De Schelde in 2050
Antwerpen, 8 mei 2014

Schepen van de toekomst

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Afdeling Maritieme Techniek

Kenniscentrum
Varen in Ondiep en Beperkt Water

Inhoud

1. **“Schepen worden steeds groter…”**

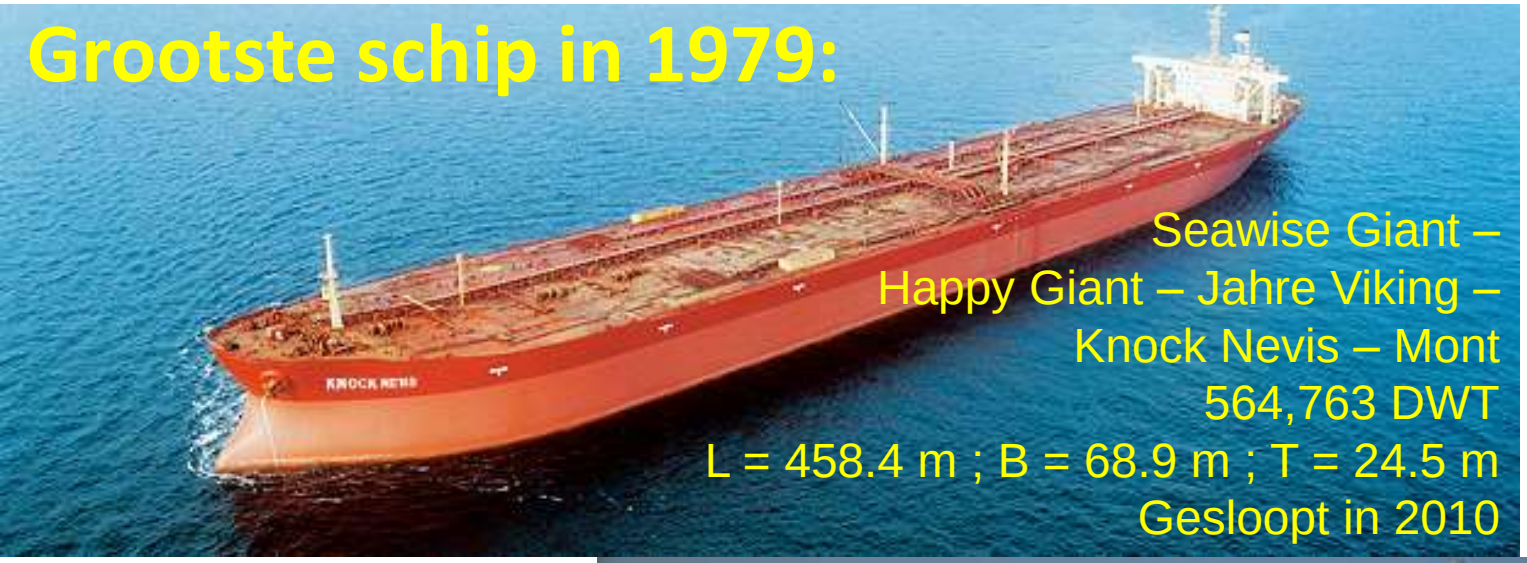
“Schepen worden steeds groter…”

2014 → 2050 ?

“Schepen worden steeds groter…”

1978 → 2014 → 2050 ?

“Schepen worden steeds groter…”



“Schepen worden steeds groter…”

PANAMA CANAL REVIEW

NOVEMBER 1967

SHIPPING

Ever Larger Tankers

THE RAPID growth in the size of the oil tanker has manifested itself in the past year by the delivery of the first vessel of over 200,000 tons deadweight, the *Idemitsu Maru*, and by the ordering of six tankers each of 276,000 tons deadweight for the Gulf Oil Company. These projected vessels will be used to transport crude oil from the Persian Gulf to a storage depot in Bantry Bay, Ireland, for trans-shipment to the European oil refineries in smaller

This system of trans-shipment is the economic solution to transportation of crude oil in large "Cape route only" vessels. If sufficient depth of water is provided at the loading and storage terminals, the growth in size may continue with a possibility that there will be 500,000 tonners and 1 million ton deadweight tankers.

Giant Bulk Carrier

THE SHOBU MARU, one of the largest bulk carriers now in service in Japan, made her maiden voyage through the Panama Canal in mid-August with a cargo of 55,000 long tons of coal from Norfolk to Japan. The big ship is 815 feet in length and has a beam of 104.49 feet which put her in a class with some of the Canal's biggest customers. Her summer deadweight was given as 62,418 tons. Her agent at the Canal is Boyd Brothers.

PANAMA CANAL TRAFFIC

STATISTICS FOR FIRST QUARTER FISCAL YEAR 1968

TRANSITS (Oceangoing Vessels)

	1968	1967
Commercial	3,316	3,035
U.S. Government	350	189
Free	19	28
Total	3,685	3,252

TOLLS*

Commercial	$20,527,815	$18,606,255
U.S. Government	2,284,978	1,168,509
Total	$22,812,793	$19,834,764

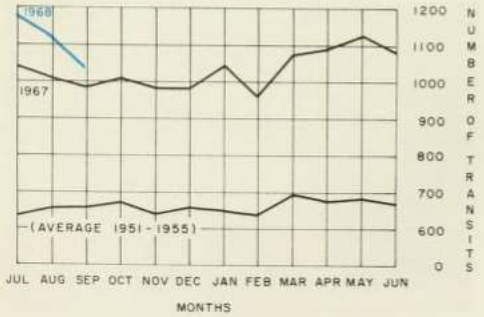
CARGO**

Commercial	23,399,819	21,331,067
U.S. Government	2,331,590	1,151,816
Free	134,260	153,481
Total	25,865,469	22,636,364

* Includes tolls on all vessels, oceangoing and small.

** Cargo figures are in long tons.

According to a recent article in the Marine Digest, the *Shobu Maru* has a revolutionary bow design which enabled her to exceed design specifications in test runs. Her new contour combines the best features of both cylindrical and bulbous bows. It was developed by Nippon Kokan K.K., builders of the vessel, for operation of large ships on engines of lower power without sacrificing speed. The *Shobu Maru* established top speed of 17.38 knots and service speed of 15.25 knots with one-third cargo load during her sea trials.



New Italian Visitor

THE 30,000-TON Italian liner *Eugenio C.* will make her first visit to the Isthmus January 3 when she docks at Cristobal during a 31-day Caribbean cruise, according to her local agents, C. B. Fenton & Company, Inc.

Built in 1966, this luxury liner is considered the largest and fastest vessel of the non-governmental Italian fleet. She is equipped with a double set of finned stabilizers which eliminate rolling and she holds the speed record (27 knots) on the Mediterranean-South America run.

The *Eugenio C.* is scheduled to visit St. Thomas, Fort de France, Bridgetown, Port of Spain, La Guaira, then Cristobal, Montego Bay, Port Everglades and finally Nassau before heading home to Genoa.

New Cargo Vessels

LYKES BROS. Steamship Co. Inc., of New Orleans, which is one of the Panama Canal's biggest customers, has invited bids for the construction of 3 new all-purpose cargo ships it plans to add to its fleet, according to an article in Brandon's Shipper & Forwarder.

These ships, to be the largest of common-carrier cargoliners ever built, will be 875 feet in length and 106 feet in beam. They are to be named the Seabee Class, in honor of the U.S. Navy construction battalions observing their 25th anniversary this year.

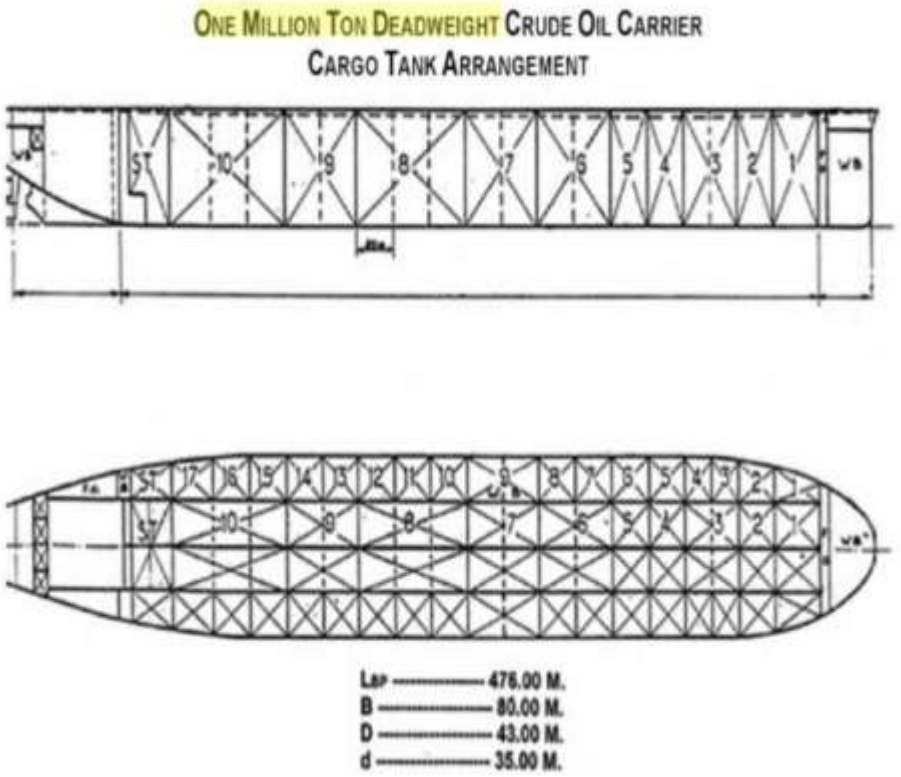
Each driven by a powerplant of 36,000 shaft horsepower, the largest ever installed in any cargo vessel, the Seabees will cross the ocean at 20 knots or faster. The company plans to place them in service between the U.S. Gulf ports and Continental Europe early in 1970.

