Autonomous Inland & Short Sea Shipping Conference

2nd & 3rd November 2021

Duisburg

Development of an Advanced, Efficient and Green Intermodal System with Autonomous Inland and Short Sea Shipping – AEGIS

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Agenda

1) Introduction to the AEGIS-Project
2) Motivation / Deficites
3) AEGIS approach and objectives
4) Use-Cases
5) Vessel Concept development
6) Evaluation and Optimization
7) Conclusion

The project has received funding from the European Union's Horizon 2020
Research and innovation program under Grant Agreement Nº859992.

EU Project AEGIS

- EU Horizon 2020 call:

  MG-2-6-2019: Moving freight by Water: Sustainable Infrastructure and Innovative Vessels
- Project title:

  AEGIS – Advanced, efficient and green intermodal systems
- Budget: 7.5 Mio. EUR
- Start: June 1st, 2020
- End: May 31st, 2023 (36 months)

http://aegis.autonomous-ship.org

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AEGIS Partners

- International consortium consitsting of 12 partners from 4 countries (NO, DK, FI, DE)

SINTEF
ISE
DTU
AALBORG UNIVERSITET
VORDINGBORG HAVN
PORT OF AALBORG
Trondheim Havn
CARGOTEC
MACGREGOR
ncl
DFDS
GRIEG CONNECT

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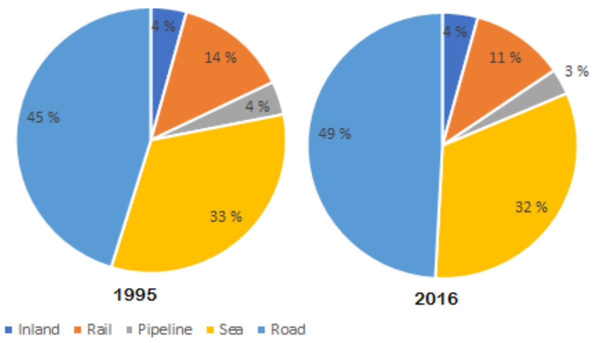
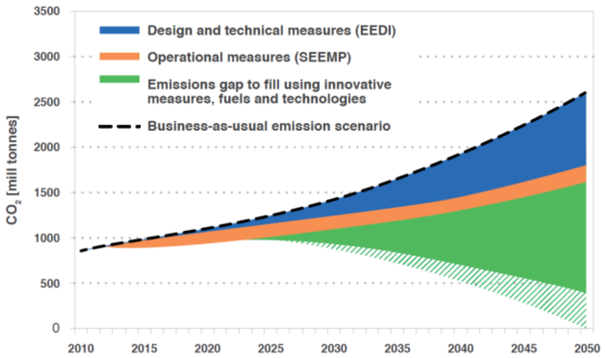
Motivation

- European Transport Policy recognize the importance of the waterborne transport system for sustainable growth in Europe
- Transport White Paper: 30% of road freight over 300 km should shift to rail or waterborne transport by 2030, and more than 50 % by 2050
- IMO initial strategy for reducing Greenhouse Gas (GHG) emissions: 50% reduction of total annual GHG emissions by 2050, Zero GHG emissions before 2100





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Current deficites of existing waterborne transport system

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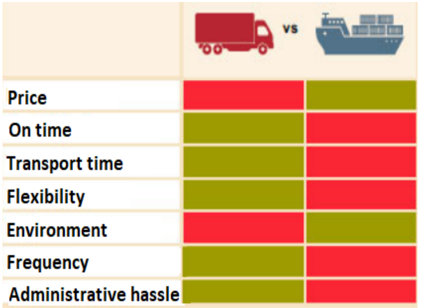
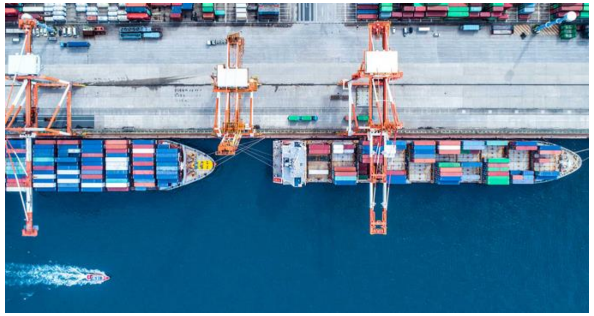
- ships have for a long time grown larger to reduce energy and operations cost
- restricted number of terminals these ships can call on
- increases costs and sizes of these terminals
- reduces service flexibility by reducing frequency and fixing one speed for all cargo on one ship
- low level of resilience
- low automation in information processing





