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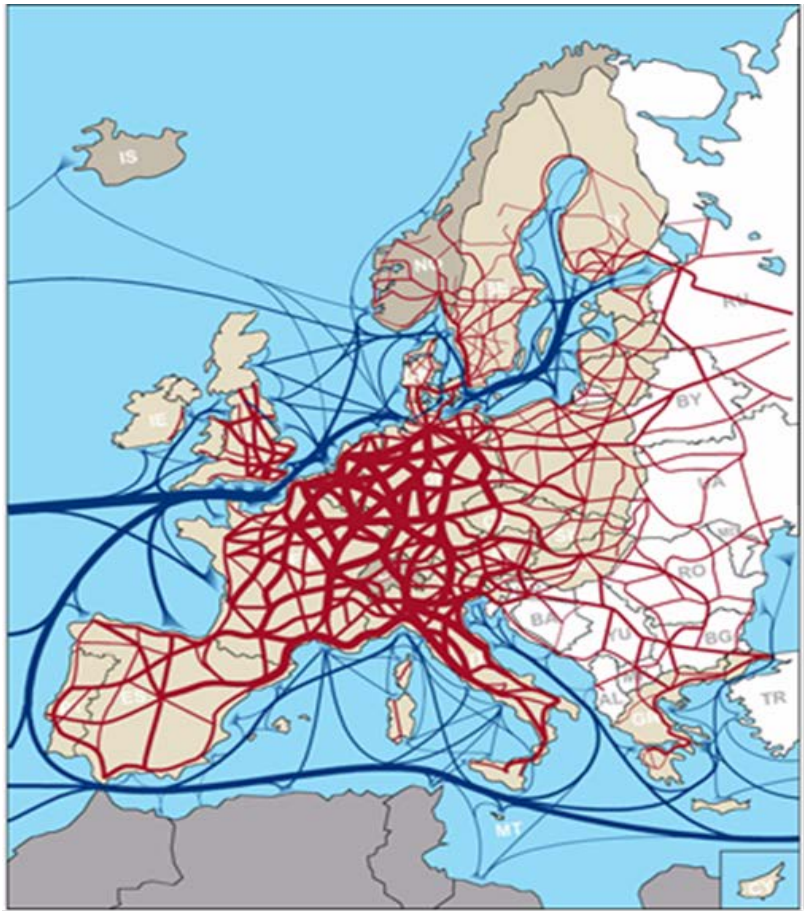
FROM ROAD TO SEA WITH AUTONOMOUS SHIPS

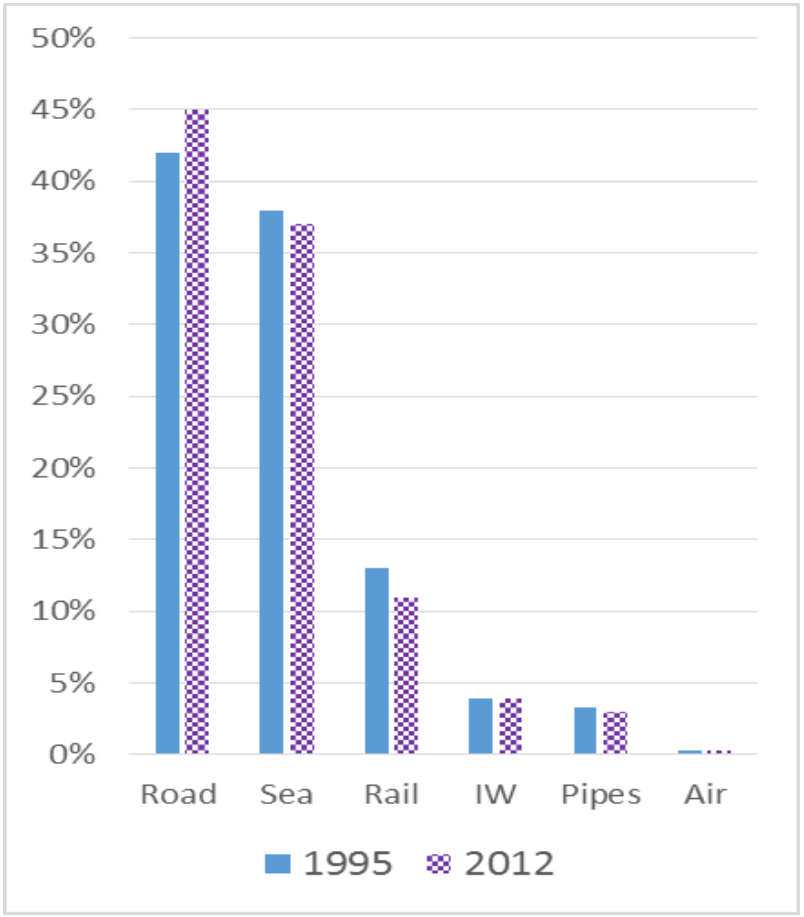
Dr. Elizabeth Lindstad

Revitalization of Coastal and Short-Sea Shipping through Autonomous Transport Systems - SATS

- SATS asks in which segments of shipping autonomous vessels can be a contributing factor to:
  - Enhance the competitiveness of maritime shipping
  - Reduce shipping's GHG emissions
  - Reduce total GHG emissions from transport.
- Autonomous thus may have its first chances where personnel costs are important such as for coastal and short sea shipping.

Despite the political objective of decreasing road transport and transfer cargo to rail and sea, short sea shipping is struggling.