Lykes president Frank A. Nemec was reported as stating that the new ships will offer unprecedented flexibility in carrying various types of commercial and military cargo. "This is not just another new ship but is a whole new method of ocean transportation based on a new method of handling shipboard cargo," Nemec was quoted in the article.

“Schepen worden steeds groter…”

vessels.

This system of trans-shipment is the economic solution to transportation of crude oil in large “Cape route only” vessels. If sufficient depth of water is provided at the loading and storage terminals, the growth in size may continue with a possibility that there will be 500,000 tonners and 1 million ton deadweight tankers.



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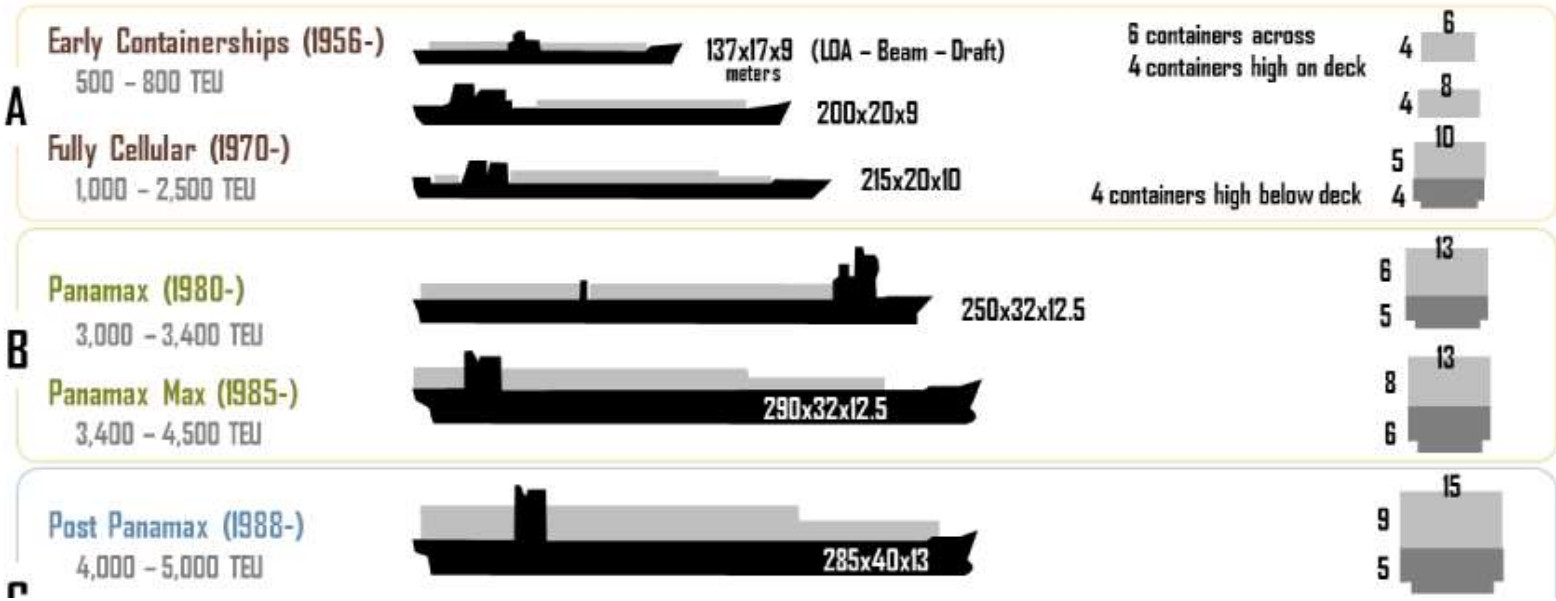


Anforderungen durch Containerschiffe der 4. Generation

Dipl.-Ing. H. Hebeler, cand. arch. nav. M. Schubring, cand. arch. nav. A. Wölper, alle Hamburg

Auf der HTG-Hauptversammlung 1983 in Kiel wurde aus der Arbeit des **Ausschusses für betriebliche Systeme des Hafenumschlages** über die logistischen Zusammenhänge des weltweiten Containerverkehrs berichtet. Ein damals vorgestelltes Kostendiagramm (Bild 1) zeigte auf, daß der Transport eines Containers pro km per Lkw mindestens zehnmal so teuer ist wie per Seeschiff und mindestens fünfmal so teuer wie per Containerganzzug oder Großraumbinnenschiff.

Diese ökonomischen Zwänge führen dazu, daß die Reeder, die ja im Containerverkehr dem Kunden die Leistung des Gesamttransportes vom Fabriktor bis in den Supermarkt anbieten, mit dem kostengünstigsten Transportmittel, dem Seeschiff, soweit wie möglich ins Binnenland (ins Zentrum der Industrie und Verbraucher) fahren wollen und deshalb auch in Zukunft nach Seattle, Montreal oder Hamburg fahren werden, obwohl diese Häfen über 100 km tief im Binnenland liegen.

So werden wir uns in den deutschen Seehäfen auch mit den Anforderungen der Containerschiffe der 4. Generation befassen müssen, über deren Eigenschaften die beiden Schiffbauer Schubring und Wölper berichten. Diese haben in mehrmonatiger Arbeit die Arbeitsabläufe auf mehreren Containerterminals im In- und Ausland genau studiert, die Werte analysiert und werden in den beiden folgenden Abschnitten über einige dieser Ergebnisse aussagen.

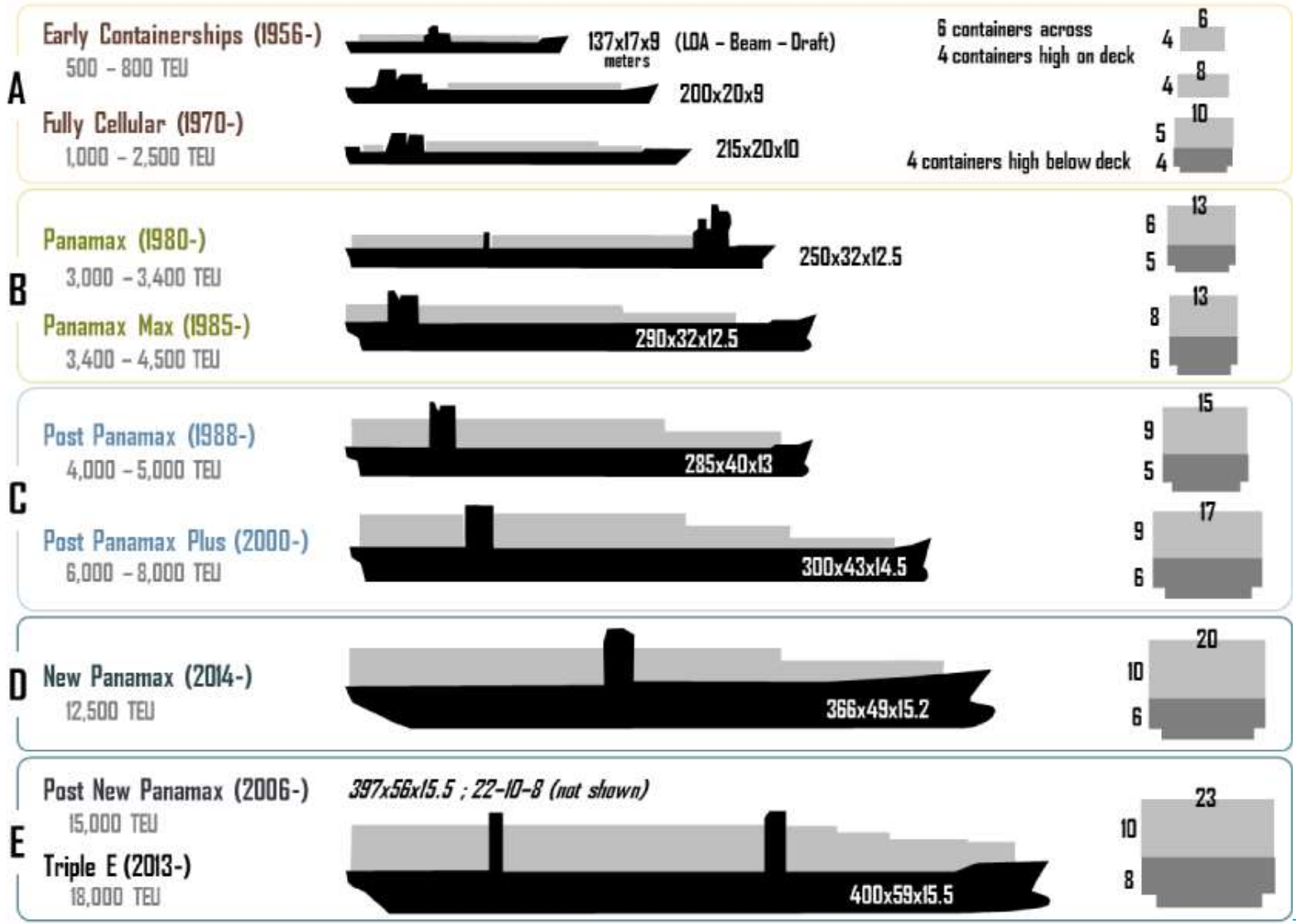
HANSA - Schiffahrt - Schiffbau - Hafen — 125. Jahrgang — 1988 - Nr. 4

“Schepen worden steeds groter…”

Schiffslänge sind wegen der konstruktiven Probleme offener Schiffe keine Änderungen zu erwarten. Es ist anzunehmen, daß die Schiffe nicht länger als ca. 300 m (PANMAX-Länge plus eine 40′-Bay) (Bild 2) werden.