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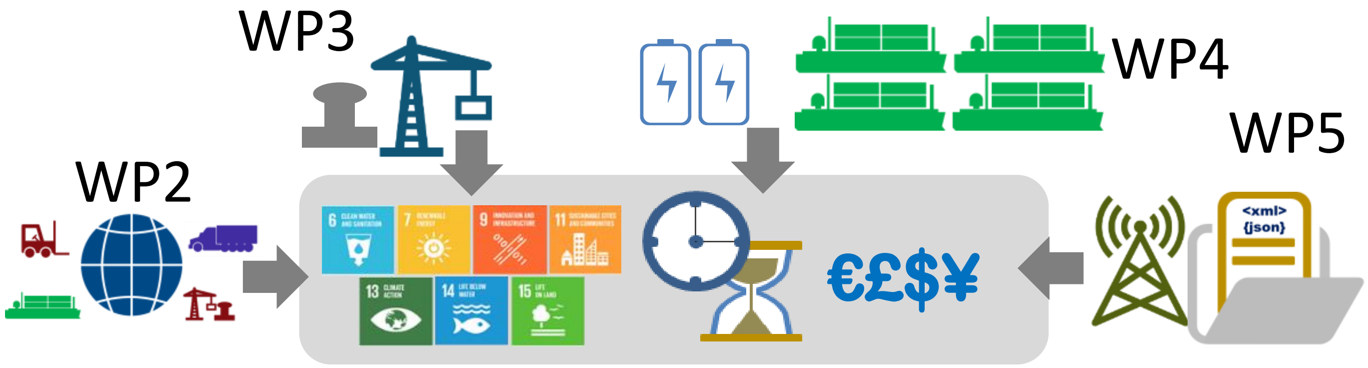
AEGIS approach and objectives

- AEGIS will leverage a multidisciplinary team to integrate new innovations from the area of *Connected and Automated Transport (CAT)*, including more *diverse sizes of ships* and more *flexible ship systems*, *automated cargo handling*, *ports and short sea shuttles*, standardized *cargo units* and *new digital technologies* to design the next generation sustainable and highly competitive waterborne transport system in Europe.



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AEGIS approach and objectives

- AEGIS specific objectives:

  - SO1: Minimum GHG emissions, pollution and noise from ship transport and terminals: **Green transport**.
  - SO2: Resilience, safety and cyber security in highly physically and digitally integrated transport systems: **Robust transport systems**.
  - SO3: More flexible ship transport by combining smaller and automatic lightweight shuttle vessels with faster medium to long distance ships: **Higher speed, timeliness and frequency**.
  - SO4: Transport to smaller quays and ports, also outside ISPS areas: **Rural connectivity**.
  - SO5: Automated short distance transport from terminals to end users where possible: **Last mile automation**.
  - SO6: Enabling ship transport into city centers with no terminal storage space by using small lightweight automated shuttle vessels and just in time arrival: **Urban connectivity**.
  - SO7: Improved access to waterborne transport for all transport users, minimum administrative hassle: **User centered services**.

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AEGIS approach and objectives

- AEGIS critical technical objectives:
  - CTO1: Logistic system redesign
  - CTO2: New terminal concepts
  - CTO3: Automated cargo handling
  - CTO4: Autonomous shuttle
  - CTO5: Digital connectivity
  - CTO6: Policy measures
  - CTO7: Safety, security and resilliance

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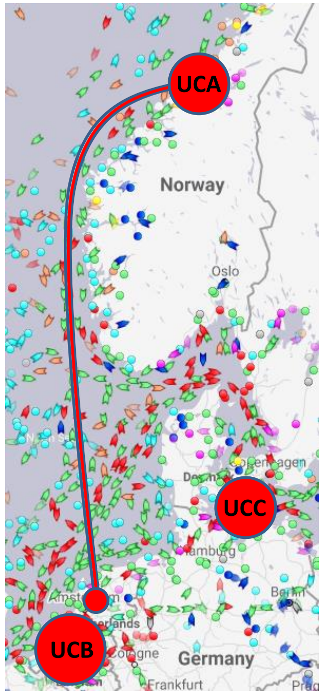
AEGIS Use-cases

- AEGIS offers three highly relevant use cases in Northern Europe, which however are applicable to other regions in Europe. The use cases represent typical short sea transports that need to be linked to last mile distribution systems.



- **Use-Case A**: Efficient connection/ interaction between *short sea shipping* and *local* rural and urban *cargo distribution*
- **Use-Case B**: Creation of an interface between *RORO transport from several West European ports and inland navigation*. Establish waterway connections between ports and smaller inland destinations. *Automated IWW transportation* system with *zero emission vessels*.
- **Use-Case C**: *Revitalizing regional ports* and *city centre terminals*. Key elements are *lower overall costs*, *higher feeder frequency* and a more *competitive RORO segment*. *Multimodal green logistics solutions* are possible with a combined short-sea shipping and rail transport.