(Source: Baltic Maritime Outlook 2006 and Eurostat, 2014)

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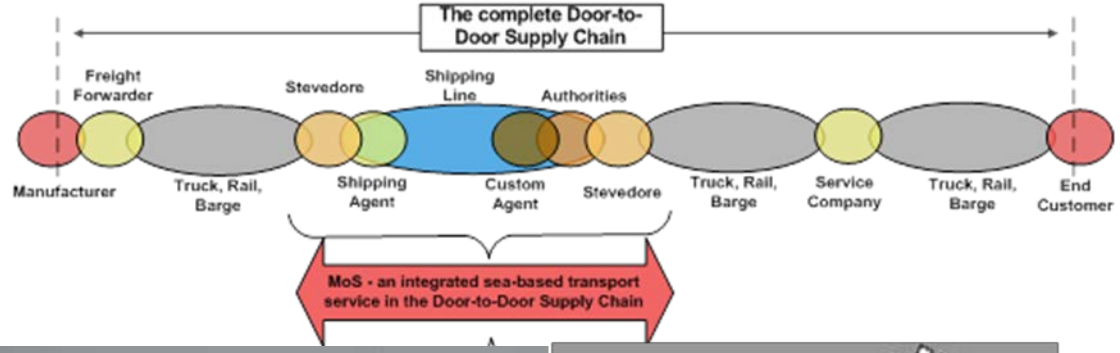
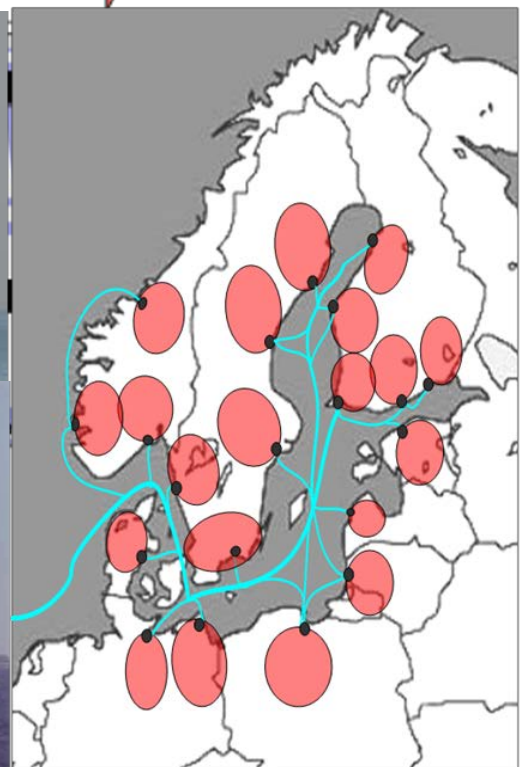
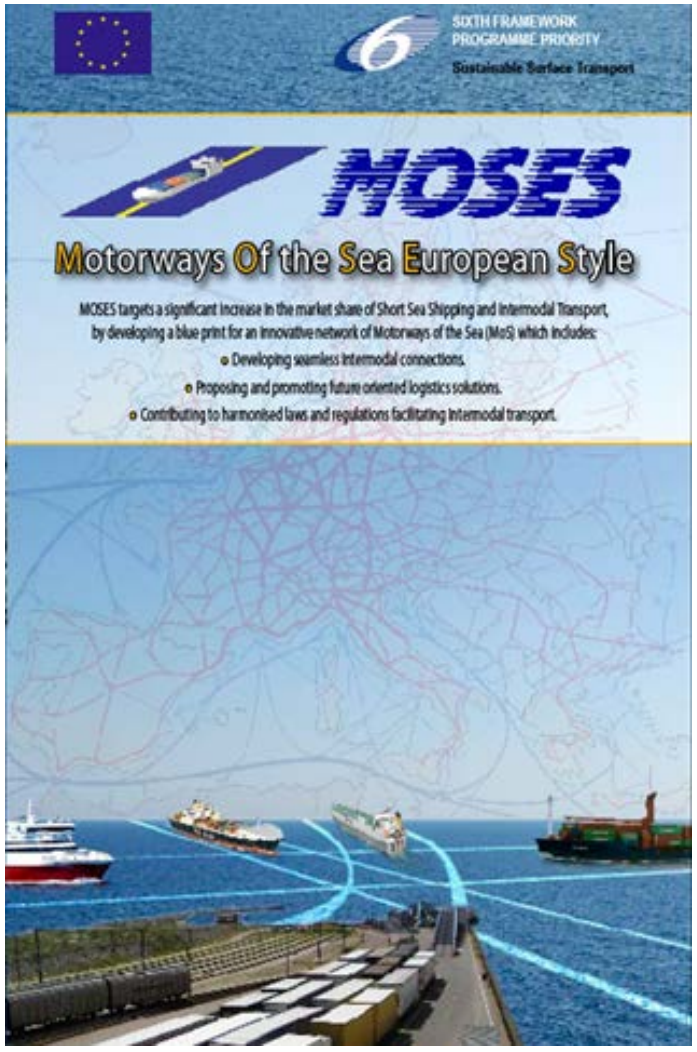
Ro-Ro and Container vessels, have been the main focus areas for EU and national funded SSS - reasearch







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The benefits of trucks (road-transport)

- Transport small batch sizes, i.e. 20 – 25 tons, allowing shipments door to door at high frequencies.
- In scheduled maritime shipping, frequencies can be two or three times a week or at best daily.
- Also, while trucks are standardized and built in huge numbers, short sea vessels are less standardized and typically built in series from a few up to one hundred.
- Moreover, the main truck manufacturers have used huge resources during the last decades on reducing the trucks lightweight and improving their engines – in other ways – reducing the fuel consumption of the trucks.

Reducing fuel consumption and cost in Maritime transport – Deep sea shipping

- Increasing vessel size or reducing operational speeds are two well-known principles for reducing the fuel consumption and cost per transported unit.
- In short-sea trades available cargoes and the required frequencies will often limit the opportunities for increasing the vessel size, or vessel sizes might be limited due to port restrictions.
- In short sea trades such as in Europe, vessels often compete with road transport both cost and time wise, this limits the opportunities for reducing their operational speeds

Compared to USA and Canada, Europe in general and Norway in particular has more ports

- Norway with 5 million people has nearly 80 commercial cargo ports, which is more than you will find along the whole West coast of USA and Canada.
- In addition Industrial companies and Fish processers tends to have their own quays/ports
- Some of these ports have major volumes and are served with large vessels (Cape size and VLCC), but the majority of the ports are served with small, general cargo vessels.