Von entscheidender Auswirkung auf den Umschlag ist die größer werdende Schiffsbreite. Man nimmt an, daß die Grenze bei 16 Deckscontainerreihen von je 8 liegt, was einer Schiffsbreite von knapp 40 m entspricht. Gegenüber PANMAX-Breite mit 13 Reihen

“Schepen worden steeds groter…”



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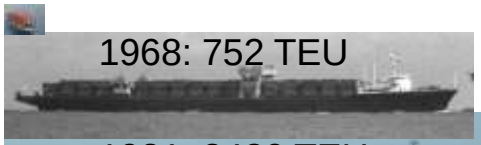

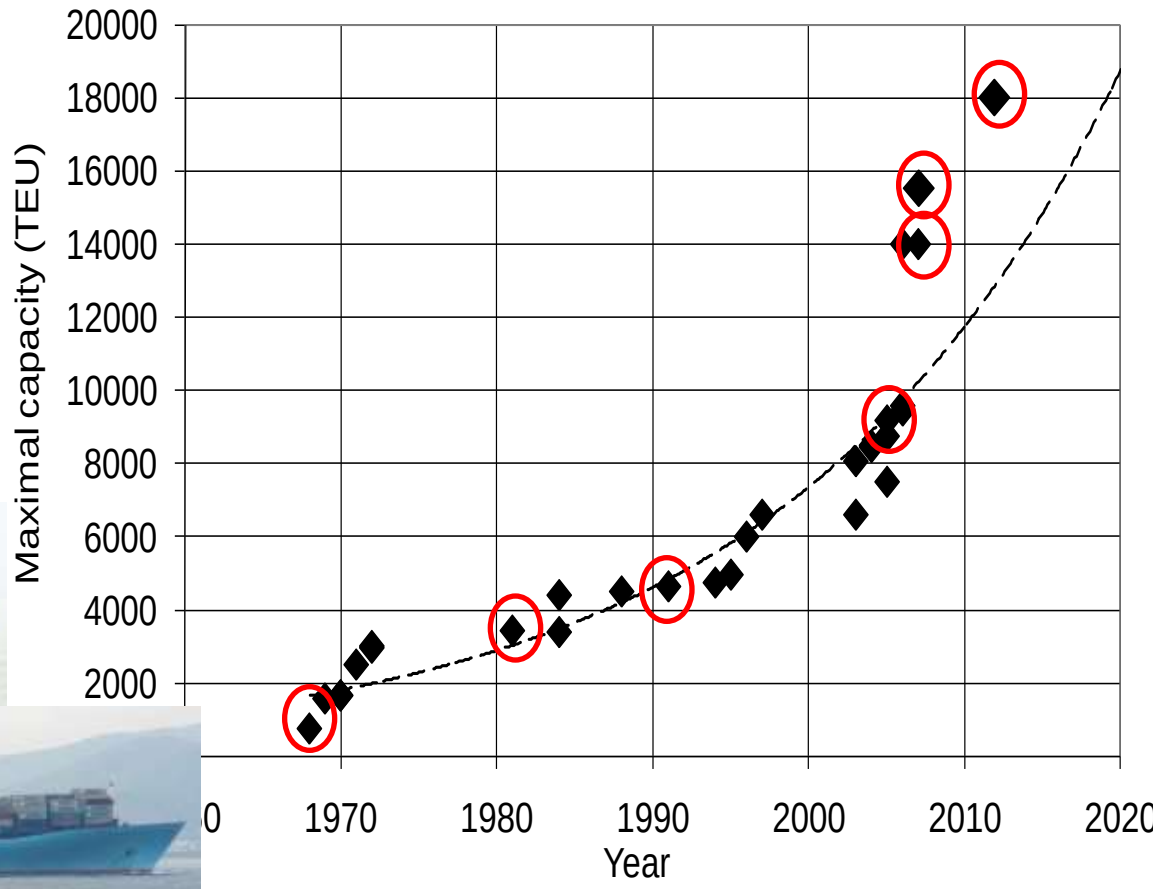

“Schepen worden steeds groter…”

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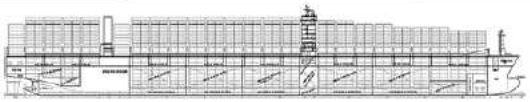
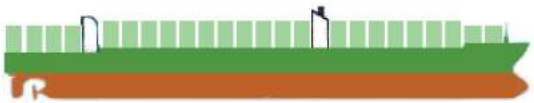
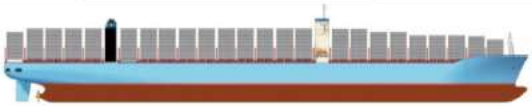
World’s Largest Containerships : 2006-2015

		TEU tdw	LOA m	Breath m	Draft m	Containers Rows across
Jiangnan Changxing Hull H6002 **CMA CGM TBN** 2015 Sep		17,859 TEU ~185,000 tdw	399.0	54.0 As advertised	16.0	21
Hyundai Samho Hull S746 **UASC TBN** 2015 Apr		18,800 TEU ~195,000 tdw	400.0	58.6 As advertised	16.0	23
DSME Hull 4277 **MSC TBN** 2015 Jan		18,400 TEU ~195,000 tdw	395.4	59.0 As advertised	16.0	23
Hyundai H.I. Hull 2696 **CSCL GLOBE** 2014 Nov		19,000 TEU ~195,000 tdw	400.0	58.6 As advertised	16.0	23
DSME Hull 4250 **MAERSK McKINNEY MOLLER** 2013 Jun		18,270 TEU 194,153 tdw	399.0	59.0	16.0	23
DSME Hull 4161 **CMA CGM MARCO POLO** 2012 Nov		16,020 TEU 187,625 tdw	396.0	53.6	16.0	21
Odense Hull 203 **EMMA MAERSK** 2006 Aug		15,550 TEU 156,907 tdw	397.7	56.4	16.0	22

ALPHALINER

“Schepen worden steeds groter…”

EVOLUTION OF THE WORLD'S LARGEST CONTAINERSHIPS (1985–2011)

LENGTH OVERALL M	NAME	YEAR	TDW	TEU	LOA M	BREADTH M	DRAUGHT M
	TBN	2014	< 220,000	<20,200	440	59.0	16.5
	Emma Mærsk	2006	175,000	15,200	397	56.4	16.0
	Gudrun Mærsk	2005	115,700	9,500	367	42.8	15.0
	Sovereign Mærsk	1997	105,000	8,200	347	42.8	15.0
	Regina Mærsk	1997	90,500	7,403	318	42.8	14.5
	Myk Altair	1994	63,000	4,953	300	37.1	13.0
	President Truman	1988	55,500	4,538	275	39.4	12.5
100 200 300 400 500							

Source: Alphaliner.

[5] At February 2011.

“Schepen worden steeds groter…”

stx news — Dream & Future — 06 — 2008. 6. 1 NO.85

Let's make STX World Best with the spirit of Creativity & Challenge

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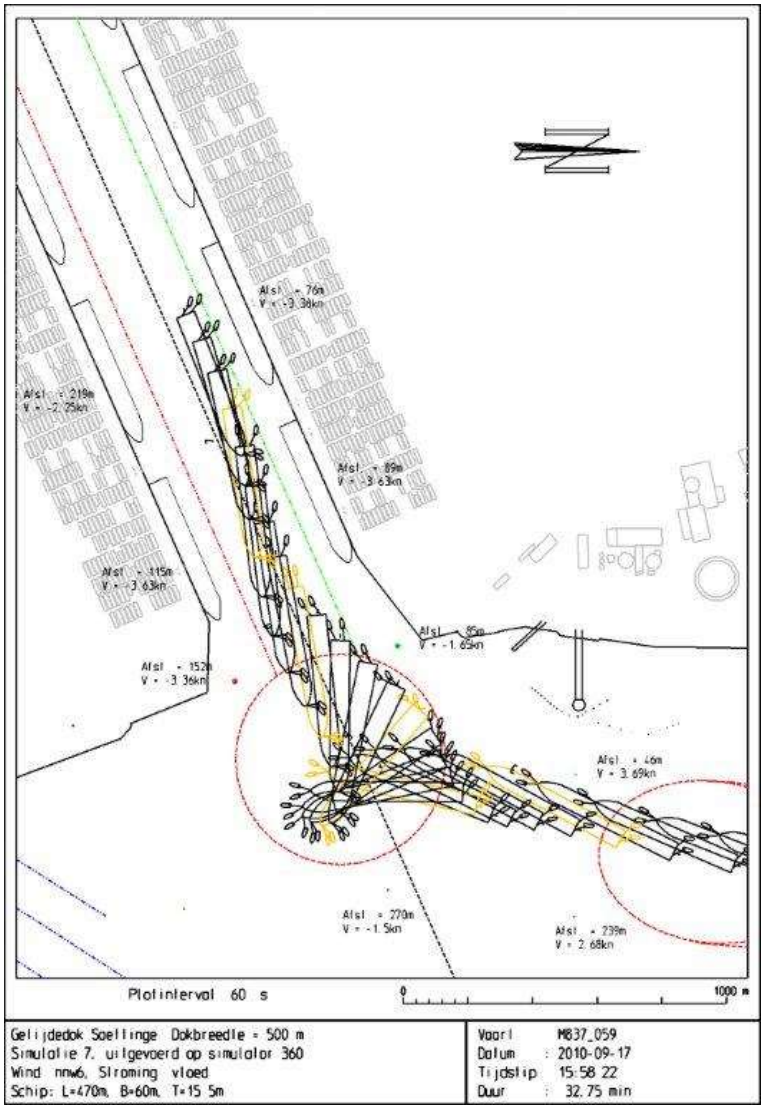
Development of the World's First 22,000 TEU Class Container Ship

STX Shipbuilding succeeded in the development of a 22,000 TEU class container ship for the first time in the world, exceeding the 20,000 TEU that has been recognized up to this point as the limit in the aspects of technology and economic efficiency.

STX Shipbuilding developed both one- and two-propeller types of container ships, which are 460m in length, 60m in width, and 30m in height, and equipped with a deck area as wide as the area of 4 football fields. Particularly, since with only one propeller it can sail at 24~26 knots which is the normal speed for medium and large container ships, it is recognized as a ship with high economic efficiency. In addition, this container ship can save more than 40% on the unit transportation cost compared with that of existing super-large container ships.

