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via donau – Österreichische Wasserstraßen-Gesellschaft mbH

Recent Developments in Ship Technology and Fleets

Danube Commission – Workshop on Future Fairway Parameters of the Waterway Danube

Juha Schweighofer

Budapest, September 29th, 2010

Contents

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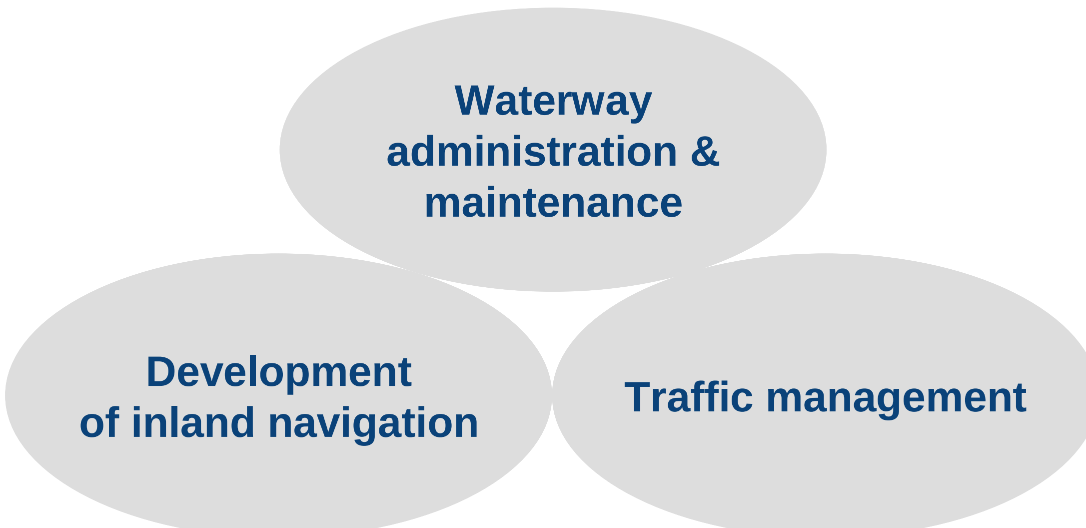
- ... the Austrian national waterway operator
- ... owned by the Ministry of Transport Innovation and Technology
- ... responsible for 351 km of the Danube waterway



Legislation – Technical Requirements

- Technical requirements for inland waterway vessels: Directive 2006/87/EC (in force since 2006 implementation 30.12.2008)

- Transport of dangerous goods: ADN (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways) =>annexed regulations in force since 28.2.2009 (not for all EU countries)

  EU Directive 2008/68/EC => 1.7.2011 (all EU countries)

  Transition period ends 2015 (gasoline) and 2018 (diesel and kerosine) => double hull tankers or risk based designs

Fuel Quality

- Directive 1999/32/EC:

  max. sulphur content of gas oil for IWT: 1000 ppm (= 0.1%) since January 1, 2008

- Directive 2005/33/EC:

  max. sulphur content of all fuels for IWT: 1000 ppm (=0.1%) starting from January, 2010

- 2011 sulpur content of all fuels used for IWT: 10mg/kg fuel (=10 ppm)

  => precondition for application of effective emission reduction technologies (e.g. PM filters, EGR, catalysts, …)

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Emissions to the Air

- Regulations of the Central Commission for Navigation on the Rhine (CCNR):
  Stage II in force since July 1, 2007

- Directive 2004/26/EC:
  Stage IIIA (V1:1 – V1:3) since 1.1.2007,
  other engine categories starting from 1.1.2009

Emissions to the Air

Table:

CCNR Stage II

Regulations

PN [kW]	CO [g/kWh]	HC [g/kWh]	NO_x [g/kWh]	PT [g/kWh]
18 ≤£ PN < 37	5,5	1,5	8,0	0,8
37 ≤£ PN < 75	5,0	1,3	7,0	0,4
75 ≤£ PN < 130	5,0	1,0	6,0	0,3
130 ≤£ PN < 560	3,5	1,0	6,0	0,2
PN ≥³ 560	3,5	1,0	n ≥³ 3150 min-1 = 6,0 343 ≤£ n < 3150 min-1 = 45 . n(-0,2) – 3 n < 343 min-1 = 11,0	0,2

Table:

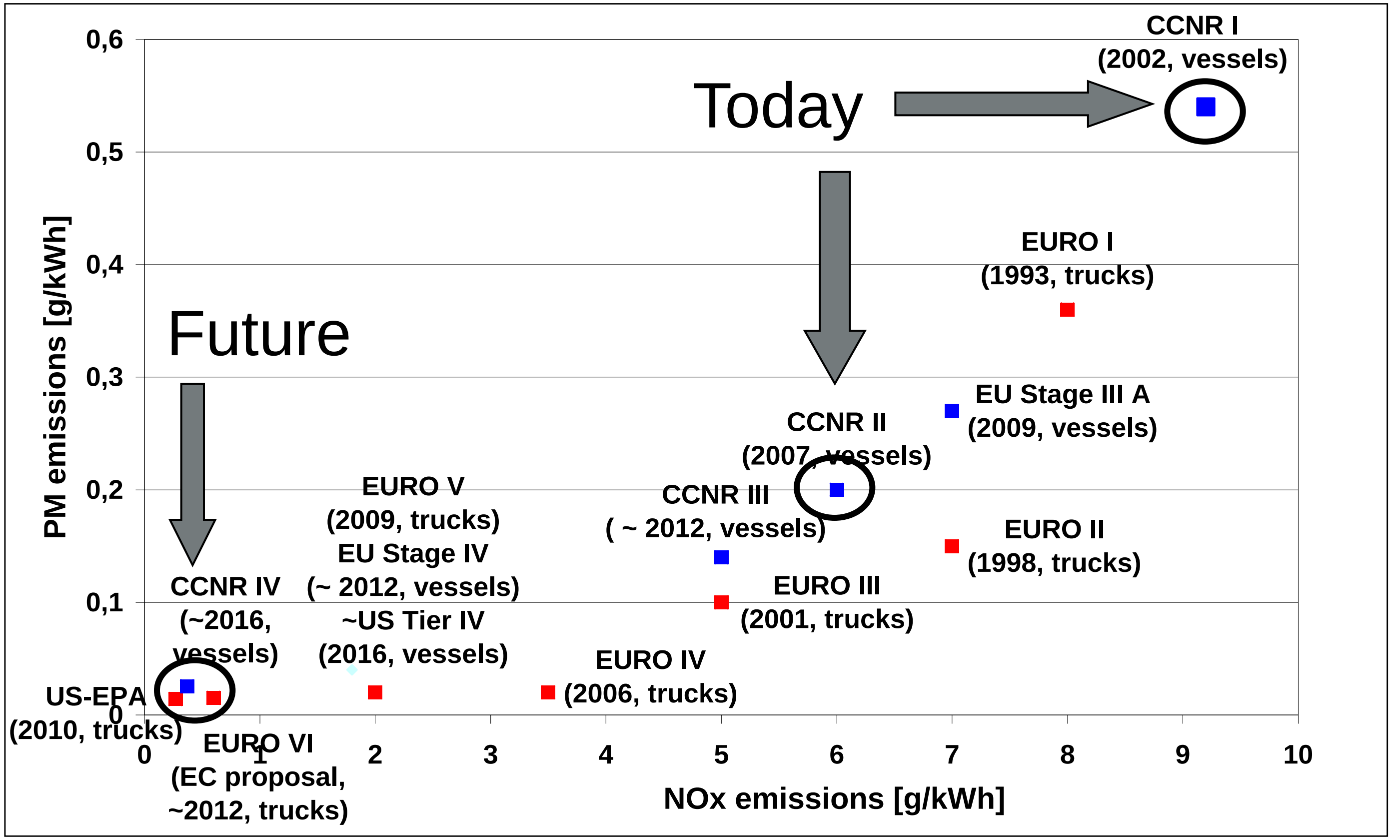
Directive 2004/26/EC

Stage IIIA Regulations

SV/P [Liter pro Zylinder/kW]	CO [g/kWh]	HC + NO_x [g/kWh]	PT [g/kWh]
V1:1 SV < 0,9 & P ≥ 37 kW	5,0	7,5	0,40
V1:2 0,9 ≤ SV < 1,2	5,0	7,2	0,30
V1:3 1,2 ≤ SV < 2,5	5,0	7,2	0,20
V1:4 2,5 ≤ SV < 5	5,0	7,2	0,20
V2:1 5 ≤ SV < 15	5,0	7,8	0,27
V2:2 15 ≤ SV < 20 & P < 3300 kW	5,0	8,7	0,50
V2:3 15 ≤ SV < 20 & P ≥ 3300kW	5,0	9,8	0,50
V2:4 20 ≤ SV < 25	5,0	9,8	0,50
V2:5 25 ≤ SV < 30	5,0	11,0	0,50

Source: Zeitschrift für Binnenschifffahrt Nr. 9/2008 (Pauli, Schweighofer)
PT = particulate matter, SV = swept cylinder volume

Emission Regulations – IWT/Road



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Diesel-Electric Propulsion

- Investigated in the EU Project **INBISHIP**
- Reduced fuel consumption, but initial capital costs too high for practical implementation as well as space and weight
