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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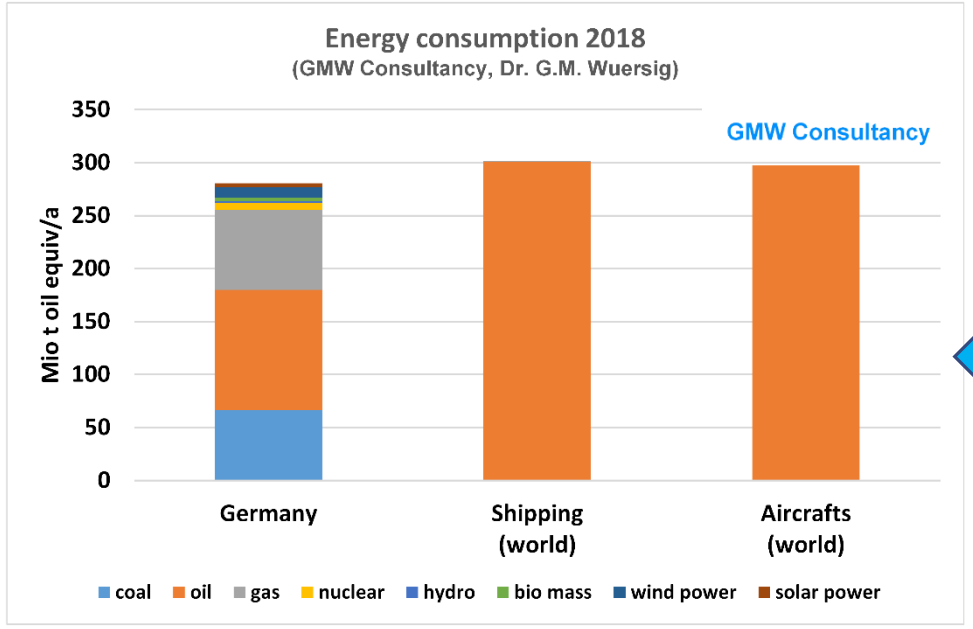
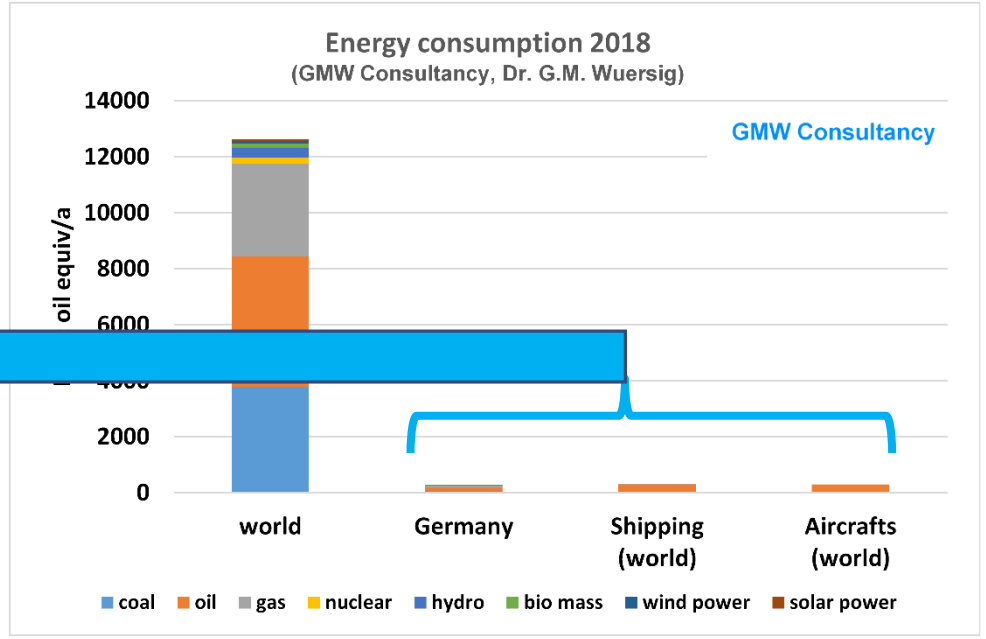
The scope of the problem and the 2 % Club





- 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!**

GMW Consultancy: Alternative Fuels for International Shipping - Some Guidance and Background for Today's Decision Making