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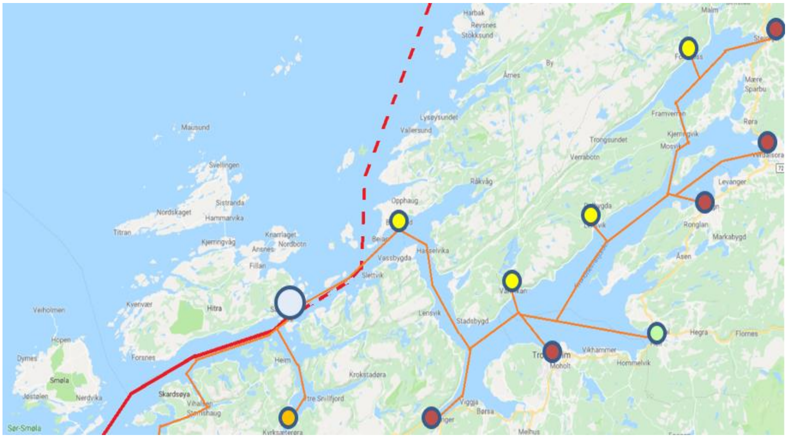
Use-case A: Short Sea, urban and rural terminals in Norway

- Use-case lead by NCL

- Short sea transport from Rotterdam along the West Coast of Norway up to Trondheim
    - Capacity of 6-7000 TEU weekly
    - Distance 800 – 850 nm



- Hinterland transportation within the region of Trondheimsfjorden
    - no shipping services today, short-sea vessels delivering some ports directly
    - Distance from open ocean to inner fjord is about 110 nm

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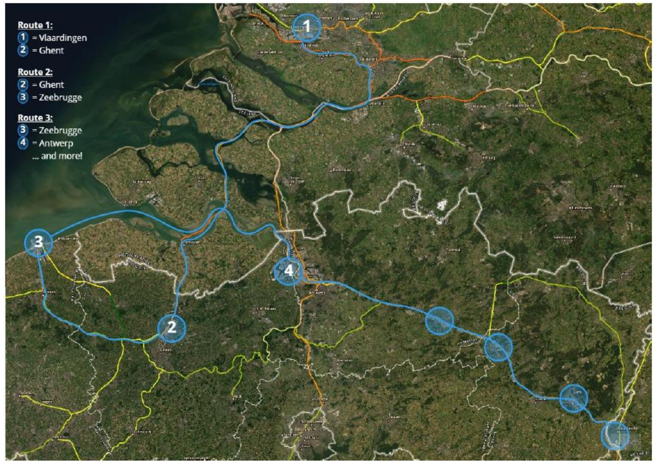
Use-case B: inland shipping interface in Belgium and Netherlands

- Use-case lead by DFDS

- Connection between short sea RoRo-service and RoRo inland waterway transportation (IWW)
- green zero emission and autonomous IWW
- automated cargo handling and transshipment



- Routes of interest between the ports of Vlardingen, Ghent, Zeebrugge, Antwerp and further along the Albert Canal up to Genk
- IWW from CEMT II to CEMT VI

