Trends bei synthetischen Kraftstoffen und zukünftigen Antriebsarten - ein Überblick

- WWW (WANN? WAS? WIE TEUER?) -

Dr.-Ing. Gerd Wuersig

GMW Consultancy

- Marine-, Process-, Energy Technology -
Dr. Gerd Wuersig and GMW Consultancy

- GMW Consultancy founded 2019 by Dr. Gerd Wuersig.

- Process and energy engineer
  - long term experience in shipping
  - GMW Consultancy offer independent consultancy to the stakeholders in shipping like owners, suppliers, yards, NGOs and authorities (comp. www.GMW-Consultancy.com).

- Professional experiences related to engineering advisory services, research & development, business development, process-, gas-, safety- and fuel cell technology.

- Long term Involvement in liquefied gas technology
  - doctorial work on the development of a liquefied hydrogen sea transport system in the early 90ies.

- Since the 90ies and until 2013:
  - contributed as a consultant for the German ministry of transport to IMO work on IGC-Code (IMO Code for Gas Carriers) amendments, development of the new IGC-Code and the development of the IGF Code (IMO Code for ships with low flashpoint fuels).
  - still contribution to the German mirror group on IGF-Code development.

- Until 2019 representation of GL, DNV and DNV GL at SIGTTO and SGMF

- Contribution to different ISO working groups.

- Member of the SGMF Technical Committee and the Environmental Committee.

- Participation in the development of the ISO and SGMF LNG bunkering requirements, SIGTTO work on LNG fires around gas carriers.

- Since early 90ies: active member of the process technology safety working group of the German chemical engineers society (DECHEMA).

- Active member of VSM, STG, VDI, DECHEMA.

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The scope of the problem and the 2 % Club

- Shipping and aviation are two sectors difficult to decarbonize.
- The energy consumption is approximately the same as the energy consumption of Germany. Together they are “The 2 % club”
- On the overall path toward zero CO2 emissions the absolute contribution of the 2% club is small. But:
  - In a e.g. 90% decarbonized energy world a non carbonization of the 3% Club would give it the majority of all remaining CO2 emissions
  - → the 3 % Club has to take it’s share!
The scope of the problem

- World population growth by 70 mio per year between and 2050.
- For this reason alone an increase in energy demand is more than likely.
- The 1,5° aim for GHG requires:
  - to cover the growing demand without fossil fuels.
  - To reduce the use of coal, oil and gas dramatically.
Diese Technologie ist aber nicht “grün”!

Vielleicht geht es gar nicht darum “grün” zu sein, sondern darum CO2 zu reduzieren?

1. CCU=Carbon Capture and Use: e.g. Methanol for chemical industry from waste combustion
2. CCS=Carbon Capture and Storage
3. Blue Hydrogen= Hydrogen from CH4 (Methane) and use of CCU/CCS
4. Use of bio mass as carbon source for PtX fuels
5. Hydrogen from CO2 free energy (nuclear power)
Auch in 100 Jahren werden Seeschiffe mit Kohlenwasserstoffen fahren.
- Was? Wie teuer? Power to X (PtX) -

- PtX: Strom plus
  - Wasserstoff (alleine)
  - oder mit
    - Kohlenstoff → Methan, Methanol, FT-Diesel
    - Stickstoff → Ammoniak

- Wie teuer:
  - Ca. 100 bis 110 €/MWh oder 0,10 bis 0,11 €/kWh
  - Bis ca. +10 % bis +40 %
  - Methan0 bis FT-Diesel, Ammoniak

Source: Alternative Fuels for International Shipping - Some Guidance and Background for Today’s Decision Making: GMW C 2020 “Fact Book” GMW Consultancy

PtX wird teuer?
Who consumes energy in international shipping

Share in fuel (Int. Shipping)

- Bulk, CV, Tank (all), GE-Ca
- Cruise, Pax, RoPax, RoRo
- Car Carrier, Ref Bulk
- others

Share in fuel (Int. Shipping, 85% fuel consumption)

- Bulk
- Cont
- Oil Tanker
- Chem Tanker
- GE cargo
- Liquefied Gas Carrier

The next decades energy converters for ships?

- No one is developing a special technology for shipping!
  - Ship energy supply is done with shore based technology.
    - Shore market is the commercial backbone of ship power supply technology
  - Historically based exceptions are:
    - slow speed 2-stroke engines.
    - wind power.

Sources: OCEANS ONE (the next generation CV), DNV (internet screen shot, PERFECt ship)
The next decades energy converters for ships?

- Slow speed 2-stroke engines will remain to be most relevant for deep sea shipping for the next decades.
  - Heavy Fuel oil will be out phased within the next ten years.

- With cleaner fuels high power demand ships (25 MW onward) Gas and Steam Turbine systems, as proposed in the PERFECT Ship project 2017, will find their market.

- Small power demands will be covered by 4-stroke piston engines mainly.

- FC-Systems will be introduced.

- Wind assistance will be used.

- Batteries will be used on nearly every ship to balance power demands and to increase overall efficiency.
  - Batteries as a single power source stay a niche market for short distances and low power demand. They will practically not used in deep sea shipping.
The next decades energy converters for ships?

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- Fuel cell systems (FC-Systems) will become available for shipping with clean fuels.
  - Hydrogen as fuel and PEM FCs for short distances.
  - Methanol and Methane as fuel for long distances. Most likely with high temperature FC-Systems (SOFC and may be HT-PEM)

- Power for FC-Systems will be in the multi Megawatt range in nearly one step.
  - Introduction will be in Cruise shipping (low price sensitivity, high public awareness, already today full electric ships)
  - The typical auxiliary power of large Cruise ships is between 5 and 10 MW.
  - To supply auxiliary power by a small FC-System and a piston engine makes no technical or political sense.
    - FC-Systems will meet the Cruise ship auxiliary power requirements practically from the beginning.

- FC-Systems will stay a high end, expensive technology for a long time.
- When? This decade in pilot applications and from next decade onward in larger scale.
Heute ist Erdgas der umweltfreundlichste Schiffsbrennstoff.

In Zukunft wird Erdgas durch PtX Methan ersetzt werden.

Es wird nicht den einen Schiffsbrennstoff geben.

Für die interkontinentale Schifffahrt wird Wasserstoff praktisch keine Anwendung finden.

### Die Beste Prognose ist die nachträgliche.

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