life	Labor conditions	Work-life-balance	🟢 ○ 🔴	○ ○ 🔴
Social	Work-life	Employment	% of change	🟢 ○ ○	🟢 🟡 🔴
Social	Work-life	Income	% of change	🟢 ○ ○	○ 🟡 ○
Social	Work-life	Worker commuting time	Distance ship-home	○ 🟡 🔴	○ 🟡 ○
Social	Work-life	Training	Time/worker	○ 🟡 ○	🟢 🟡 🔴
Social	Others	Traffic	# TEU/port call	○ 🟡 ○	○ 🟡 🔴
Social	Others	Resilience	?	🟢 ○ ○	○ ○ 🔴
Social	Others	Citizen complaints	#	○ ○ 🔴	○ ○ 🔴
Social	Others	Port operations area	m^2	○ 🟡 ○	○ 🟡 🔴

The project has received funding from the European Union's Horizon 2020

Economic analysis

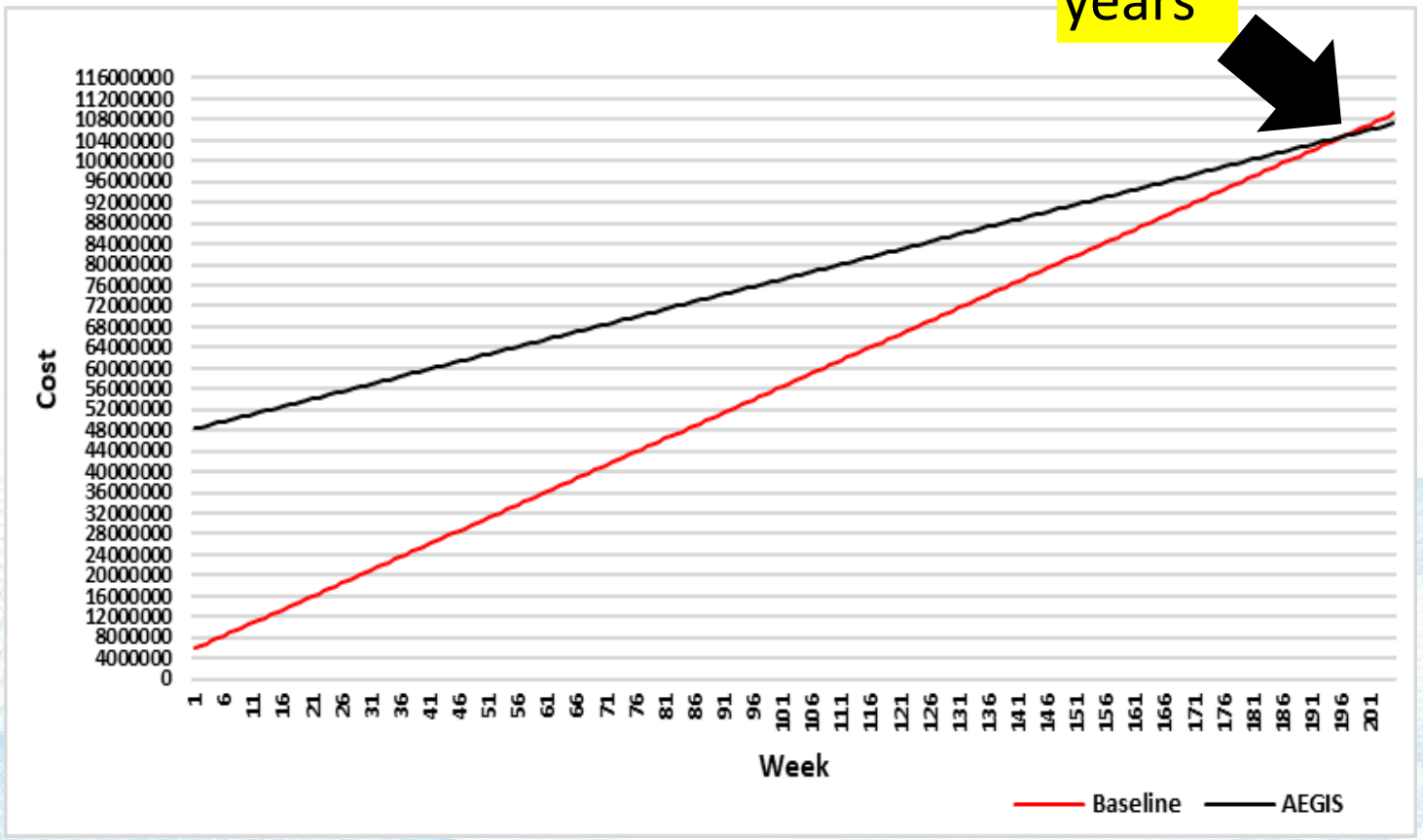
- The big picture

- The AEGIS solution is better than the baseline (non-AEGIS) solution in terms of most economic KPIs
- CAPEX and Time KPIs are the exception