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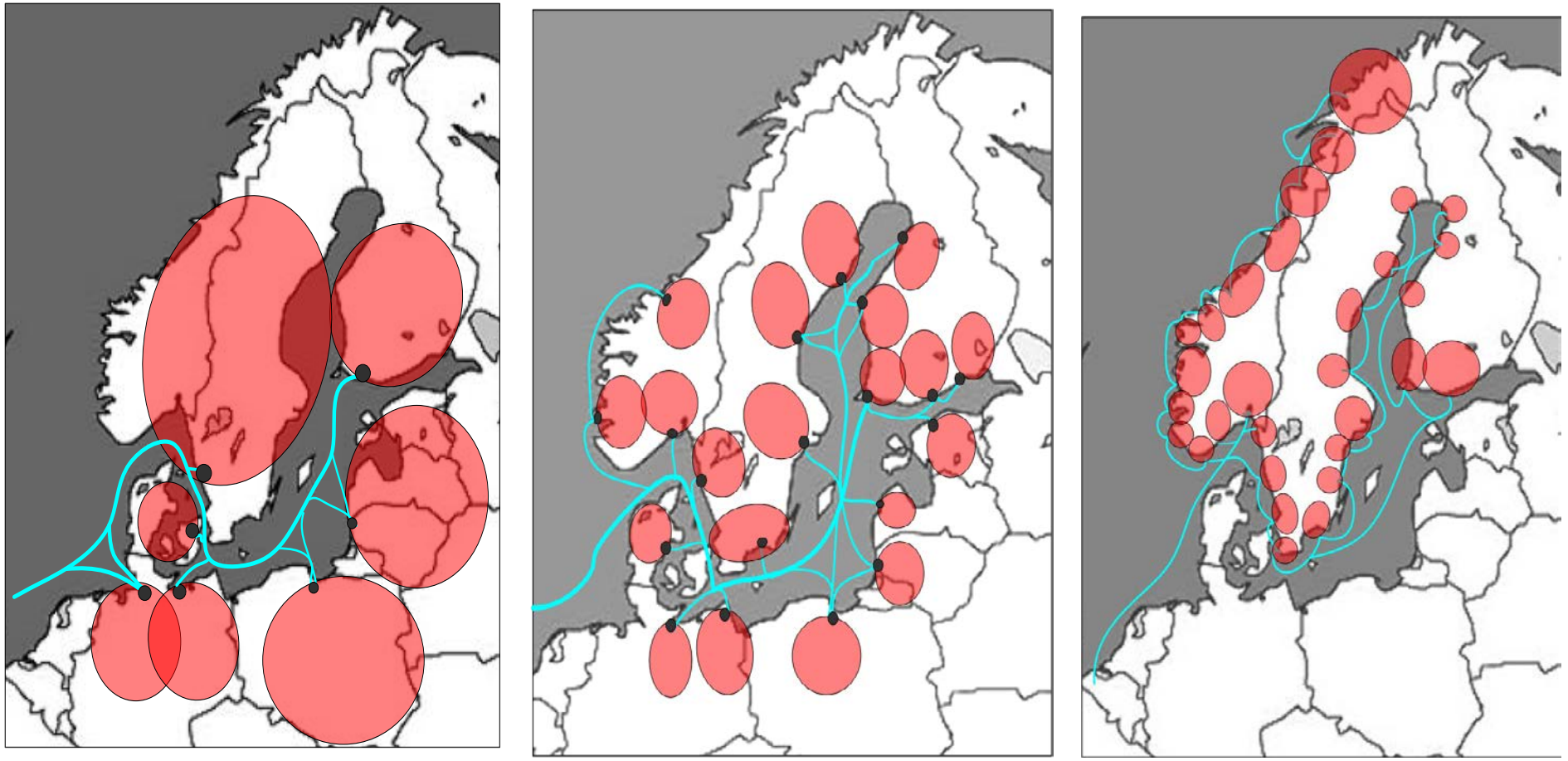
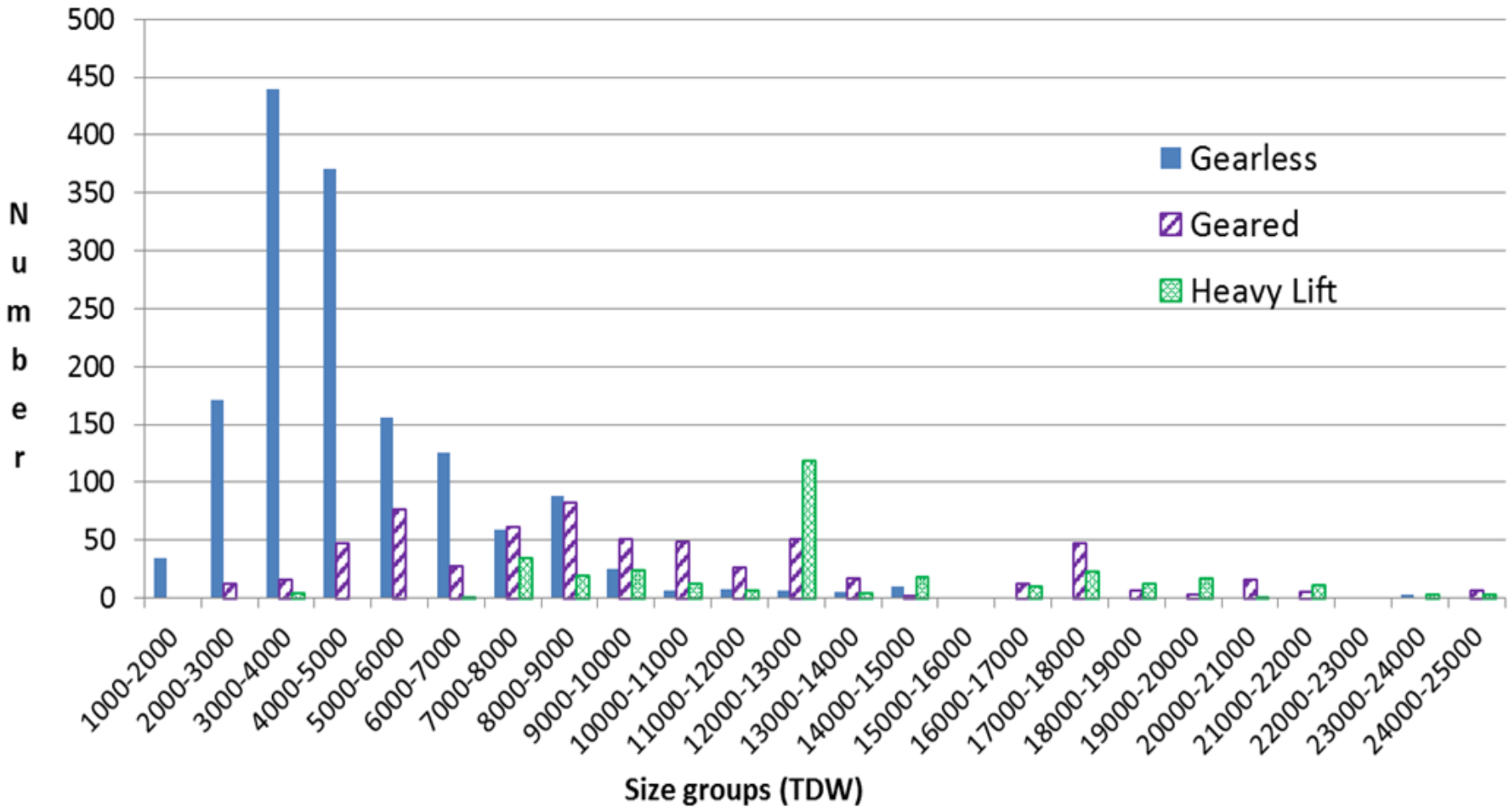
Policy options such as MoS (Motorways of the seas) tend to requires concentrantion of cargoes and few ports (as in the left or middle picture)