- Modern diesel engines today very good part load performance

- **Viking Legend**: claimed to be the first passenger vessel on IWW with diesel-electric propulsion (in service since July 2009)
- **MS Enok** first cargo vessel (August 2010)
- **Röthelstein**: first inland waterway vessel with AZIPOD (operational since 1995, Helsinki Shipyard)

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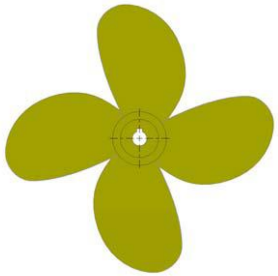
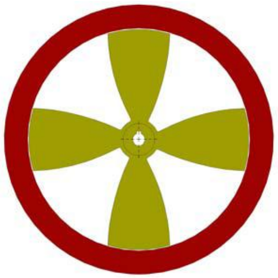
Propulsion Devices

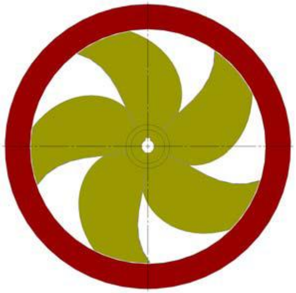
- Ordinary propeller e.g. Wageningen Series
- Kaplan propeller in nozzle
- High skew propeller in nozzle



Wageningen Series propeller.



Kaplan propeller in nozzle



High skew propeller in nozzle

	P_B [kW]	spezifischer CO_2-Ausstoß [g/tkm]		
		zu Berg	ohne Strömung	zu Tal
freier Propeller	715	25,3	16,8	11,5
Kaplan-Propeller in Düse	572	20,2	12,6	9,2
Skew-Propeller in Düse	536	18,9	11,8	8,6

Tab. 2: CO_2-Ausstoß GMS (L x B x T = 110,0 m x 11,4 m x 2,5 m)

Source: Zöllner, DST, IVR Workshop on Innovations in Inland Waterway Transport, 2010

The Cleanest Ship

- Lube oil tanker MV Victoria

- Owner:
  BP Shipping
- Management:
  Verenigde Tankrederij (VT)