Use case B

KPI Name	AEGIS	Baseline-Truck
CAPEX		
OPEX		
Maintenance Cost		
Fuel Cost		
Wages		
Transport Cost Per Unit		
Cost Per Unit Cargo		
Loading Time		
Sailing or Drive Time		
Unloading Time		
Energy consumption		
Cargo Carried		
Frequency of service		
Energy efficiency		

7.5 years



After around 4 years

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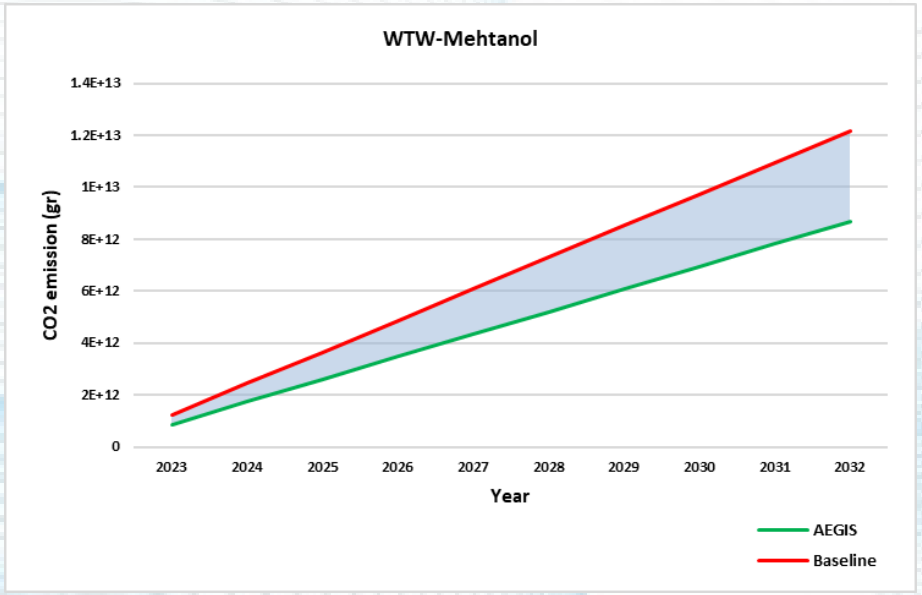
Environmental analysis:

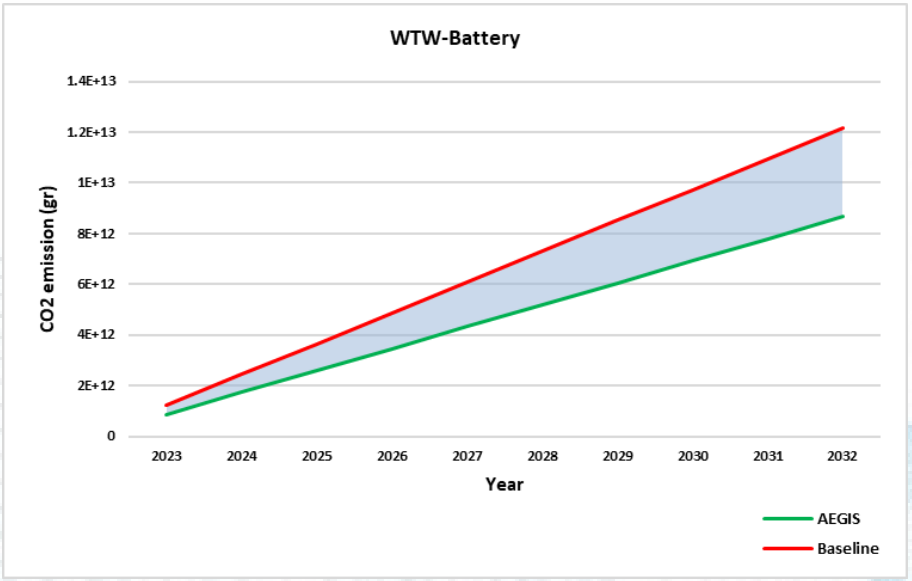
- The big picture

- The AEGIS solution is better than the baseline (non-AEGIS) solution in terms of environmental KPIs

Use Case C-Aalborg WTT+TTW

KPI Name	AEGIS Battery	AEGIS Methanol	Baseline-Truck	
			Battery	Methanol
CO_2-WTT (gr/tkm)				
CO_2-TTW (gr/tkm)				
NOx-TTW (gr/tkm)				
SOx-TTW (gr/tkm)				
Particulate Matter (PM)-TTW (gr/tkm)				





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Social analysis

- The big picture

  - The AEGIS solution is probably better than the baseline (non-AEGIS) solution in terms of reduction of accidents and fatalities (road)
  - The AEGIS solution will likely result in some higher paying jobs

Final CBA task

- The “win-win” task

  - Identify “win-win” solutions, as well as the conditions for these solutions to be realized.
  - A “win-win” solution is defined in terms of being acceptable in terms of most of the KPIs that have been identified.
  - Expected to finish soon

Credits

- Odd Erik Mørkrid, SINTEF Ocean
- Sayed Parsa Parvasi, DTU

- EU H2020 AEGIS project, Grant No. 859992 (2020-2023)

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Thank you very much!

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