Autonomous vessels might serve even 10 or 100 times the ports in the right picture



The North European General Cargo Fleet



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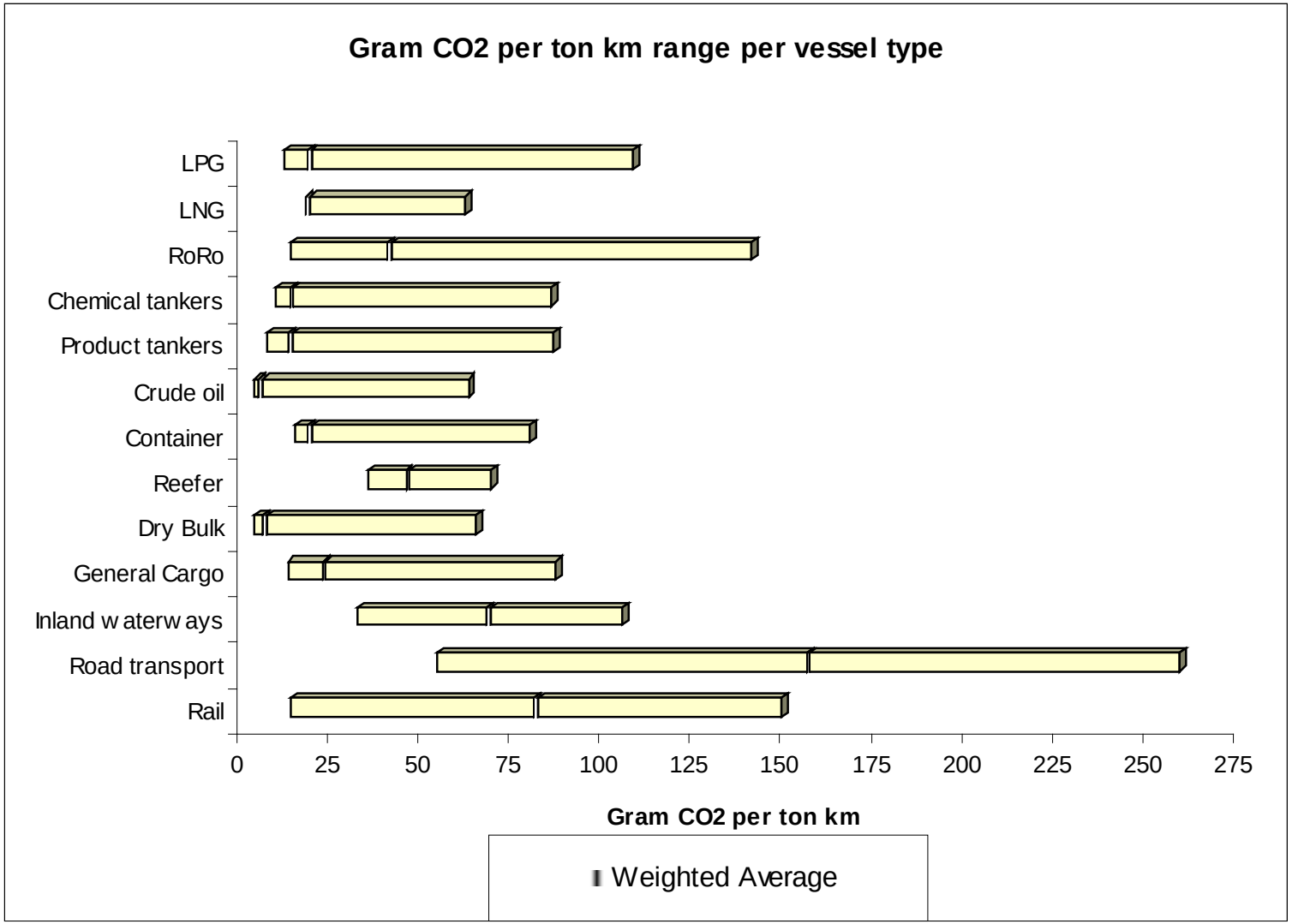