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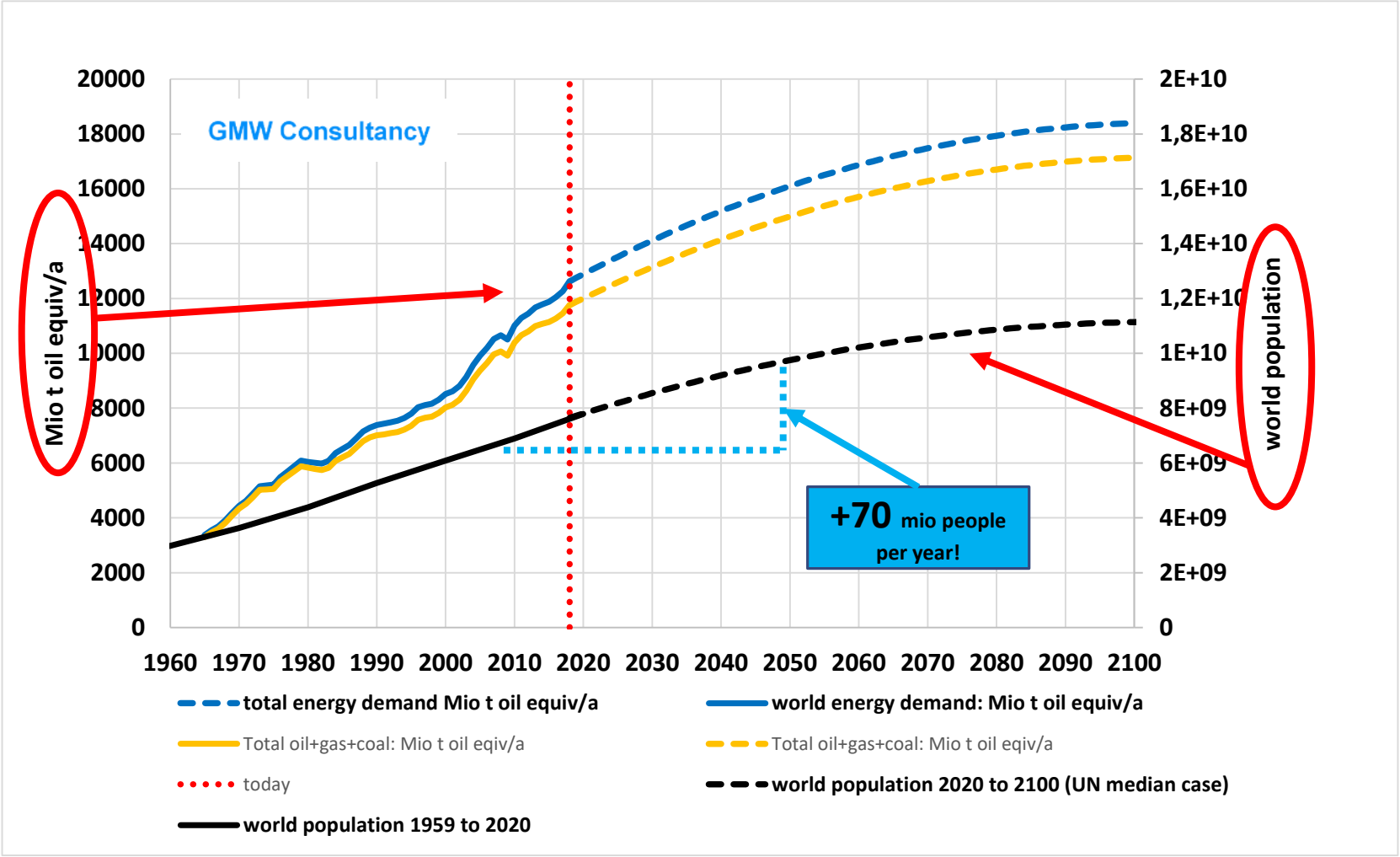
The scope of the problem

- 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.