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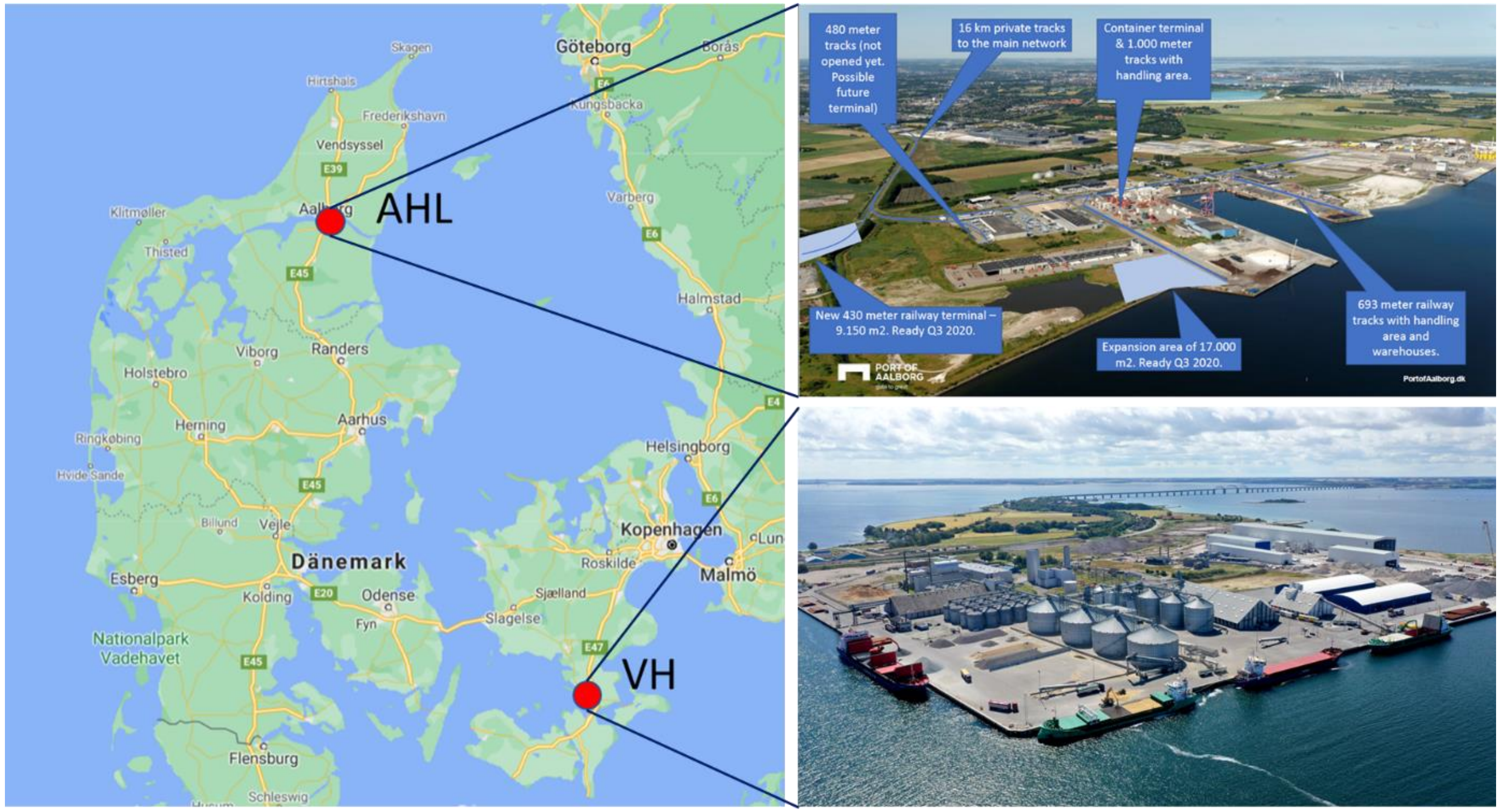
Use-case C: Revitalizing regional ports and city terminals in Denmark

- Use-case lead by AHL



- Current bulk and container transport
- development of green terminal
- RoRo connections with Scandinavia and central europe

- Current bulk transport
- improved port logistics
- automated cargo handling
- Redirect road transport to sea
- Decrease traffic in city centre of Copenhavn

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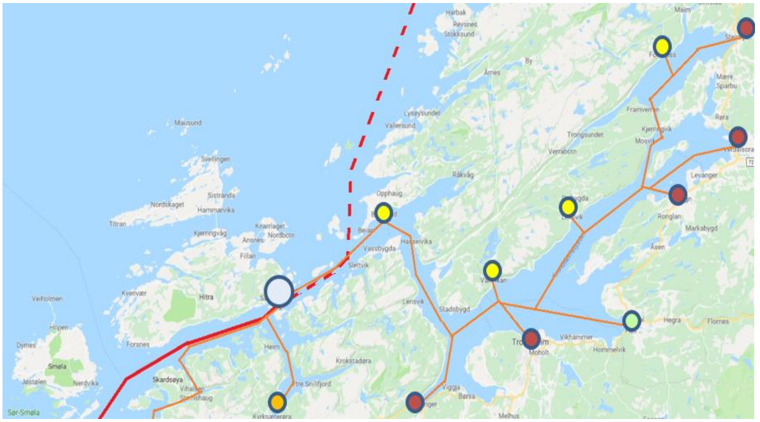
- AEGIS-Concept: Mother daugther vessel concept

- mother vessels deliver along a main route from Rotterdam along several destinations of the West Coast of Norway
- small daughter vessels distribute cargo in fjord to customers
- advantages are:
  - saving of sailing time
  - Opportunity to call on smaller ports
    as well as city centres