STX Shipbuilding, which received orders for 9 container ships of 13,000TEU from European shipping companies, proved again its advanced technological power and simultaneously provided an important base from which it can leap toward becoming the world's leading shipbuilding company.

“Schepen worden steeds groter…”



“malaccamax”:

470 m * 60 m

flanders HYDRAULICS RESEARCH
KNOWLEDGE CENTRE MANOEUVRING IN SHALLOW AND CONFINED WATER

UNIVERSITEIT GENT

MARITIME TECHNOLOGY GHENT UNIVERSITY

“Schepen worden steeds groter…”

“Schepen worden steeds groter…”

Tot 2008:	L < 340 m, T < 140 dm
	L < 360 m, T < 130 dm
2009:	MSC Beatrice (366 m * 51.3 m)
2011:	MSC Daniela (366 m * 51.3 m met T = 152.5 dm)
2012:	Edith Maersk (397 m * 56 m)
2013:	Mary Maersk (399 m * 59 m)

April 2009 – MSC Beatrice

Januari 2012 – Edith Maersk

“Schepen worden steeds groter…”

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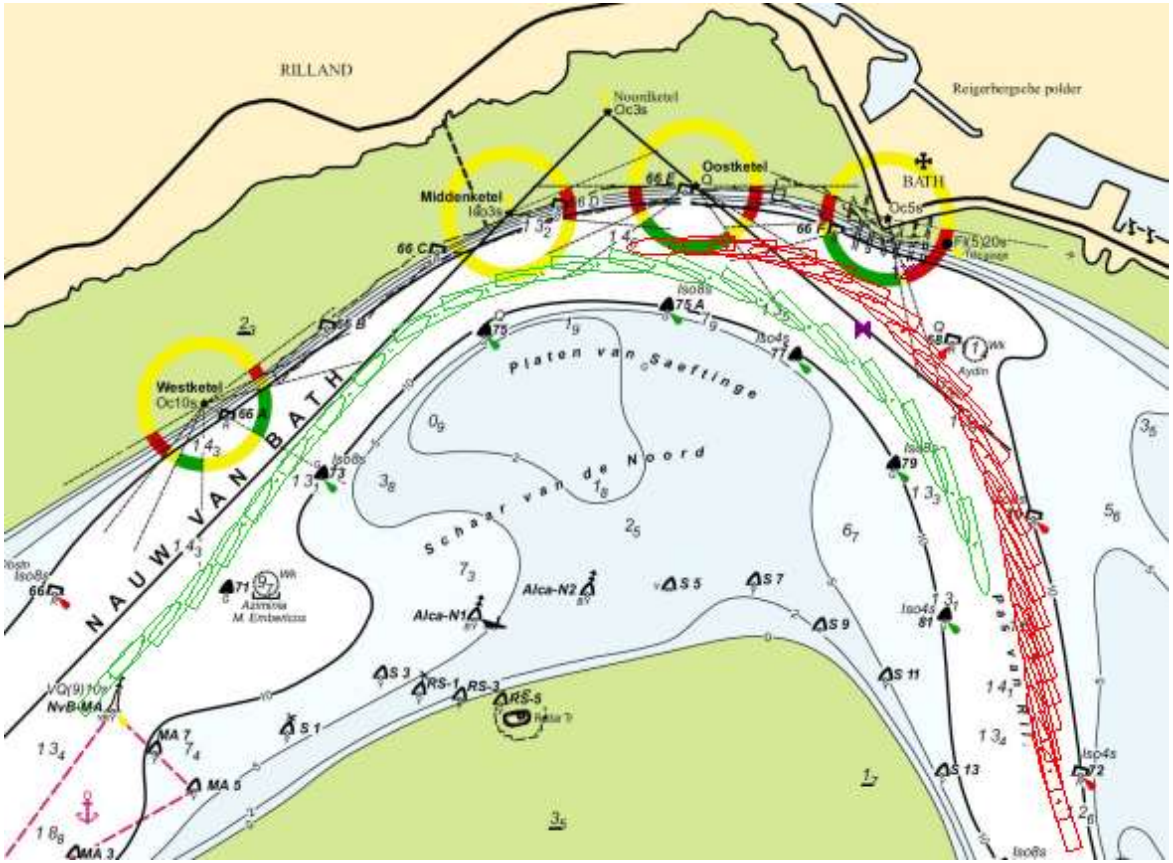

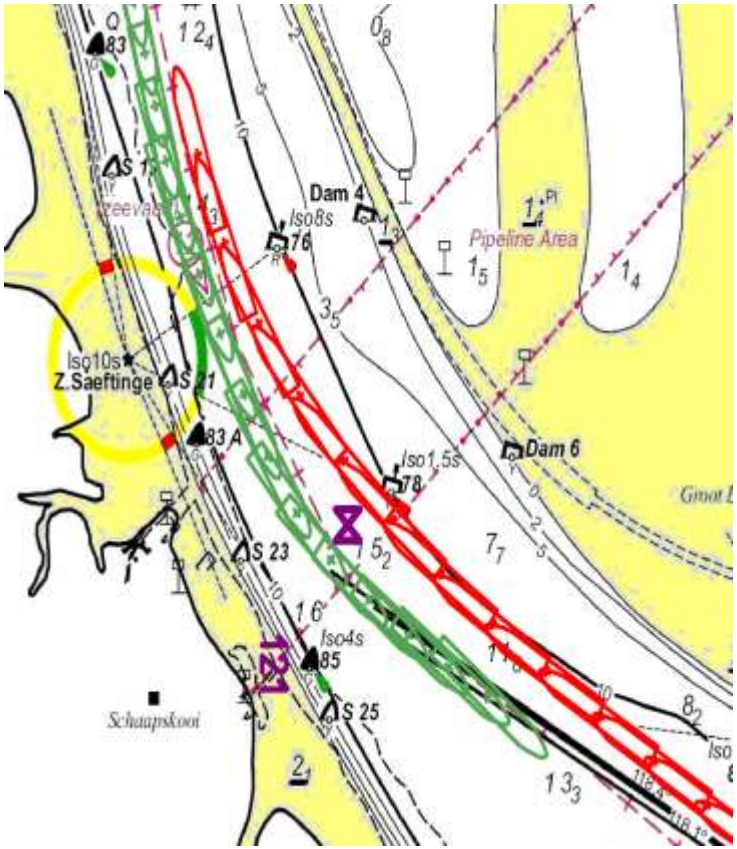

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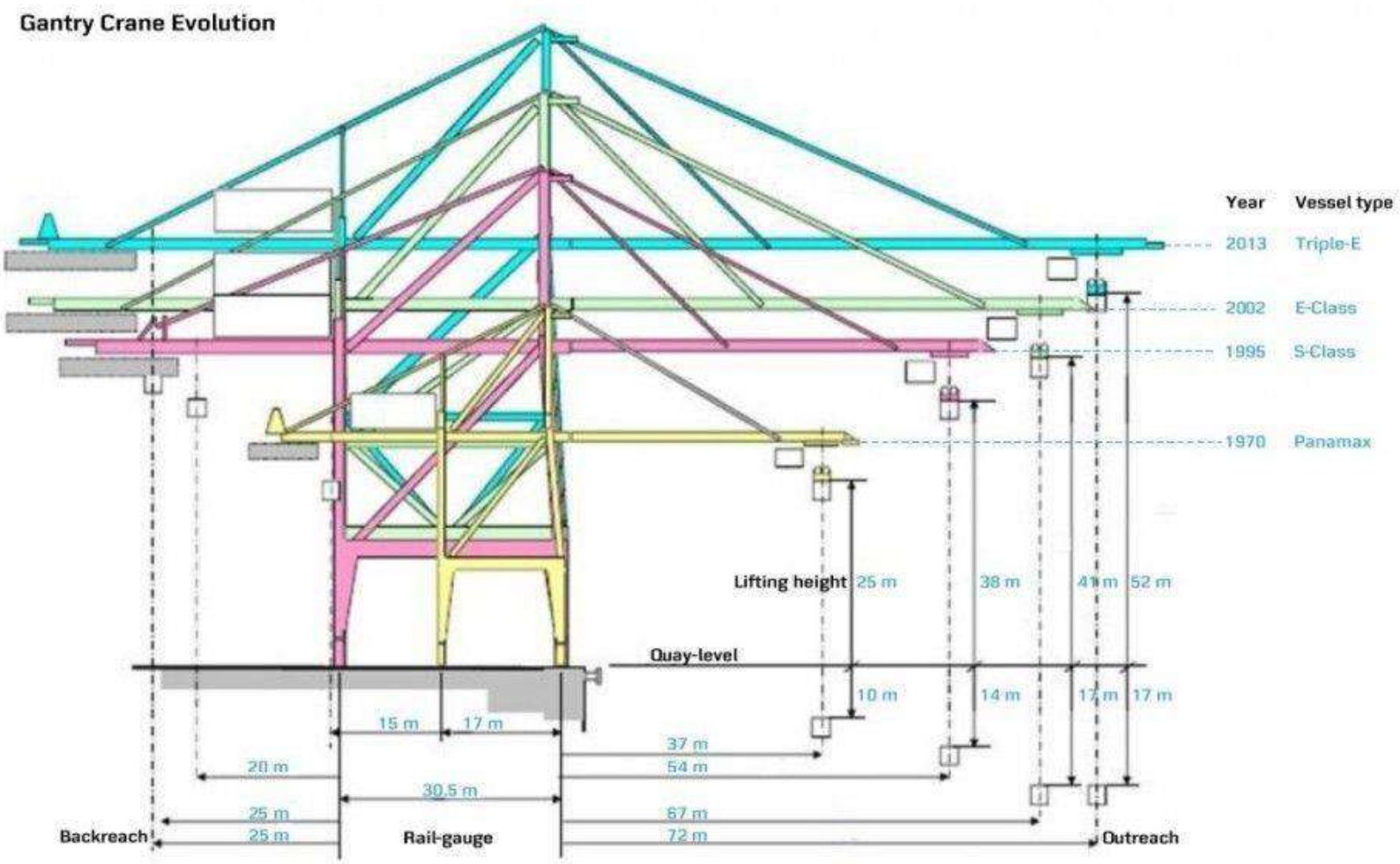