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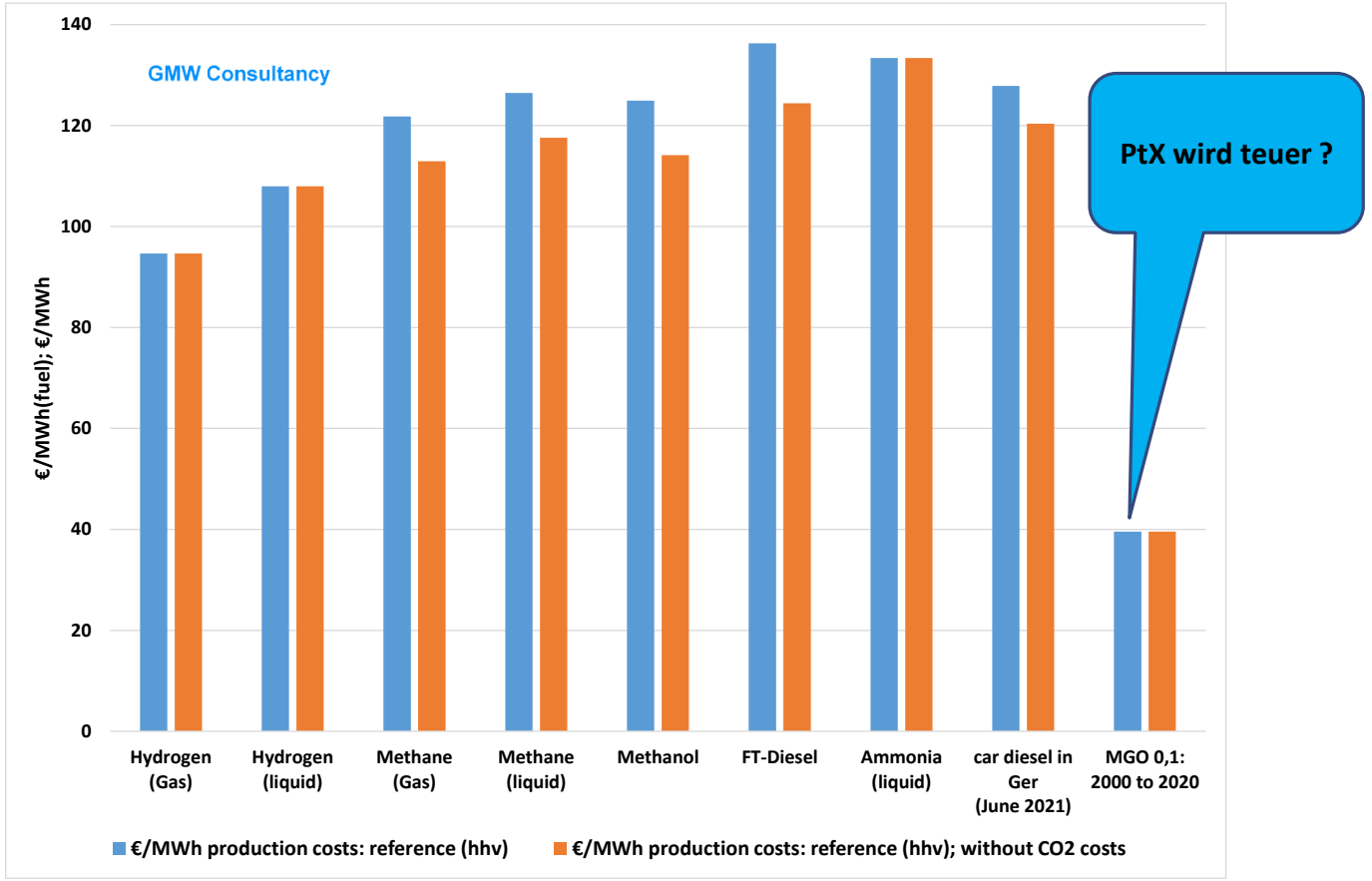
Diese Technologie ist aber nicht “grün”!