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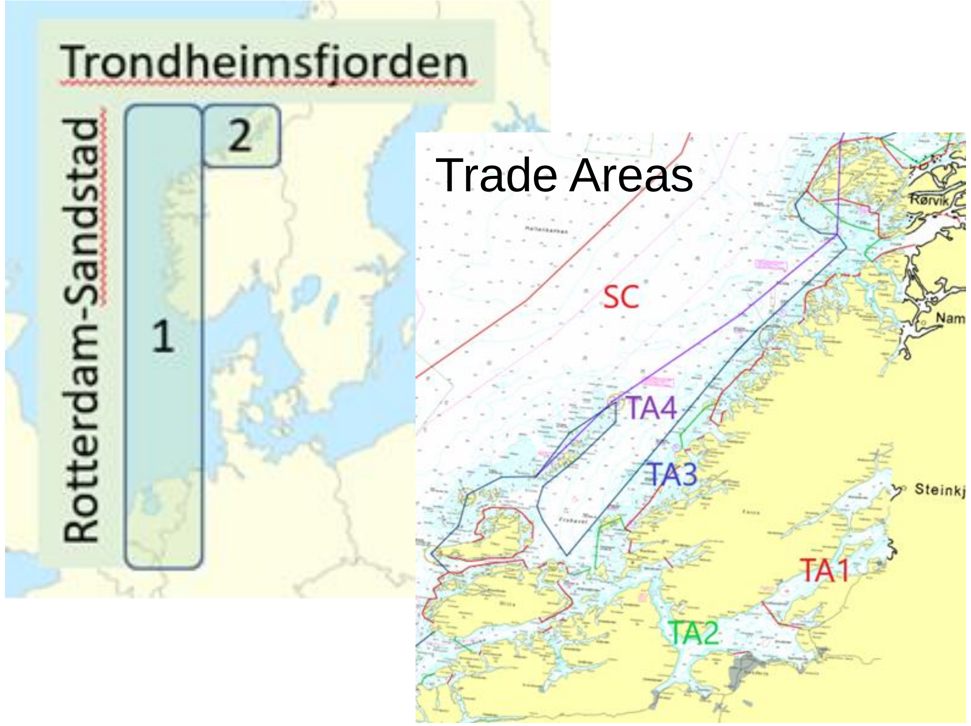
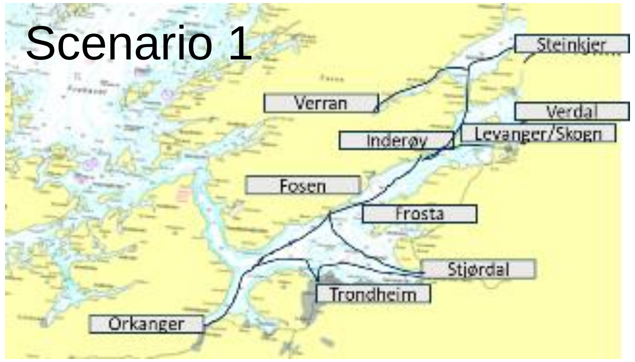
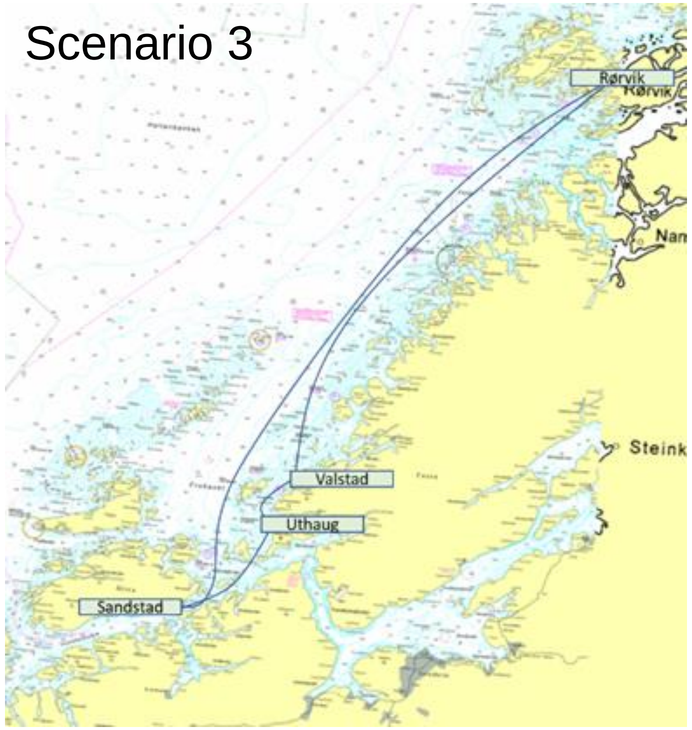
Use-case A: Short Sea, urban and rural terminals in Norway