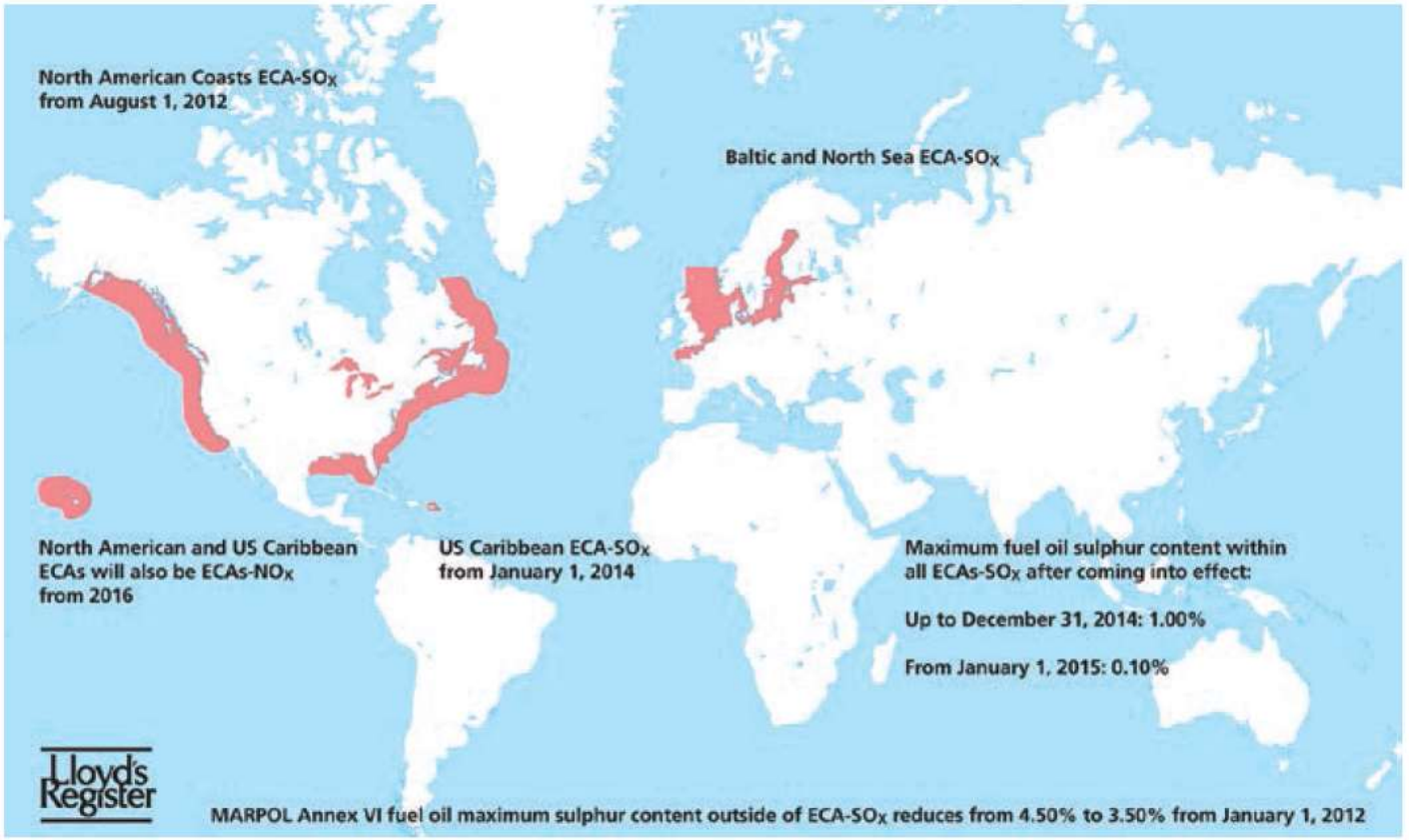
Inhoud

1. “Schepen worden steeds groter…”
2. “Schepen worden steeds groener…”

“Schepen worden steeds groener…”

MARPOL Annex VI

- **NOx Emission Standards**
- **SOx: cf. Emission Control Areas (ECA)**



“Schepen worden steeds groener…”

MARPOL Annex VI

- **NOx Emission Standards**
- **SOx: cf. Emission Control Areas (ECA)**

1 July 2010	Tier II NO_X limit for new engines [Global]
1 July 2011	US Caribbean Sea ECA adopted at IMO MEPC 62
1 Jan 2012	Cap on sulphur content of fuel[(a)] 4.50% to 3.50% [Global]
1 Aug 2012	North American ECA took effect SO_X and NO_X[(b)] [Local]
1 Jan 2014	US Caribbean Sea ECA takes effect SO_X and NO_X[(b)] [Local]
1 July 2015	ECA cap on sulphur content of fuel 1.00% to 0.10% [Local]
1 Jan 2016[(c)]	Tier III NO_X limit for new engines NO_X ECA's only [Local]
1 Jan 2020[(d)]	Cap on sulphur content of fuel 3.50% to 0.50% [Global]

“Schepen worden steeds groener…”

Maersk E Class (2006)		Maersk Triple E Class (2013)	
Lengte	397 m	Lengte	400 m
Breedte	56 m	Breedte	59 m
Diepgang	15.5 m	Diepgang	14.5 m
Capaciteit	14 770 TEU	Capaciteit	18 340 TEU
Vermogen	80 MW	Vermogen	2 * 32 MW
Snelheid	25.5 kn	Snelheid	19 kn

➔Nieuwe schepen: **lagere ontwerpsnelheid**
lager vermogen

➔ Bestaande schepen: **lagere vaarsnelheid**

“Schepen worden steeds groener…”

➔**Nieuwe schepen:** **lagere ontwerpsnelheid**
lager vermogen

➔**Bestaande schepen:** **lagere vaarsnelheid**

Motivatie:

➔**Brandstofprijzen, economisch optimum**

➔**Beperking emissie van broeikasgassen (GHG)**

“Schepen worden steeds groener…”

IMO (MARPOL):

In voege vanaf 2013:

- **Nieuwe schepen:**
  EEDI = Energy Efficiency Design Index
  [g CO_2 / ton / zeemijl]

- **Bestaande schepen:**
  SEEMP = Ship Energy Efficiency Management Plan

“Schepen worden steeds groener…”

SEEMP (Ship Energy Efficiency Management Plan)

SEEMP measures	
1. Fuel efficient operations	**4. Machinery and equipment optimisation**
1.1. Improved voyage planning	4.1. Main and auxiliary engine optimisation
1.2. Weather routeing	4.2. Equipment and systems
1.3. Just-in-time	4.3. Heat recovery
1.4. Speed optimisation	
1.5. Optimised shaft power	
2. Optimised ship handling	**5. Cargo handling optimisation**
2.1. Optimum trim	5.1. Cargo heating and insulation
2.2. Optimum ballast	5.2. Other measures for cargo handling optimisation
2.3. Optimum propeller and propeller inflow considerations	
2.4. Optimum use of rudder and autopilot	
3. Hull and propeller optimisation	**6. Energy conservation and awareness**
3.1. Hull resistance optimisation	6.1. Accommodation energy optimisation
3.2. Propeller management	6.2. Use of renewable energy
	6.3. Use of shore-based power sources when at port (cold ironing)
	6.4. Energy conservation investigation projects
	6.5. Training and awareness

“Schepen worden steeds groener…”

SEEMP (Ship Energy Efficiency Management Plan)

SEEMP measures

1. Fuel efficient operations
   - 1.1. Improved voyage planning
   - 1.2. Weather routeing
   - 1.3. Just-in-time
   - 1.4. Speed optimisation
   - 1.5. Optimised shaft power
2. Optimised ship handling
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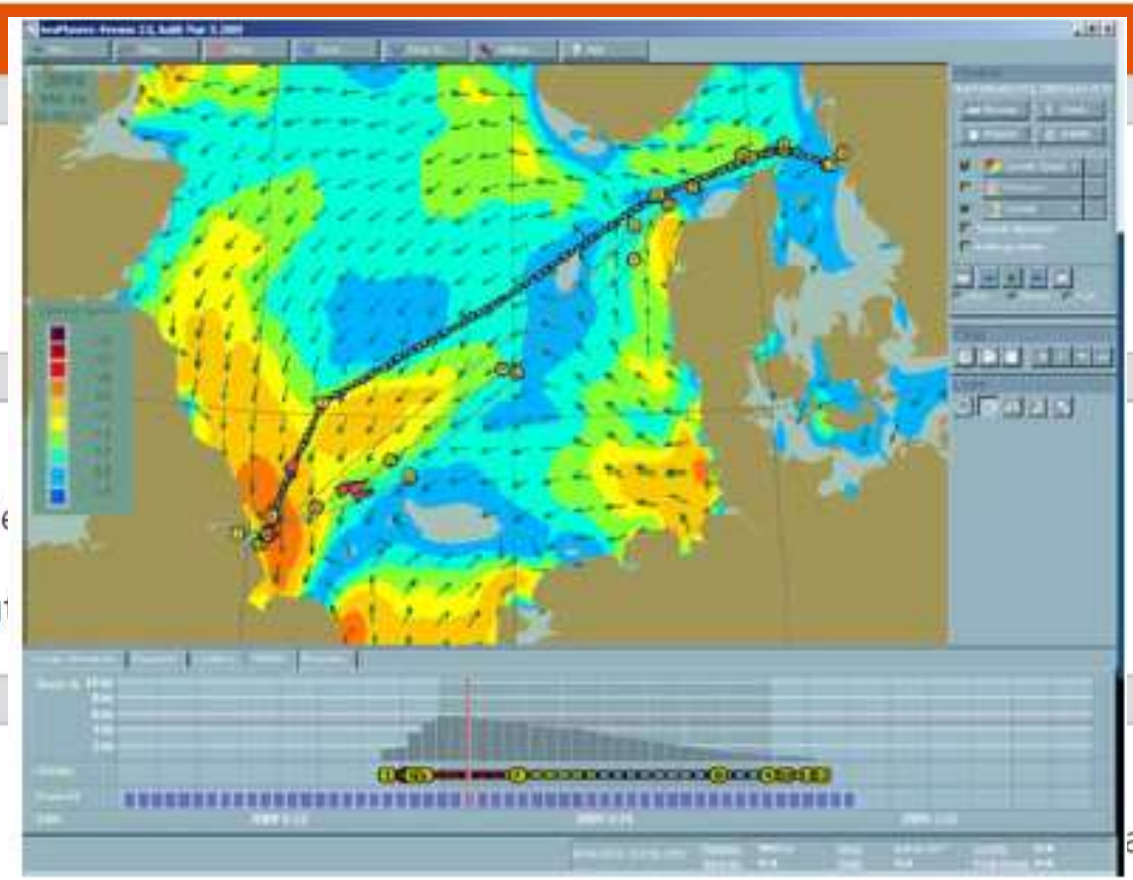
3. Hull and propeller optimisation
   - 3.1. Hull resistance optimisation
   - 3.2. Propeller management



at

port (cold ironing)