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

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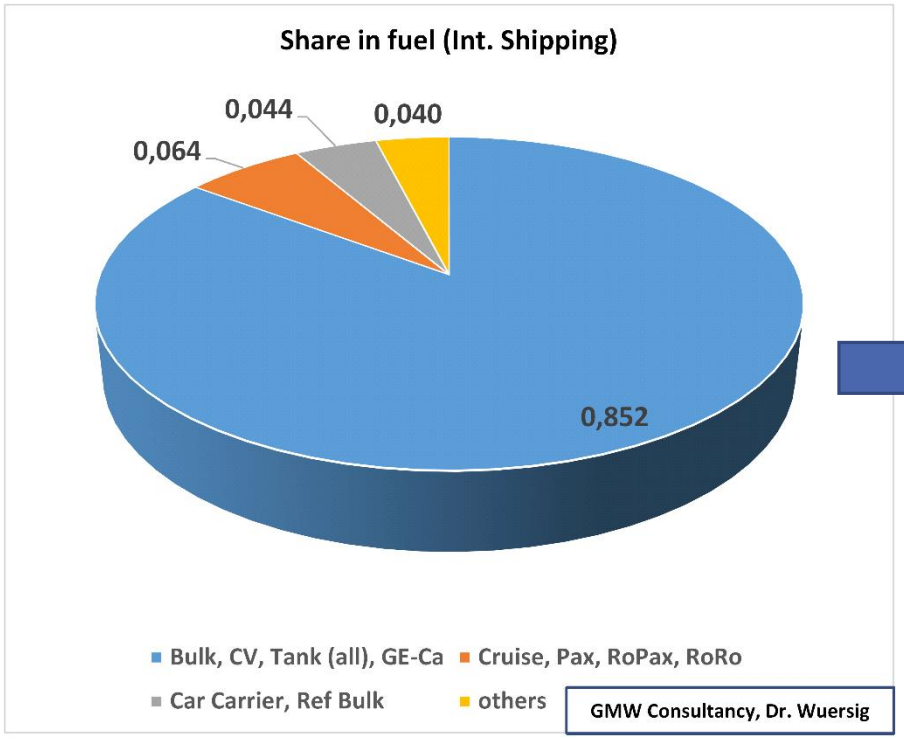
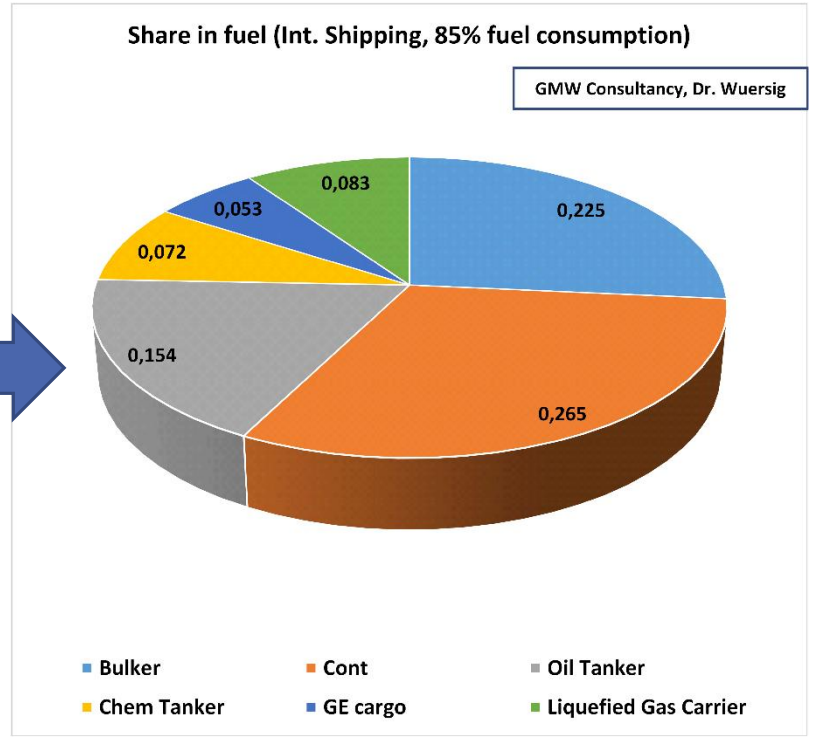
Who consumes energy in international shipping





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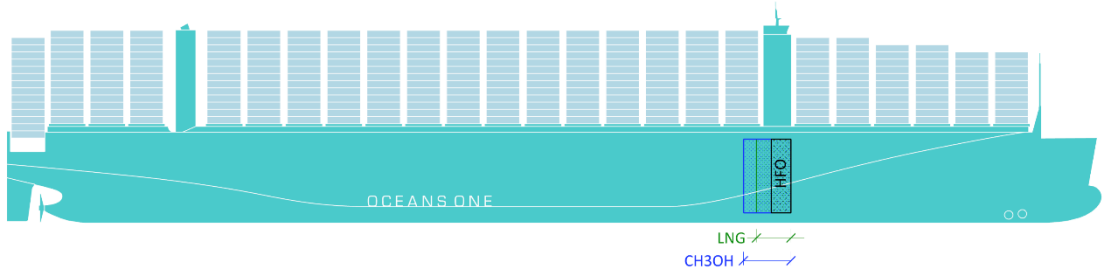
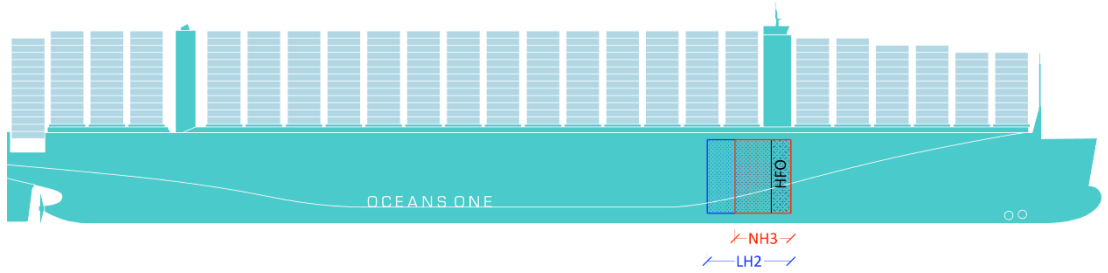
The next decades energy converters for ships?