- Operational:
  Rotterdam und Antwerpen

- Main dimenaions:
  - L = 69.9 m
  - B = 11.4 m
  - T = 2.96 m
  - dwt = 1377 t

- Application of: SCR, particulate matter filter, low sulphur fuel (EN 590, max. 50 ppm sulphur content, ATM) => 90% reduction of emissions to the air

	NO_x	PM	FC	CO_2	SO_x
Emissions without emission reduction techniques [g/kWh]	8	0.15	203	644	0.81
Emissions with emission reduction techniques [g/kWh]	2.2 – 0.8	0.004	203	644	0.004
Total emission reduction [g/kWh]	5.8 – 7.2	0.146			0.806
Total emission reduction [%]	72.5 – 90.0	97			99.5
Total emission reduction expected [%]	86	96	5	5	99.5

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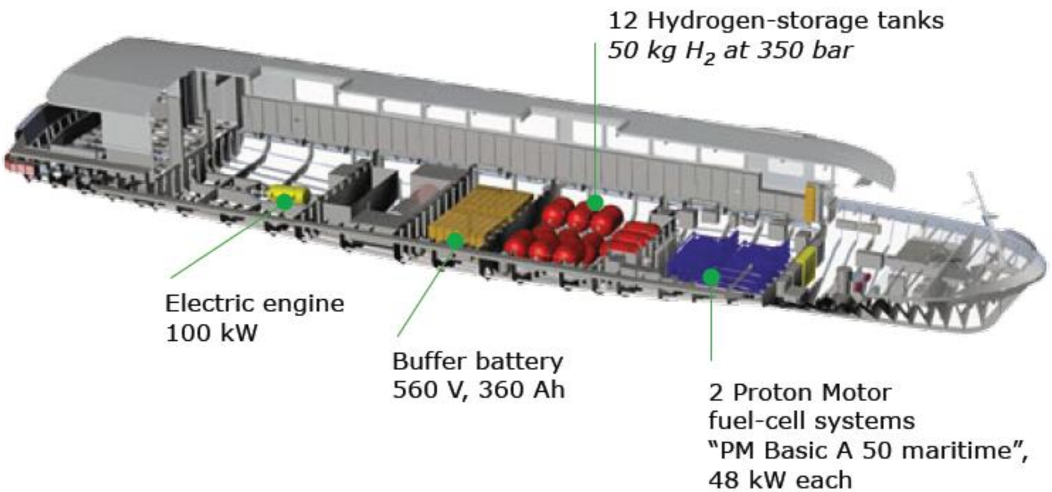
Fuel Cells

- First applications in submarines
- EU project ZemShips: www.zemships.eu
- Zem-Ship Alsterwasser: operative since 2008 in Hamburg



The propulsion system (Source: Schiffstechnik Buchloh)

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Alternative Fuels – Natural Gas

- Availabilty for transportation:
  - CNG – compressed natural gas
  - LNG – liquified natural gas

- Engine solutions available
  - Pure gas engines (spark igniton)
  - Dual fuel engines (diesel or gas with 1% diesel)
  - Gas-diesel engines (mixture of diesel and gas)

- Numerous working applications:
  - Ferries, canal boats, offshore vessels, LNG carriers
  - German Lloyd: in 5 years first commercial cargo vessels
- First studies related to application in IWT: The Netherlands, Austria