- 6.4. Energy conservation investigation projects
- 6.5. Training and awareness

“Schepen worden steeds groener…”

SEEMP (Ship Energy Efficiency Management Plan)

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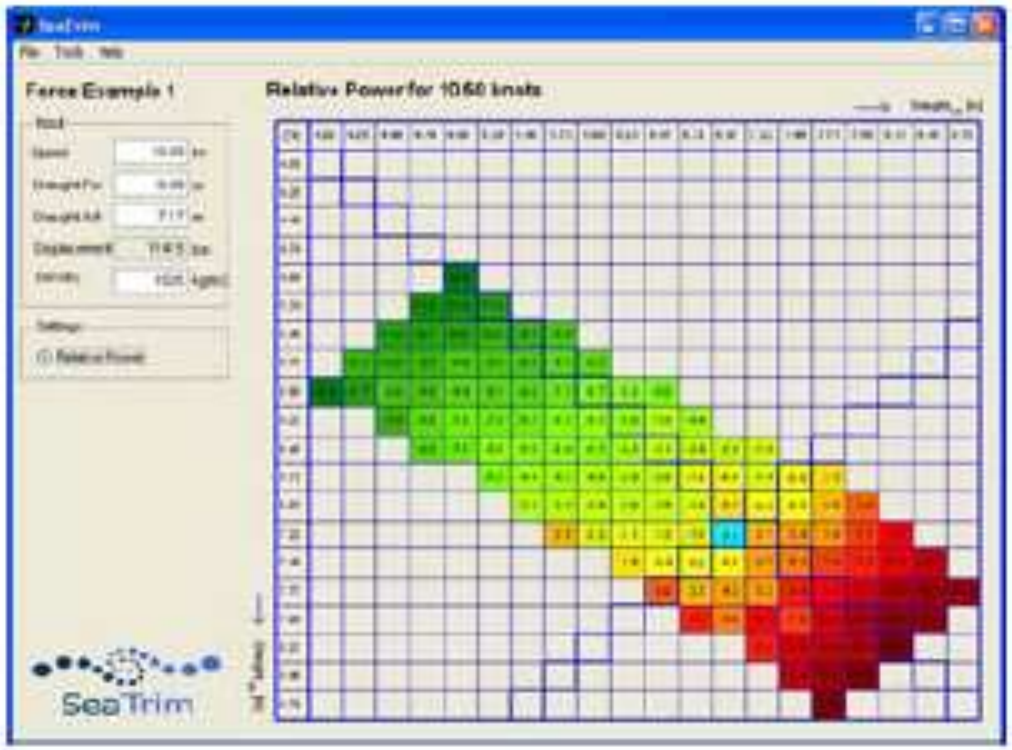

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“Schepen worden steeds groener…”

SEEMP (Ship Energy Efficiency Management Plan)

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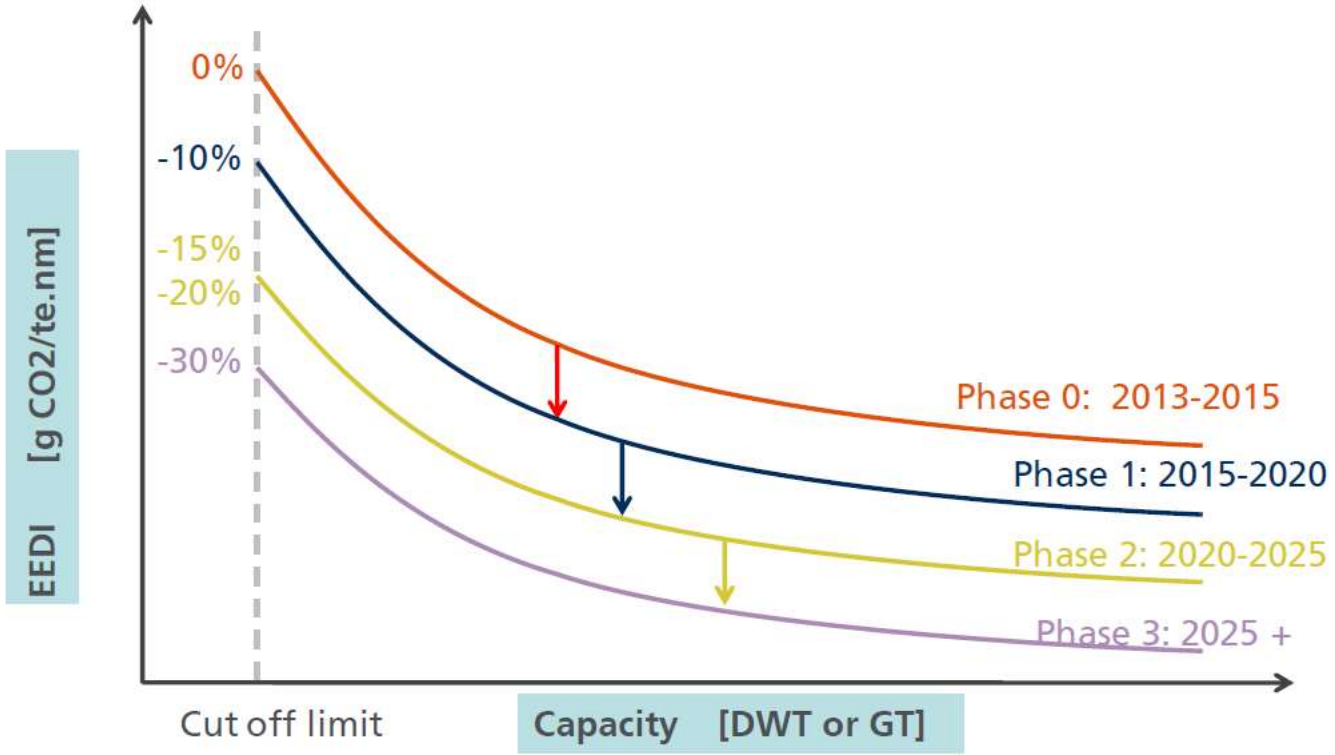
3. Hull and propeller optimisation
   - 3.1. Hull resistance optimisation
   - 3.2. Propeller management
4. Machinery and equipment optimisation

“Schepen worden steeds groener…”

EEDI (Energy Efficiency Design Index):

Attained EEDI ≤ Required EEDI = (1-X/100) × Reference line value



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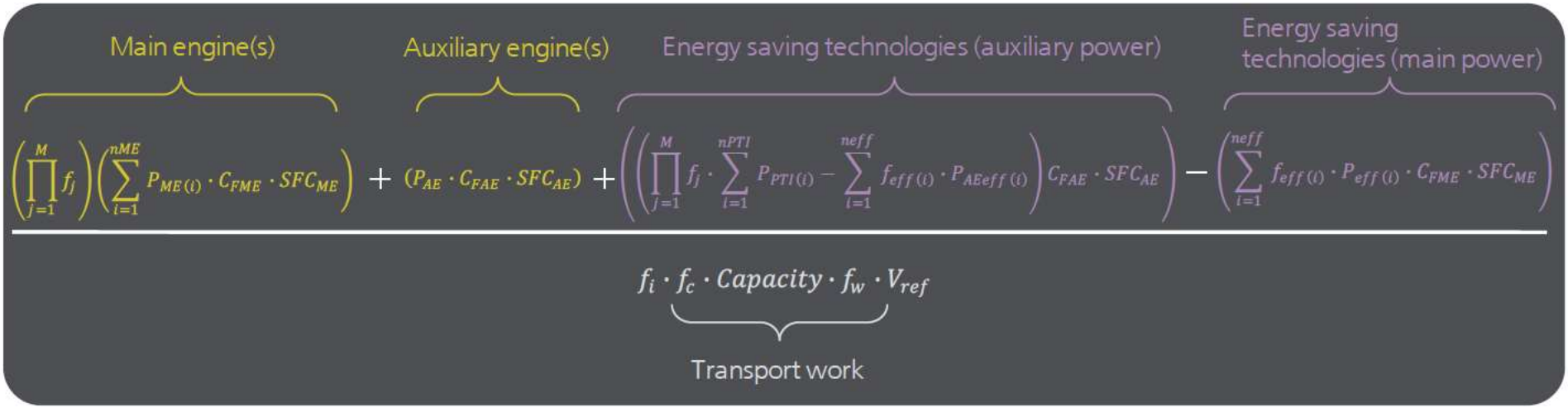

Reductie vermogen?