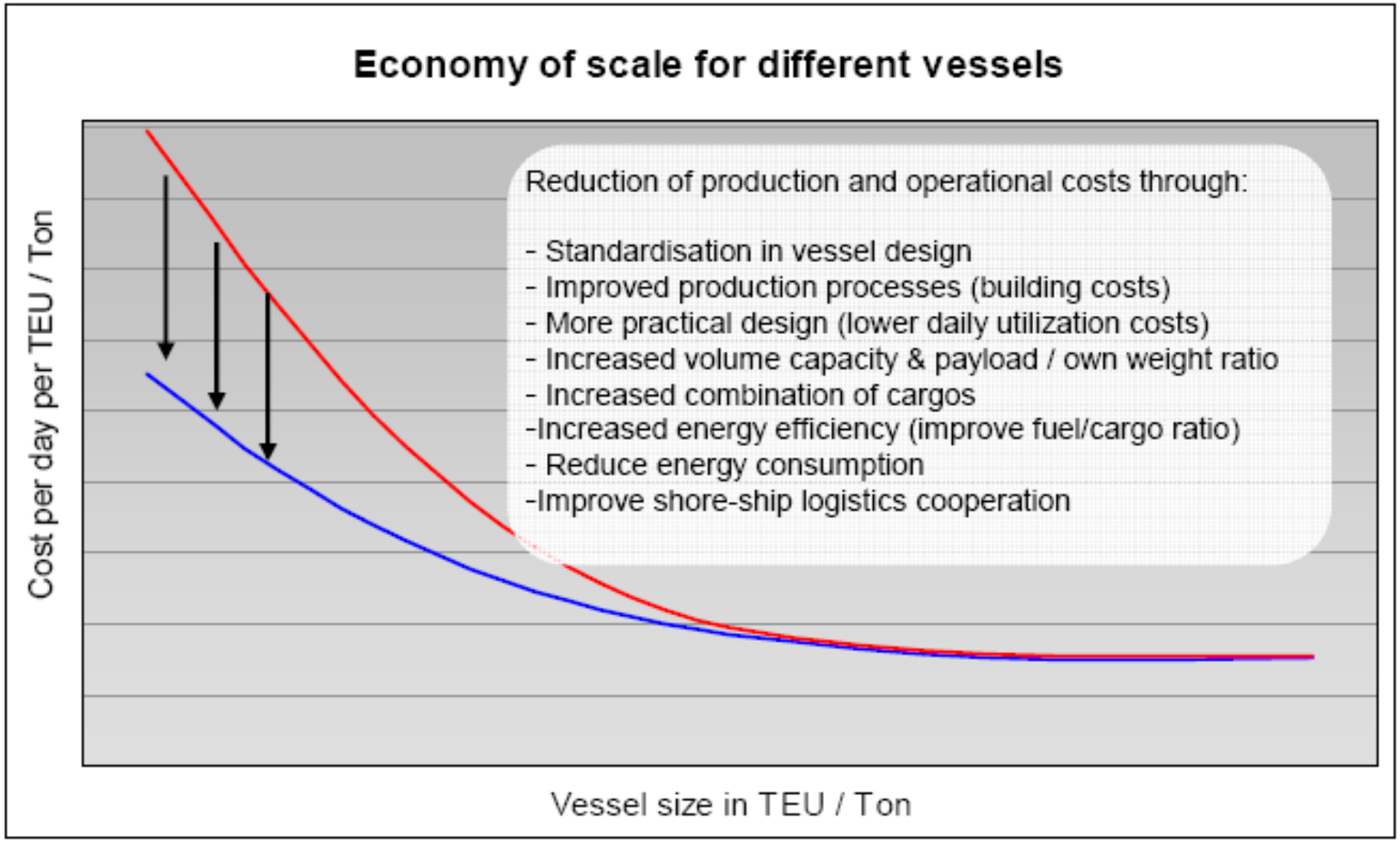
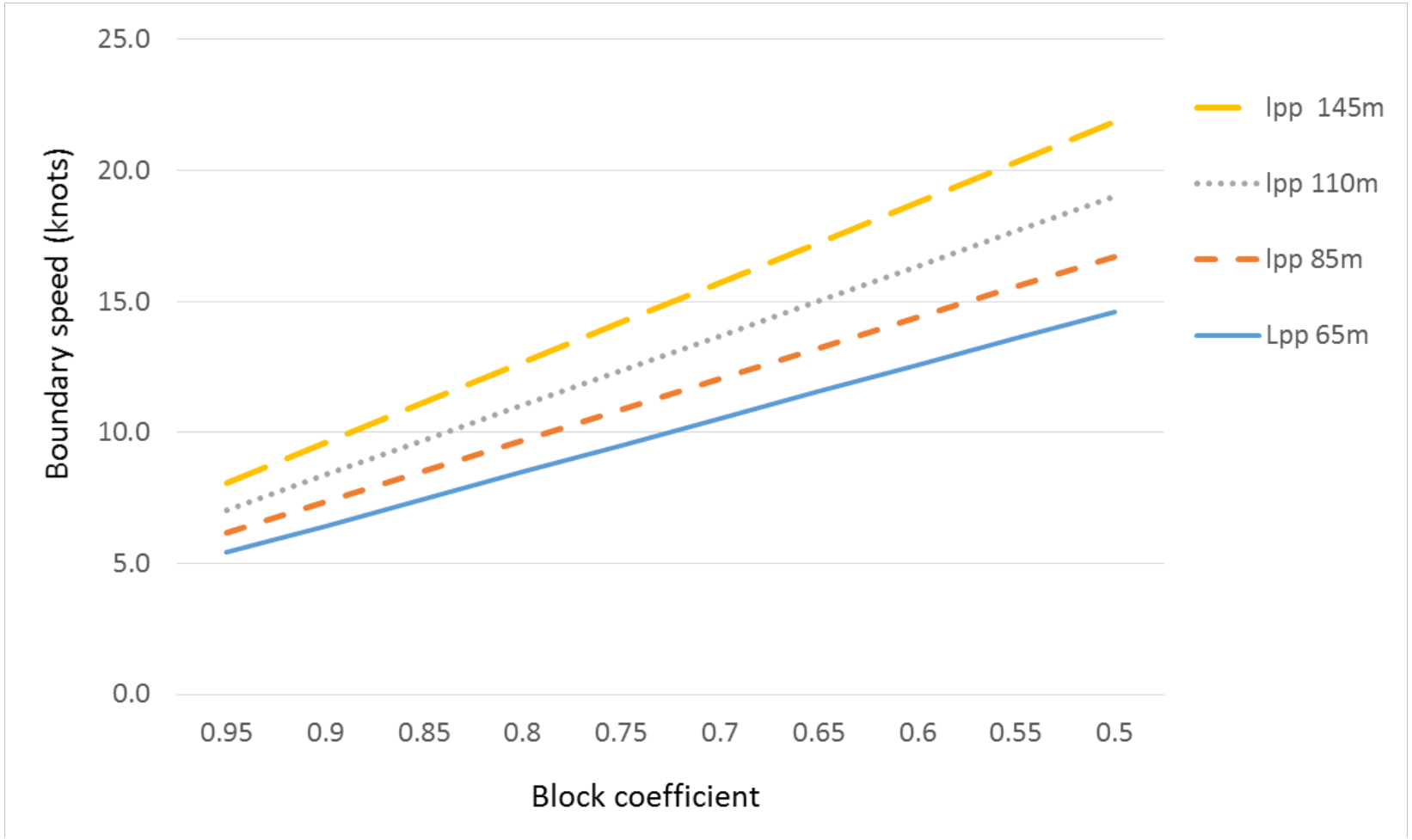
Large vessels might be 10 times more energy efficient than trucks while small vessels, i.e. less than 5000 dwt might be at a comparable level.