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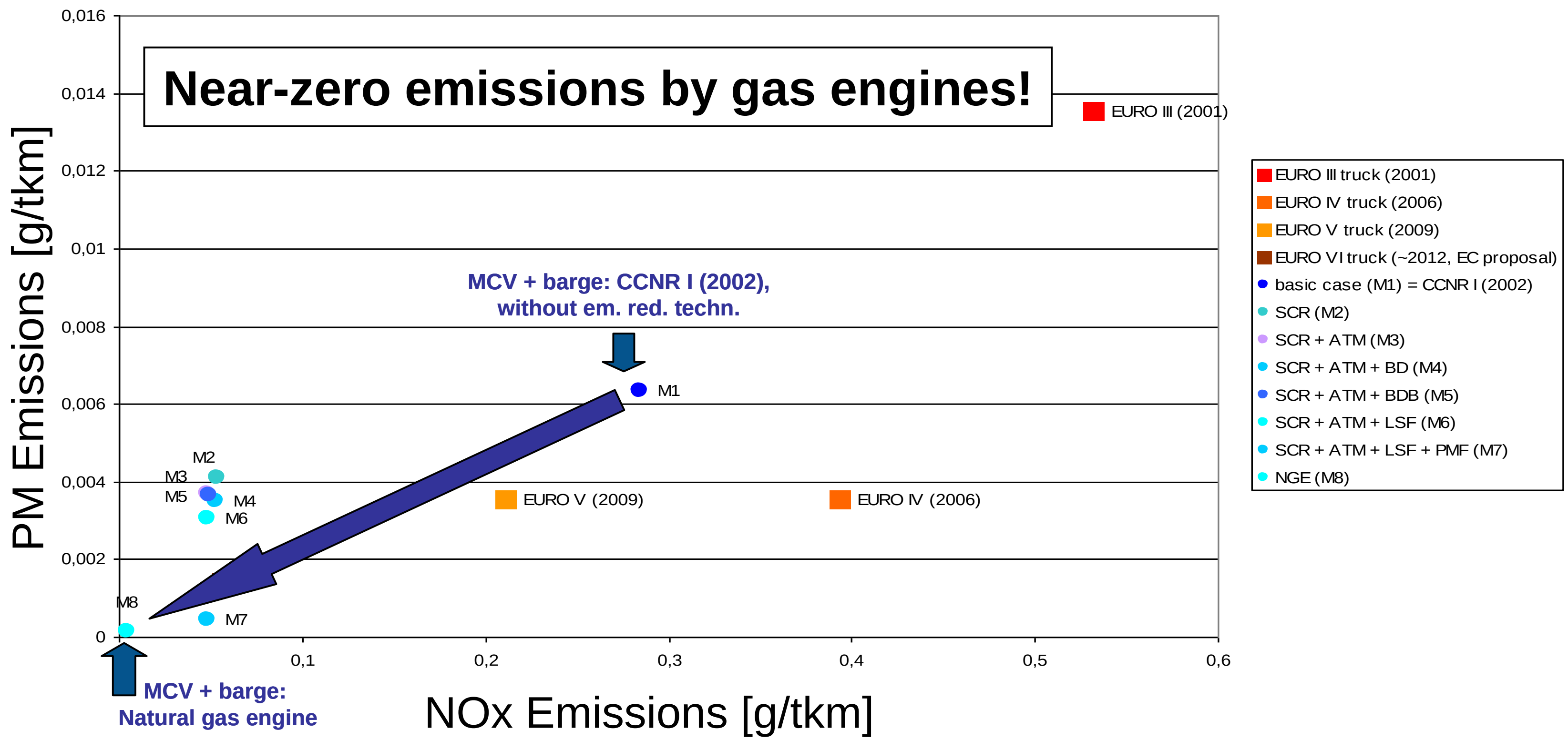
Emission Reduction