- 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)

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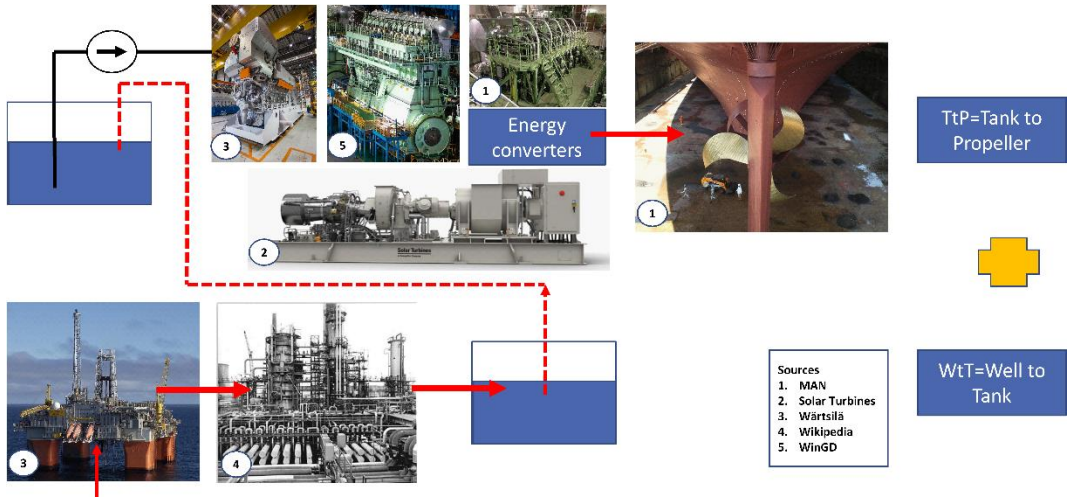
The next decades energy converters for ships?

- 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.



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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**.
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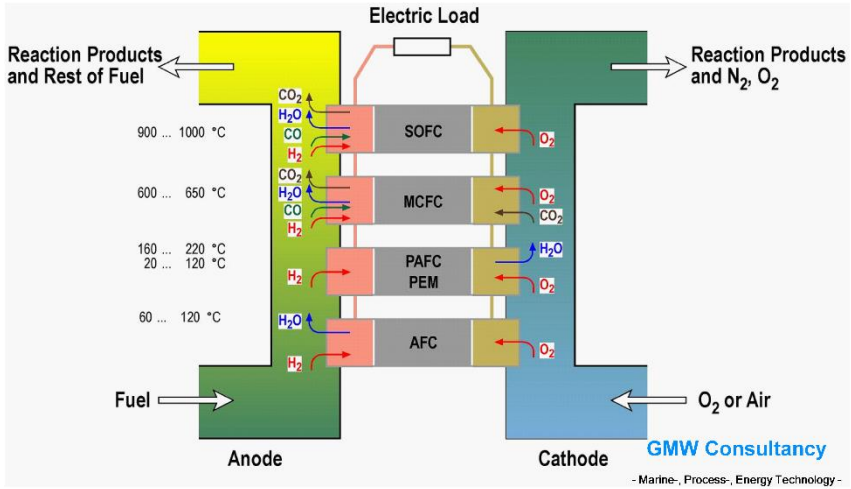

- **Fuel cell** systems (FC-Systems) will become available for shipping with clean fuels.
  - **Hydrogen** as fuel and PEM FCs for **short distances**.
  - **Methanol** and **Methane** as fuel for **long distances**. Most likely with high temperature FC-Systems (SOFC and may be HT-PEM)

- 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.

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Die Beste Prognose ist die nachträgliche.

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
LNG											
PtX LMG											
LPG											
CH3OH											
Bio Fuel											
PtF (FT-Diesel)											
PtX H2											
PtX NH3											
HFO, LSHFO											
MGO											

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

- 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

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Die Beste Prognose ist die nachträgliche.

	2030	2040	2050	2060	2070	2080	2090	2100
LNG								
PtX LMG								
LPG								
CH3OH								
Bio Fuel								
PtF (FT-Diesel)								
PtX H2								
PtX NH3								
HFO, LSHFO								
MGO								

GMW Consultancy, Dr. Wuersig

- Auch in 100 Jahren werden Seeschiffe mit Kohlenwasserstoffen fahren. Nur das der Kohlenstoff nicht aus fossilen Energieträgern kommen wird, sondern aus geschlossenen Kreisläufen.

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