- **Schepen moeten kunnen controleerbaar blijven in storm**
- **Schepen moeten controleerbaar blijven in vaargeulen en bij naderen van havens**

“Schepen worden steeds groener…”

EEDI (Energy Efficiency Design Index):

Reductie vermogen?

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“Schepen worden steeds groener…”

EEDI (Energy Efficiency Design Index):

Alternatieve brandstoffen?

Type of fuel	Reference	Carbon content	C_F (t-CO_2/t-Fuel)
1 Diesel/Gas Oil	ISO 8217 Grades DMX through DMB	0.8744	3.206
2 Light Fuel Oil (LFO)	ISO 8217 Grades RMA through RMD	0.8594	3.151
3 Heavy Fuel Oil (HFO)	ISO 8217 Grades RME through RMK	0.8493	3.114
4 Liquefied Petroleum Gas (LPG)	Propane	0.8182	3.000
	Butane	0.8264	3.030
5 Liquefied Natural Gas (LNG)		0.7500	2.750

“Schepen worden steeds groener…”

Alternatieve brandstoffen:

LNG

- **Opslag aan boord**
- **Distributie, bunkering**
- **“Methane slip” vermijden**

Biofuels

“Schepen worden steeds groener…”

Alternatieve energiebronnen:

Batterijen

Figure 3.9 *Ar Vag Tredan* super-capacitor driven ferry [Courtesy stx-Lorient]

“Schepen worden steeds groener…”

Alternatieve energiebronnen:

Brandstofcellen

Waterstof

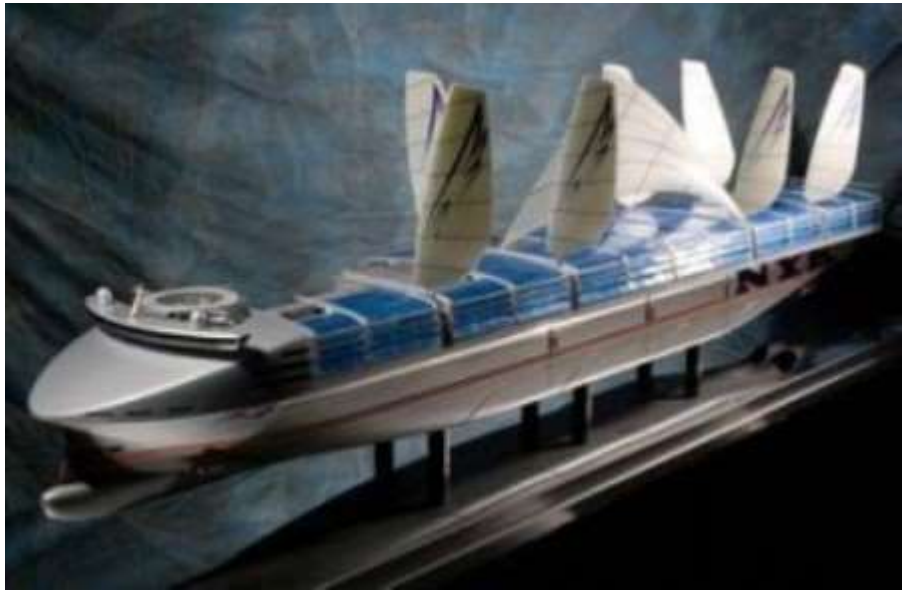
Nucleaire aandrijving

…

“Schepen worden steeds groener…”

Duurzame energiebronnen: wind, zon

Eoseas STX Europe
LNG-diesel, solar, wind



NYK Eco Ship 2030
Fuel cells, solar cells, wind sails

“Schepen worden steeds groener…”

Duurzame energiebronnen: wind, zon

EcoMarine ship
rigid sails, photovoltaic cells

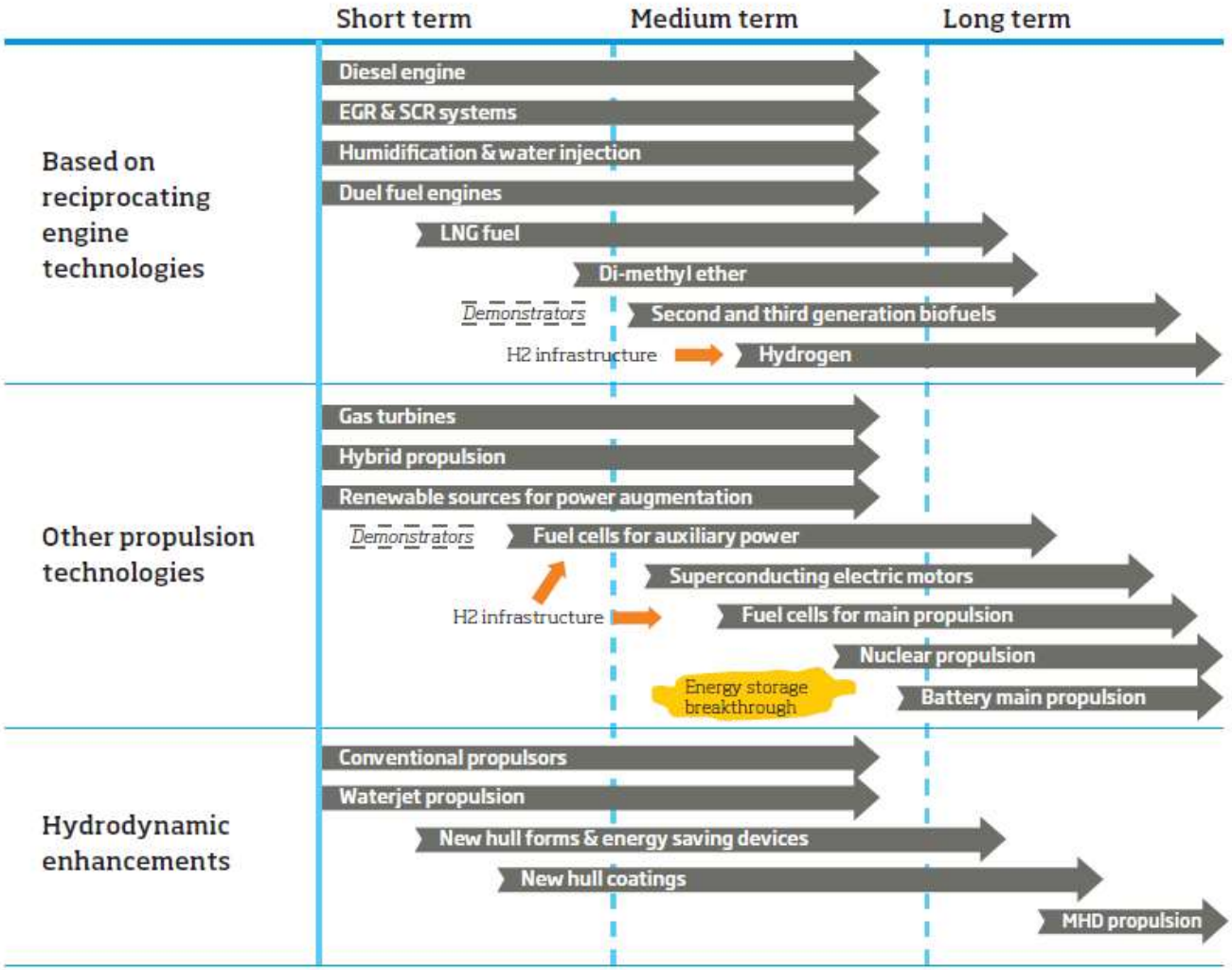
E/S Orcelle (WW)
Zero emission

“Schepen worden steeds groener…”

Duurzame energiebronnen: wind, zon

SCOD Green Tanker
LNG, wind, zon

“Schepen worden steeds groener…”



Inhoud

1. “Schepen worden steeds groter…”
2. “Schepen worden steeds groener…”
3. … ook de binnenschepen

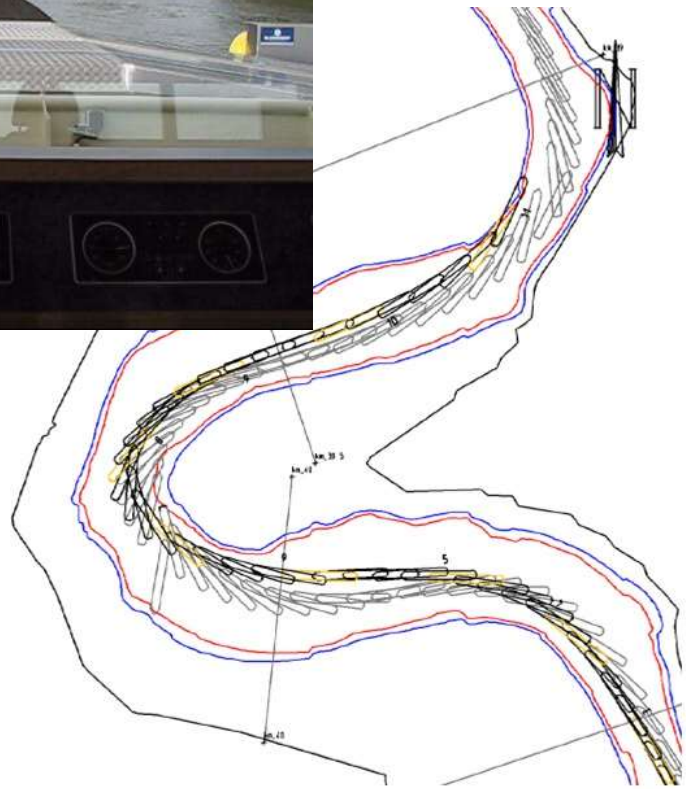
… ook de binnenschepen

… ook de binnenschepen

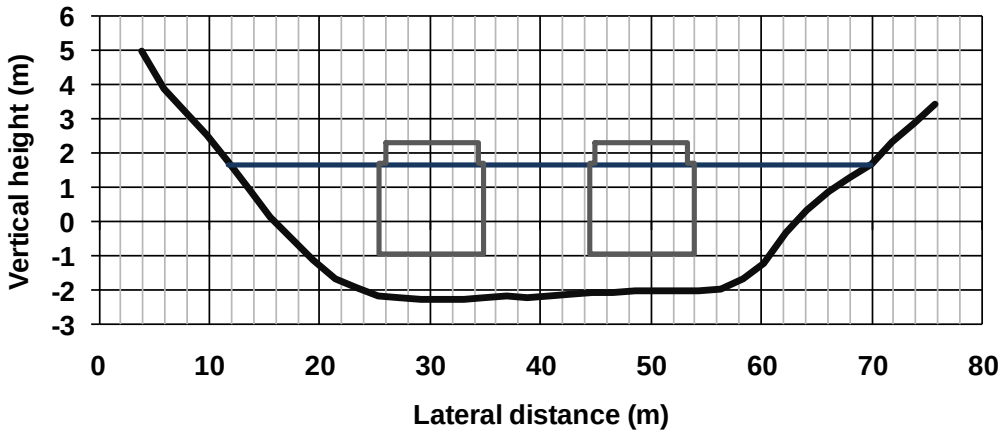
- **Schaalvergroting ➔lagere kost per ton**
- **Vereist aangepaste kunstwerken (sluizen, bruggen)**
- **Vereist aangepaste waterwegen**