CO_2: - 10 up to - 25%

SOX: - 100 %

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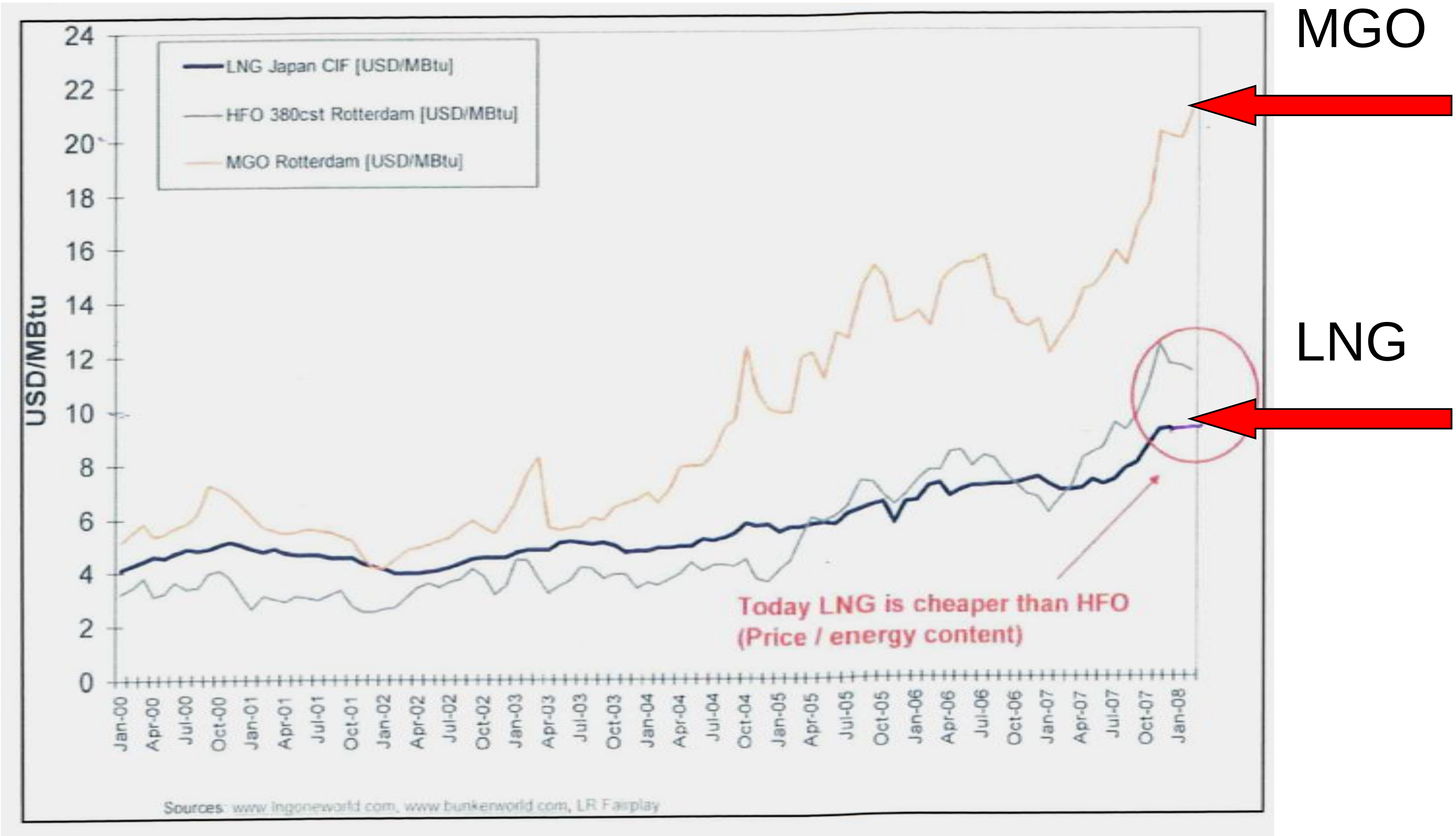
Reduced Fuel Costs



Yearly fuel costs with MGO: 400 000 EUR =>
Yearly savings of approx. 200 000 EUR!