- AEGIS-Concept: scenarios and trade areas







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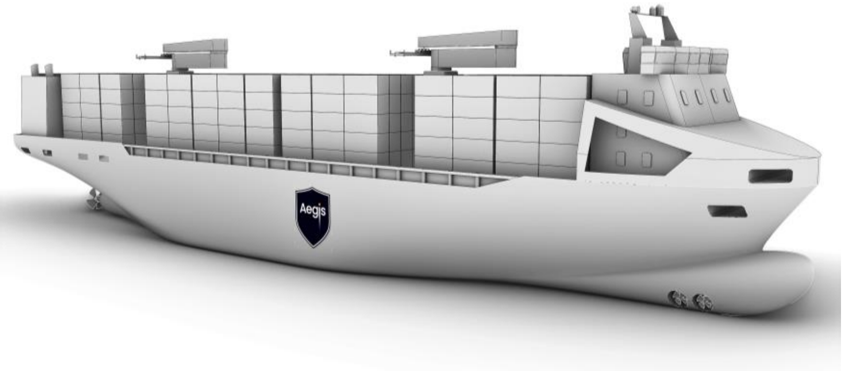
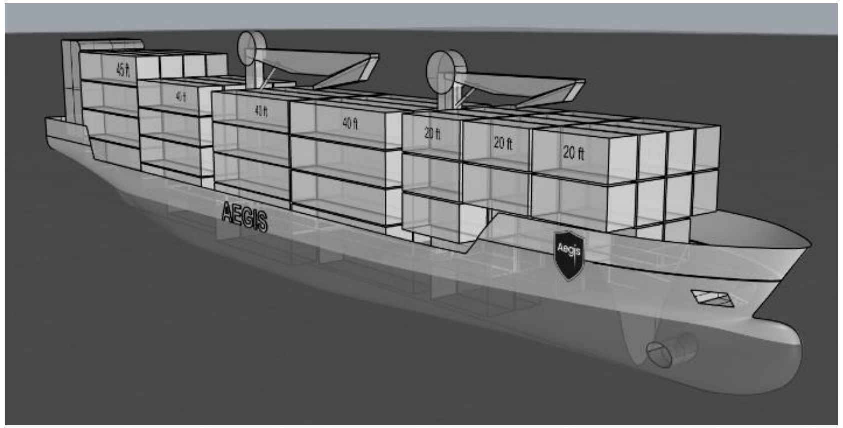
Use-case A: Short Sea, urban and rural terminals in Norway

- mother vessel concepts for coastal feeder service

	Cargo type	Capacity	Propulsion	autonomy level
	Container	900-1000	hybrid propulsion system (electrical + methanol, ammonia, bio-/e-fuels)	level 1 - 2
	Container	200	hybrid propulsion system (electrical + methanol, ammonia, bio-/e-fuels)	level 2 - 3

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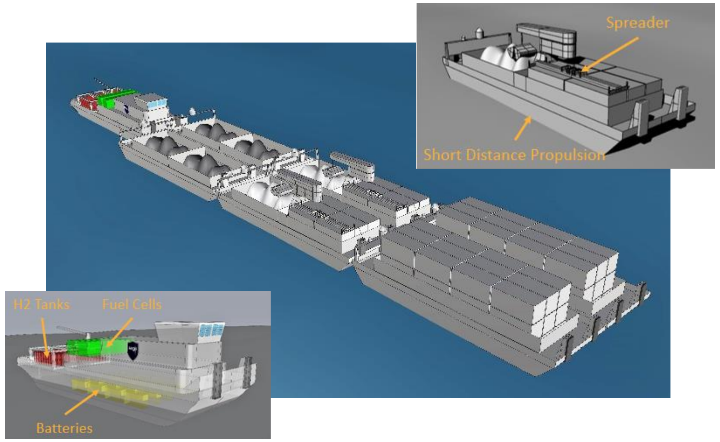
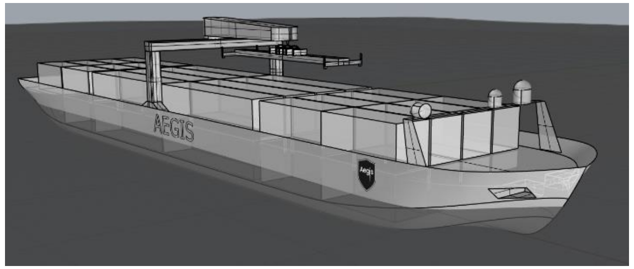
Use-case A: Short Sea, urban and rural terminals in Norway

- daughter vessel concepts serving ports and industry sites within Trondheim fjord



- convoy concept
- highly autonomous push barge (level 3 - 4)
- powered by fuel cells and batteries
- unpropelled/self propelled barges for different types of cargo (capacity of 36 containers), optional on board-handling system



- self-propelled, highly autonomous shuttle (level 3 - 4)
- on-board handling system
- powered by battery or regional bio-fuels (LBG)

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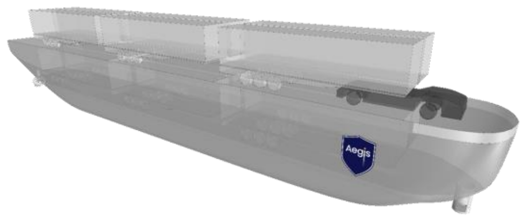
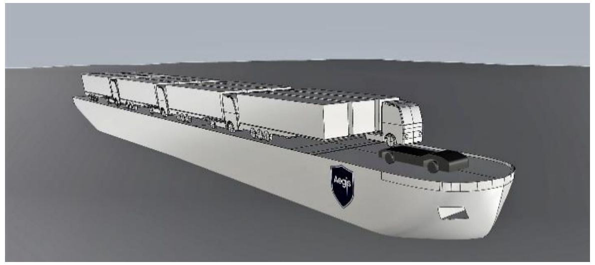
Use-case B: inland shipping interface in Belgium and Netherlands