Economy of scale for different vessels
Reduction of production and operational costs through:
- Standardisation in vessel design
- Improved production processes (building costs)
- More practical design (lower daily utilization costs)
- Increased volume capacity & payload / own weight ratio
- Increased combination of cargos
-Increased energy efficiency (improve fuel/cargo ratio)
- Reduce energy consumption
-Improve shore-ship logistics cooperation
Cost per day per TEU / Ton
Vessel size in TEU / Ton

Boundary speed as a function of vessel length and block coefficient



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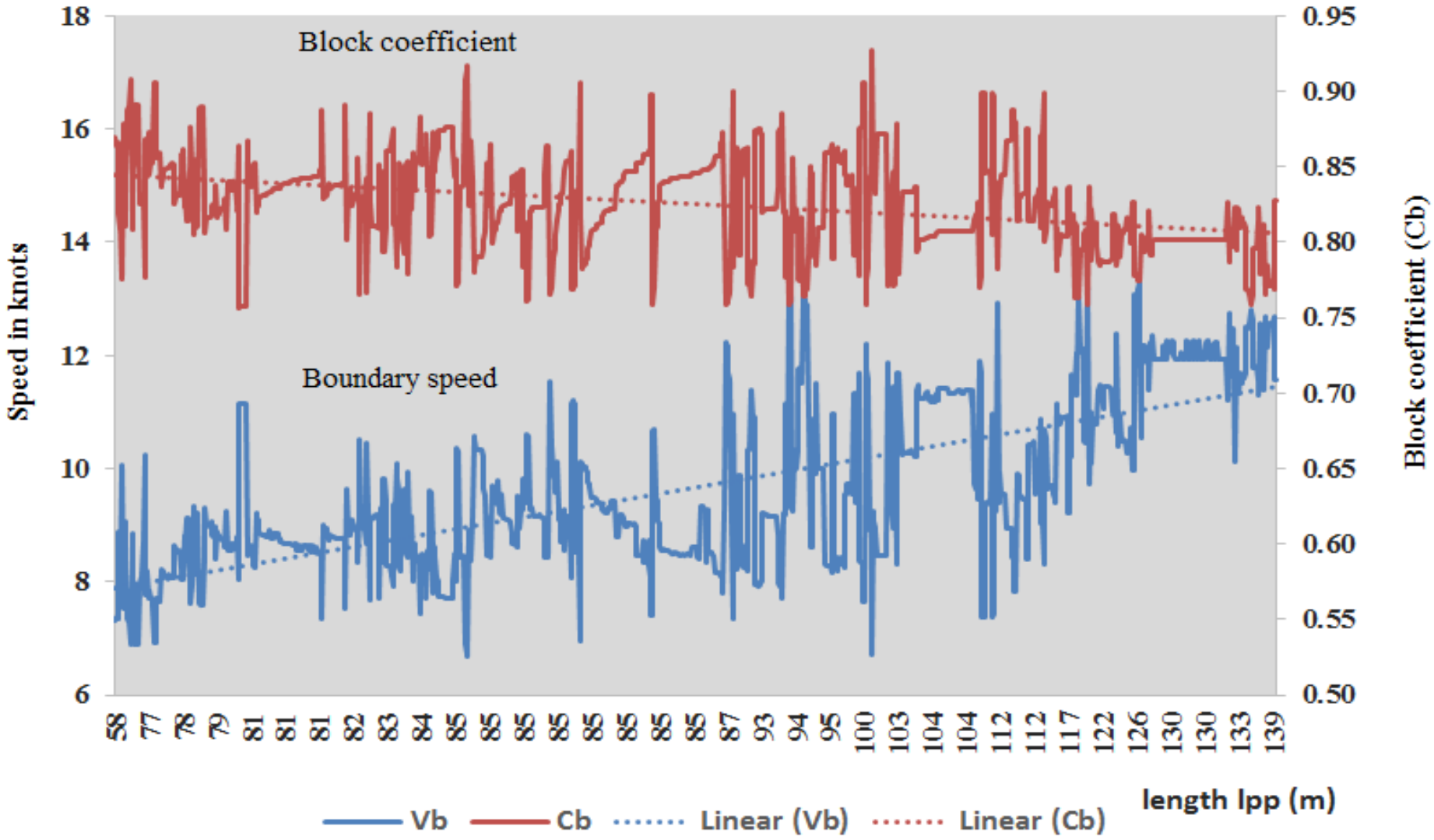
Boundary speed as a function of block coefficient and vessel length (1169 gearless vessels)



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FORSIDEN / VIL TESTE FØREFRØSE SKIP I TRONDHEIMSFJORDEN

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STÅLE LANGØRGEN
Mobil: 988 07 152

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Konsernsjef Walter Qvam i Kongsberg Gruppen mener at Norge både kan og bør ta en ledende rolle innen utviklingen av autonome skip. FOTO: KRISTEN SVORTE

Vil teste førerløse skip i Trondheimsfjorden

Kongsberg Gruppen mener det bør opprettes et testområde for førerløse skip i Trondheimsfjorden og utenfor kysten av Trøndelag.