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LNG and SPS

- Woodchip supply vessel for Finnish Lakes: Bioship 1
- L = 110 m, B = 14 m, T = 2.4 m, capacity = min. 7000 m^3
- Propulsion 4 Azipod units (2 bow, 2 stern)
- Fuel: LNG (-170 C)
- SPS:
  steel/aluminium foam/steel
  aluminium/aluminium foam/
  aluminium
- Expected launch: 2010

- SPS in general: not sufficiently developed and too expensive

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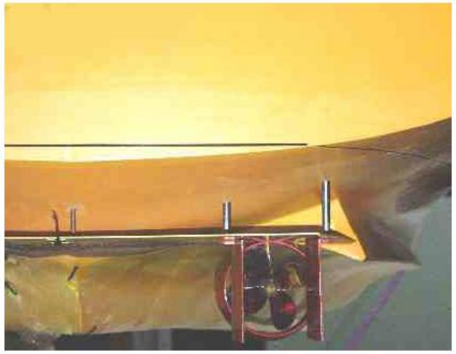
Composite Materials

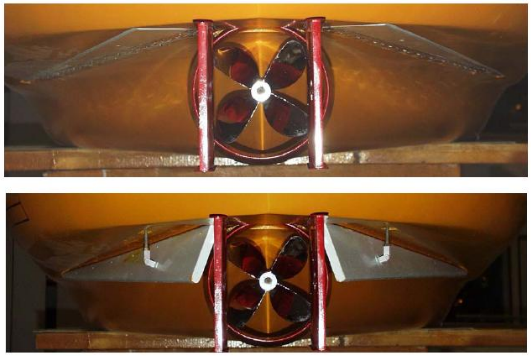
- CompoCaNord vessel project
- Innovative, multi-purpose, light-weight IWW vessel
- Small waterway networks: France to Germany, Poland,
- the Czech Republic, Romania, …
- Dutch initiative ELV, TNO an 10 partners
- L = 65 m, B = 5.75 m, T = 2.5 m
- Polymer/foam/polymer sandwich (side walls 25 -28 cm, bottom 30 cm) => hull more than 50% lighter
- Expensive solution obstacle for implementation

Hull Form (Source DST)

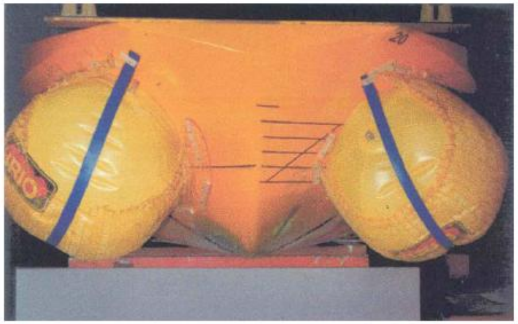
Transom stern



Transom stern with flap



Adjustable stern tunnel



- Up to 25 % less fuel consumption with improved inter-connection between pushed units!

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… bigger and bigger …

- Container vessel JOWI class: MCS Bolero
  - L = 134.95 m, B = 17.35 m T = 3.6 m
  - Deadweight = 5327 tons
  - Container: 500 TEU

- Tanker:
  - MTS Vlissingen
  - Biggest heavy fuel oil tanker (IWW)
  - L = 134.6 m, B = 21.8 m, T = 4.4 m
  - Deadweight = 9297 tons

- Ship size: again under discussion due to hypothesis of shallow water appearance associated with CC

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Importance of Proper Navigation Conditions for Fleet Modernisation

- Innovations: high costs preventing often their implementation
- Currently the income from ship operation is just sufficient for proper maintenance of the existing fleet
- Investments in new technologies or even new buildings are very rare and almost not possible
- Proper fairway conditions will improve the economical situation of ship owners => availability of financial means for modernisation of existing fleet
- Proper fairway conditions will lead to increased volumes to be transported => new vessels will be required

PROPER FAIRWAY CONDITIONS ARE THE PRECAUTION FOR A MODERN DANUBE FLEET

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Juha Schweighofer, D.Sc., MRINA
Senior Expert for Ship Technology

via donau – Österreichische Wasserstrassen-Gesellschaft mbH
A-1220 Wien, Donau-City-Strasse 1
Tel +43 (0)50 4321 1624, Fax +43 (0)50 4321 1050,
juha.schweighofer@via-donau.org, www.via-donau.org