- RoRo-barge concepts for IWW transportatipn of trucks or trailers



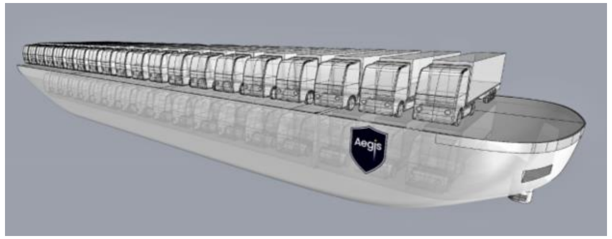
- Small RoRo-barge (CEMT II)

capacity	propulsion	autonomy level
12 trailer	thruster propulsion powered by battery	level 3 - 4



- Medium RoRo-barge (CEMT IV)

capacity	propulsion	autonomy level
21 trailer	thruster propulsion powered by battery	level 3 - 4



- Large RoRo-barge (CEMT VI)

capacity	propulsion	autonomy level
38 trailer	thruster propulsion powered by battery	level 3 - 4

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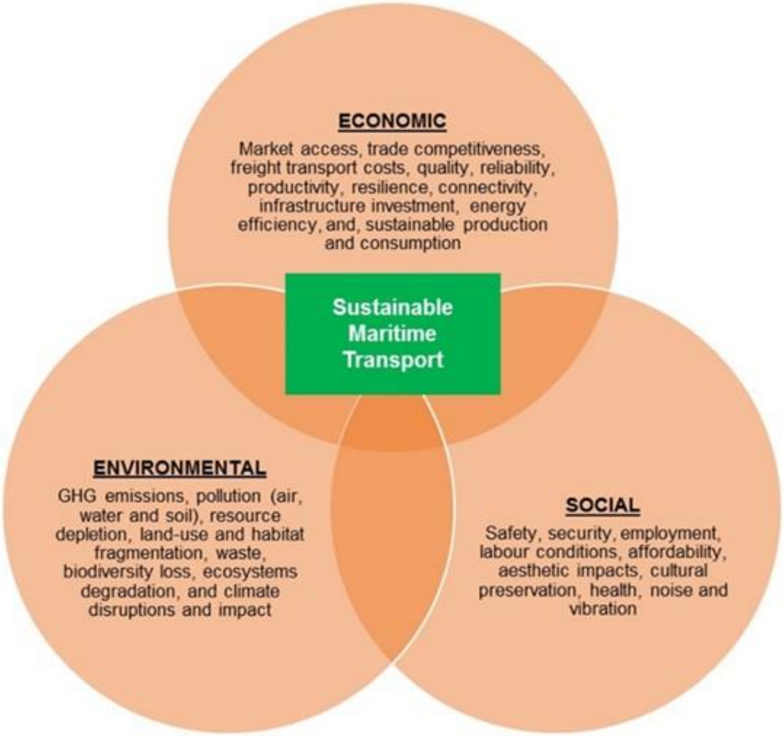
Waterborne transportation concept validation

- Developement of KPIs



- Definition of KPIs to do a quantitative cost-benefit analysis (CBA)
- 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

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Waterborne transportation concept validation

- Development of a simulation tool for evaulation and optimization
  - Comparison of different scenarios
    - routes
    - cargo
    - vessels
    - technology/ autonomy

  - Subsettings
    - Vessel characteristics (machinery (type, fuel type, cost, OPEX, CAPEX), average hotel power, reference vessel, cost of newbuild, cargo handling, Key enabling technology (autonomy technology), crew costs)
    - Remote Control Centre (OPEX per year)
    - Port Costs (terminal costs)
    - Locations (characteristics of each location, terminal crane and charging costs)
    - Shipments (orders definition: where and how much)
    - Voyage plan (deliver order, start and stop defining)
    - Weather (different weather profiles for each part of the voyage possible)