I Trondheim har forskerne i mange år studert hvordan skip kan operere uten verken kaptein eller mannskap, og konsernsjef Walter Qvam i Kongsberg Gruppen spår en rivende utvikling av slike såkalte autonome fartøy i årene fremover.

Han mener at Norge med sine maritime tradisjoner både kan og bør ta en ledende rolle

TU MENY LOGG INN TUs bidragsytere: Ekspertene skriver

Rolls-Royce (Foto: Rolls-Royce)

Norge blir først i verden: Peker ut fjord til testing av skip uten mannskap

Etablerer fast testområde.

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Kystverket lanserer planene i innspill til ny Nasjonal Transportplan (NTP) 2018-2029. Forslaget blir svært godt mottatt i det maritime miljøet.

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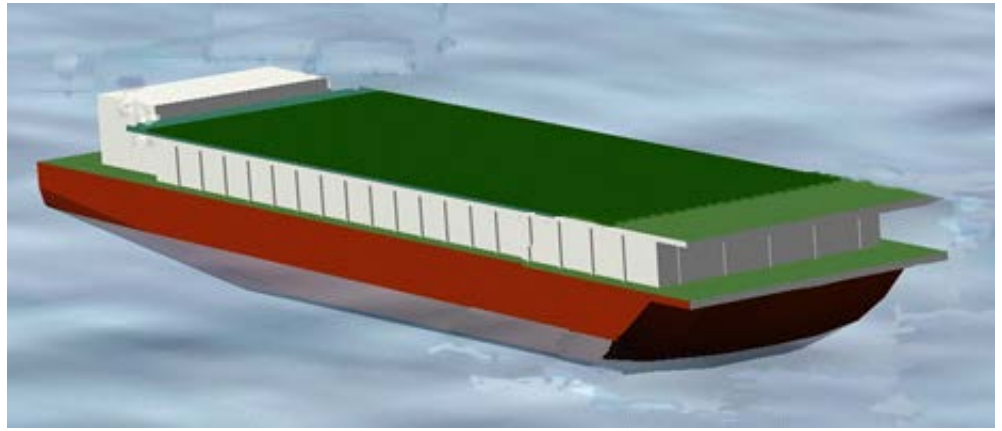
Autonomous Ship Transport at Trondheimsfjorden (ASTAT)

- Short voyages
- 12-50 TEU
- Inland, fjords/sheltered
- Low cost: Wait in port
- Legs 4-12 hours
- Port cranes
- Automated berthing
- Batteries



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Yara Birkeland – Fully autonomous and electrical

Main particulars

- **Length o.a.**: 79,5 m
- **Length p.p.**: 72,4 m
- **Width mld.**: 14,8 m
- **Depth shelter deck**: 10,8 m
- **Draught (full)**: 6 m
- **Draught (ballast)**: 3 m
- **Service speed**: 6 knots
- **Max speed**: 13 knots

Capacity

- **Cargo capacity**: 120 TEU
- **Deadweight**: 3 200 mt

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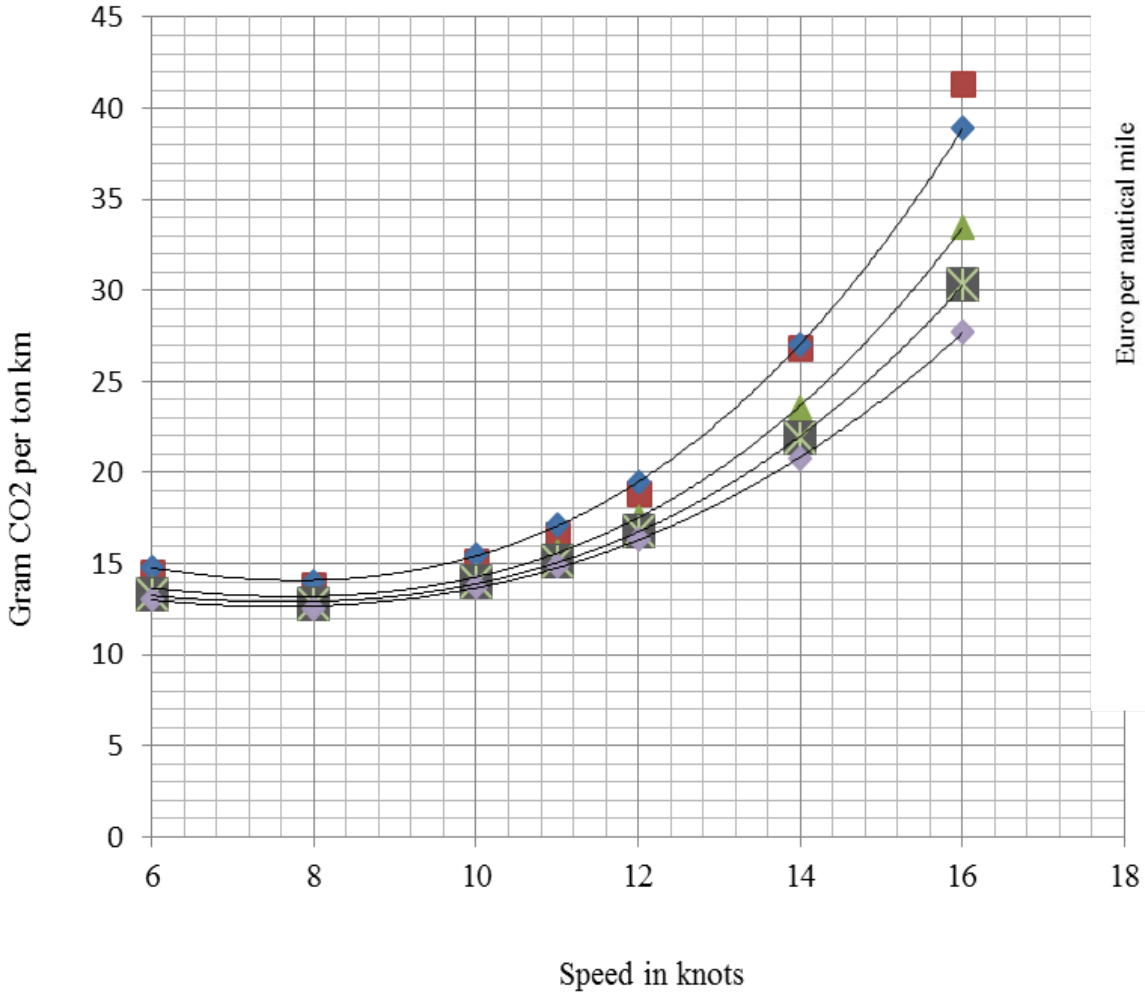
Traditional Vessels