➔ niet altijd haalbaar

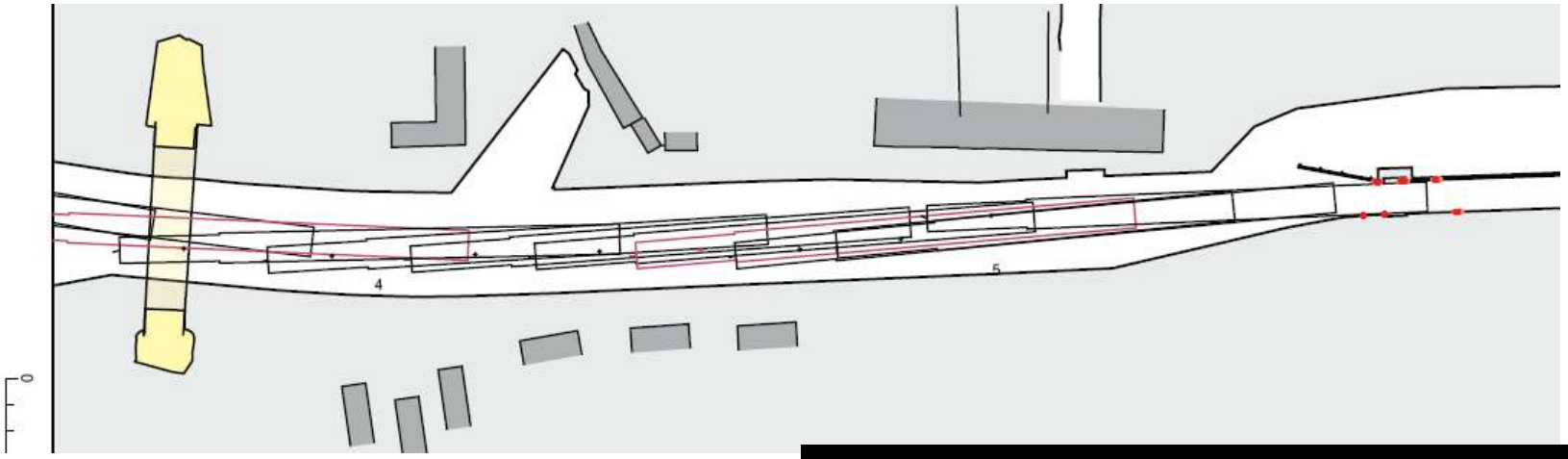
… ook de binnenschepen



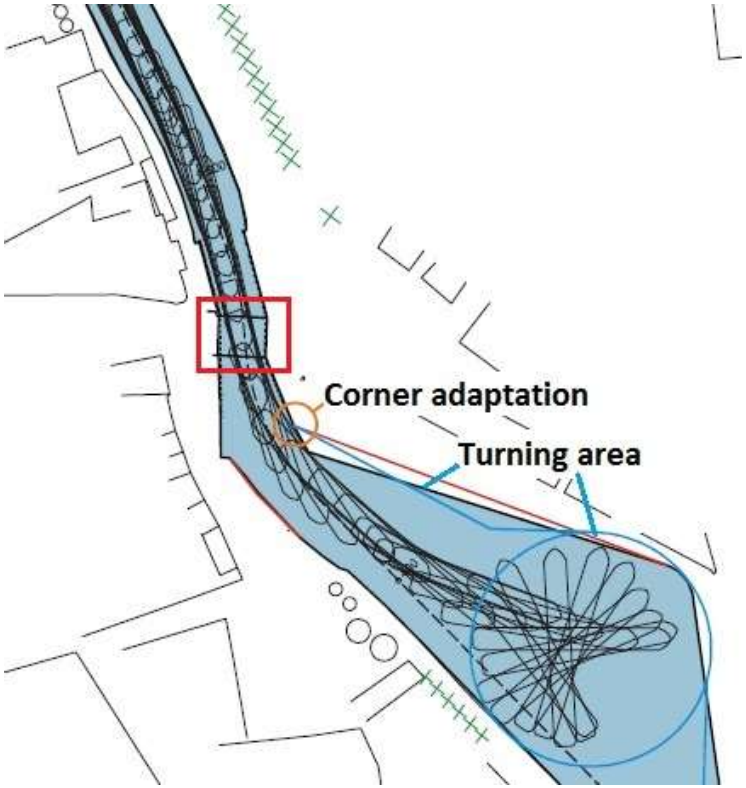
… ook de binnenschepen



… ook de binnenschepen



… ook de binnenschepen



… ook de binnenschepen

- **Diversiteit in scheepstypes en –klassen gewenst**

  ➔ ook kleinere waterwegen benutten

- **Flexibiliteit**

- **Betere plaatsbepaling, communicatie, controleerbaarheid**

  ➔ nauwere marges

… ook de binnenschepen

- **Brandstofverbruik (kost, uitstoot)**
- **Alternatieve brandstoffen / energiebronnen**

  ➔ eenvoudiger dan op zee??
- **Andere reglementeringsmechanismen**
  - **Zeevaart: IMO**
  - **Binnenvaart: ROSR, EU, nationale wetgeving, …**

… ook de binnenschepen

- **Binnenvaart: uitbreiding van het estuarium naar binnenland**
- **Short sea shipping: uitbreiding zeewaarts**

  ➔ enkel zeevaart?
- **“sea-river vessels”**

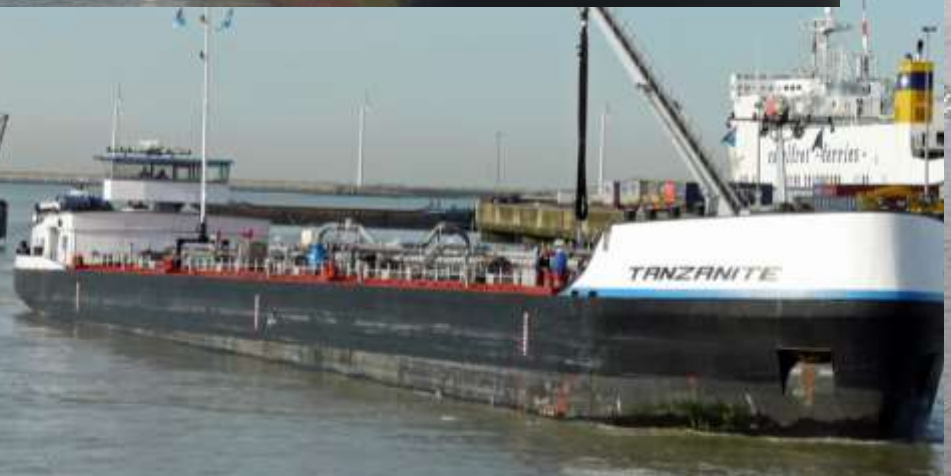
… ook de binnenschepen

… ook de binnenschepen


BREITLING


MONTANA


MOZART


TANZANITE


TEXAS


cobelfret - ferries -
POLYBOTES

… ook de binnenschepen

… ook de binnenschepen

… ook de binnenschepen

- Economic Commission for Europe
  - UN-ECE aanbevelingen
    - Standaard voor technische voorschriften binnenvaart
  - Oorspronkelijk niet voor “sea-river navigation”
  - Voor binnenschepen in Europese binnenwateren: zones volgens golfklimaat:
    - Zone 1: **H(1/10)** < 2.0 m; **H(1/3)** < 1.57 m
    - Zone 2: **H(1/10)** < 1.2 m; **H(1/3)** < 0.94 m
    - Zone 3: **H(1/10)** < 0.6 m; **H(1/3)** < 0.47 m

… ook de binnenschepen

- Economic Commission for Europe
  - Speciale voorzieningen voor “river-sea nagivation”:
    - “river-sea navigation vessel” is defined as a vessel intended for navigation on inland waterways and suitable for restricted navigation at sea
    - “international voyage” ⇔ “coastal voyage”
      - International: SOLAS, ICLL, MARPOL, …
      - Coastal: national certificates + selected IMO conventions

… ook voor binnenschepen

- Economic Commission for Europe
  - Special provisions for river-sea nagivation:
    - Zones en voorwaarden voor “sea navigation”:
      - Restricted zone between ports – inland vessels allowed with season & wave height restrictions + vessel requirements
      - ZONES RS 2,0 – RS 3,0 – RS 3,5: sea areas within specific borders where river-sea vessels are allowed with season restrictions
      - ZONES RS 4,5 – RS 6,0: of same country

        closed/open seas with distance to shelter < 100/50 nm

De Schelde in 2050
Antwerpen, 8 mei 2014

Schepen van de toekomst

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Kenniscentrum
Varen in Ondiep en Beperkt Water