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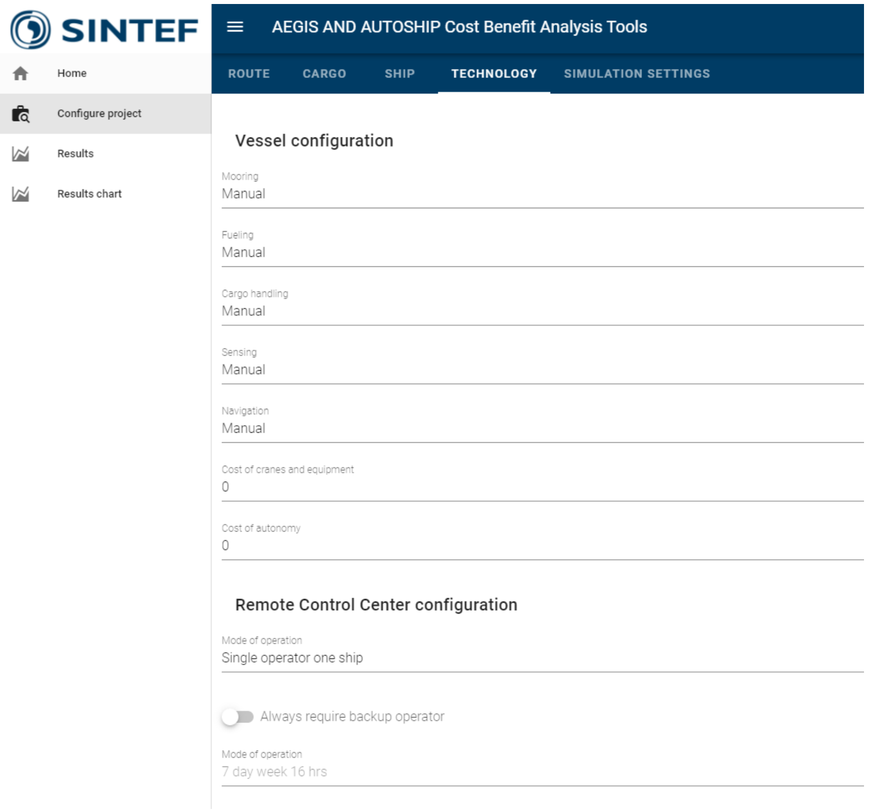
Waterborne transportation concept validation

- Developement of a Simulation tool



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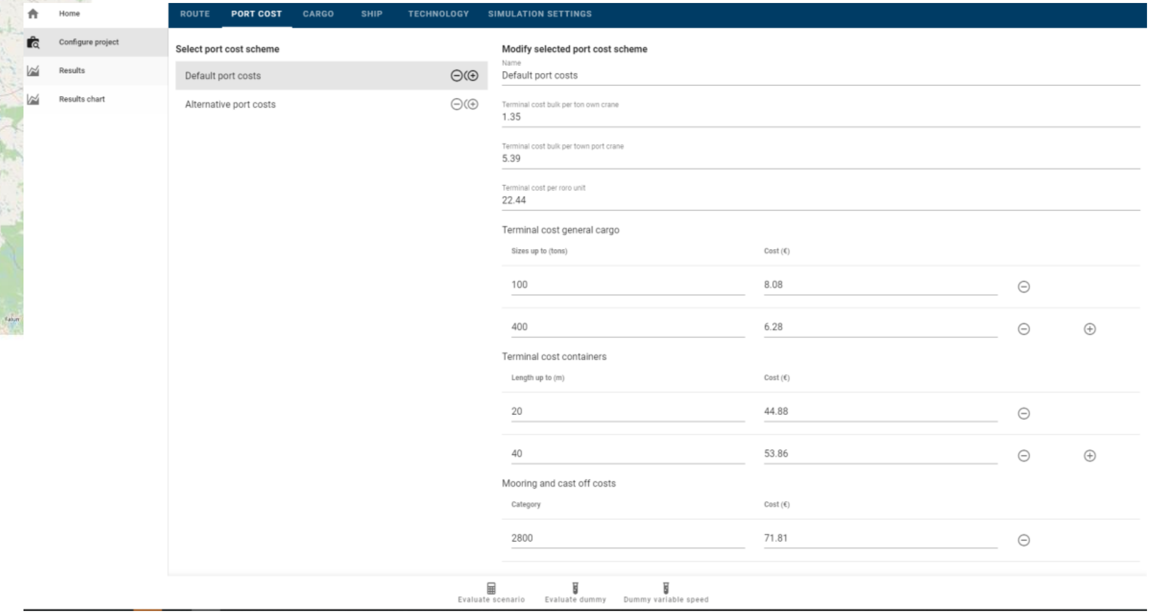
Waterborne transportation concept validation

- Developement of a Simulation tool for evaulation and optimization



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Conclusion

- establishment of three use cases and specific user scenarios
- draft designs of advanced green autonomous vessel according to the secific use-case conditions
  - daughter vessels, autonomous shuttle and barges
  - RoRo vessels for different inland waterways
- development of KPIs (ecomical, environmental, social)
- development of a simulation tool for evaulation and optimization of the waterborne transport system
- further investigation/ simulations for the specific vessel concept development necessary

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https://aegis.autonomous-ship.org/

https://institut-se.de/projekte/aegis/

Thank you for your attention!

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