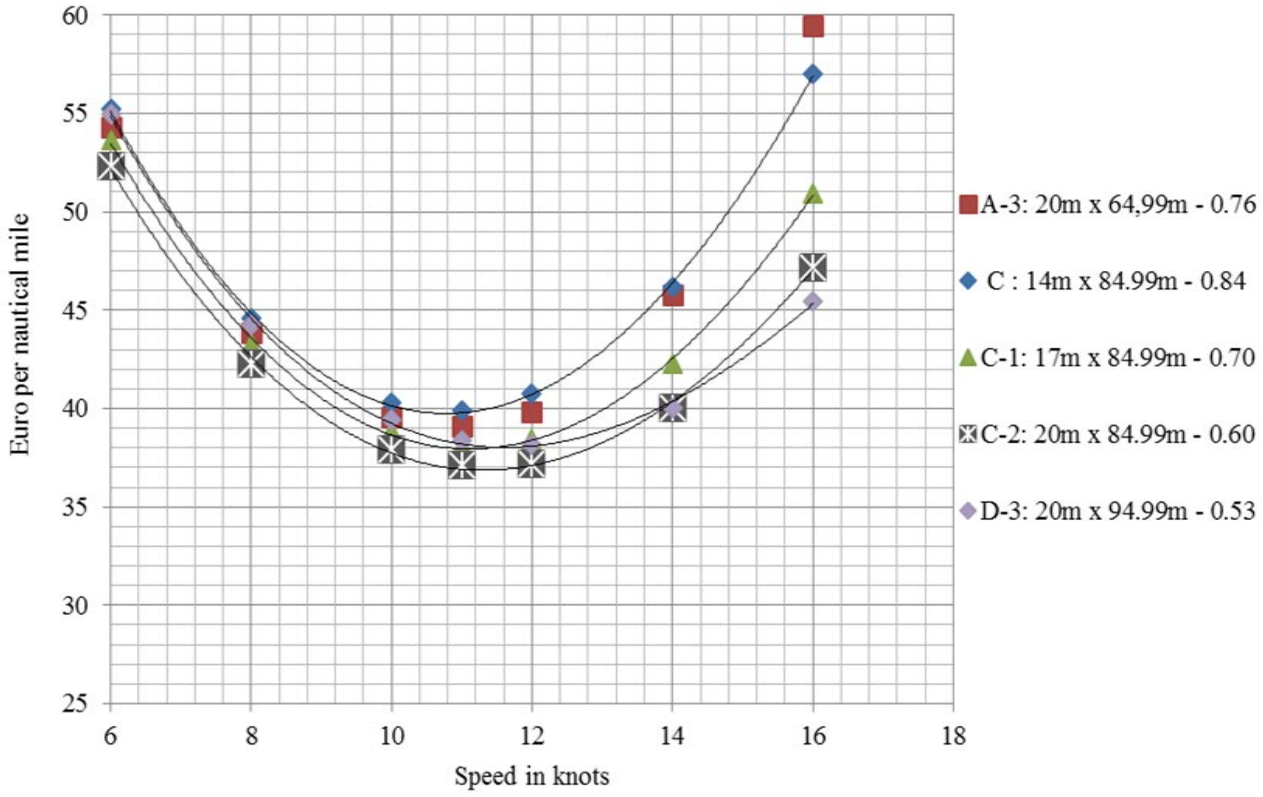
Length : 85 m
Beam : 14 – 16 m
Draught : 5 – 7 m
DWT : 2 500 – 5000 t
Speed 10 – 13 knots

Newbuilt cost, Capex and Opex for traditional vessels

Design characteristics							Daily Cost - 12 knots (Euro - €)				
Alt	Length BP (m)	Beam (m)	Draught (m)	Cb	Dead weight Dwt_s (ton)	New-built cost V_d =12 knots (M.€)	Depre-ciation & Interest	Opera-tion	Fuel 400 €/ton	Fuel 800 €/ton	Total cost with Fuel 800 €/ton
B	74.99	14	7.15	0.84	4 132	7.6	2 634	2 309	1 691	3 382	8 325
B -1	74.99	17	7.25	0.70	4 132	7.6	2 620	2 322	1 459	2 919	7 861
B -2	74.99	20	7.35	0.59	4 132	7.5	2 602	2 325	1 369	2 739	7 665
C	84.99	14	7.20	0.84	4 680	8.7	3 007	2 380	1 695	3 390	8 777
C - 1	84.99	17	7.30	0.70	4 680	8.7	3 019	2 395	1 532	3 064	8 479
C - 2	84.99	20	7.40	0.59	4 680	8.7	3 001	2 398	1 451	2 902	8 302

8 knots gives lowest Gram CO2 per ton nm – While 11 knots gives lowest cost with fuel = 800 Euro per ton for traditional designs





SATS - Gant Chart		Leader	Duration		2018				2019				2020			
WP	Title				1	2	3	4	1	2	3	4	1	2	3	4
WP 1	Mapping and assessment of technology and concepts for autonomous ship transport	Sintef	M1	M6												
WP 2	Identify cargoes which can be moved from road to sea	Sintef	M4	M9												
WP 3	Development of basic shipconcepts including cargo handling	Sintef	M4	M12												
WP 4	Novel methods for design of transport systems utilizing autonomous vessels and ports	NTNU	M7	M18												
WP 5	Development of models for operational optimization of autonmous transport systems	NTNU	M13	M24												
WP 6	Models for environmental and economic analysis of autonomous transport systems	SNF	M6	M18												
WP 7	Case studies for demonstration of the developed methods and models	Sintef	M19	M36												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THANK YOU !
Dr. Elizabeth Lindstad
Lindstad@sintef.no