

LNG TRANSITION FUEL and CCS



ANTHONY VEDER



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HISTORY

1937
ESTABLISHMENT



1940
WORLD WAR II



1968
FIRST GAS
TANKER



1990
FOCUS ON GAS



2009
FIRST TANKER
FUELED BY LNG

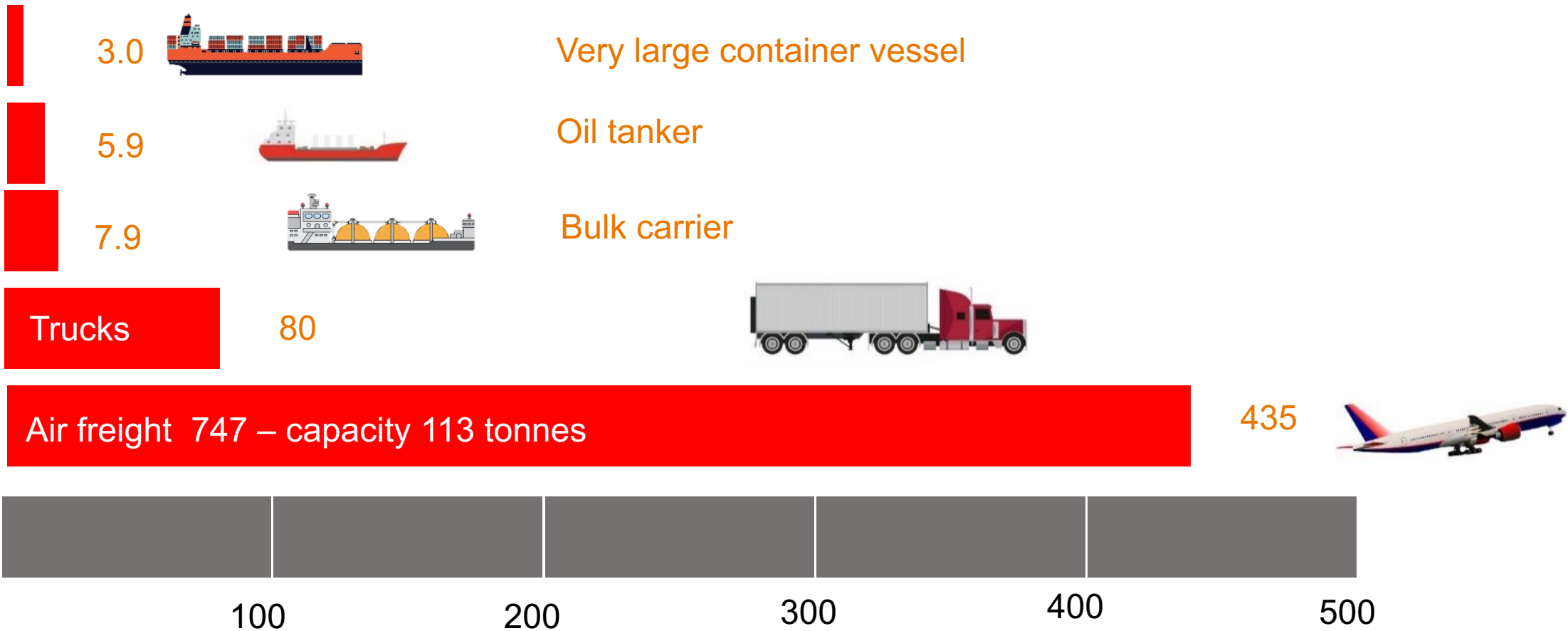


TODAY
30 GAS TANKERS
10 of these with
LNG propulsion



SHIPPING: CLEANEST MODE OF TRANSPORT

CO₂ emissions per kg per km



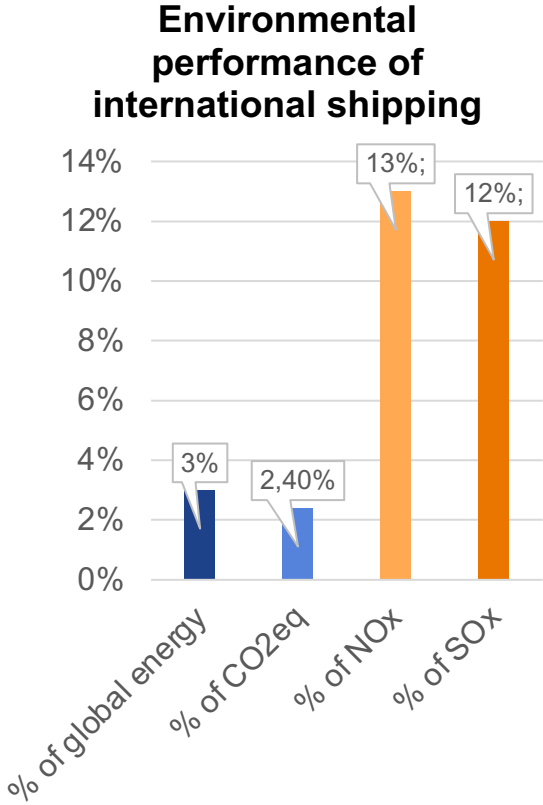
DRIVERS FOR CHANGE



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GLOBAL



INDUSTRY



NATIONAL




COMPANY

CO2 Environmental roadmaps



□ AV Environmental roadmap related to green house gasses.

 <p>NET ZERO GREEN HOUSE GASES</p> <p>Our goal is to reduce energy consumption and carbon emissions in the shipping industry by improving vessel and operational efficiency, lowering the carbon content in fuel, enabling carbon capture on board, and using shore energy. We need the development of low carbon fuels to achieve our 2035 goal.</p>	<p>Target</p> <p>2025 95% NZR 2022 2030 60% NZR 2022 2035 0% NZR 2022 base year 2022</p>	<p>Indicators</p> <p>We use a modified Annual Efficiency Ratio (AER) including Well to Wake emissions (WtW) and CH4 and N2O emissions. We call this Net Zero Ratio (NZR) which is the average of all NZRs of our vessels.</p>	<p>Process</p> <p>Our fleet strategy is based on replacing ships to be on track to have a fleet operating at net zero emissions by 2035.</p>	<p>Partnership across the chain</p> <p>We must cooperate with customers to achieve win-win situations in contracts and build smarter, future-proof ships to further reduce emissions.</p>
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□ The International Maritime Organisation (IMO) has set a goal of net zero GHG emissions by 2050.

□ In 2019, the Netherlands signed the Green Deal Shipping, Inland Navigation and Ports which aims to achieve climate-neutral shipping by 2050.

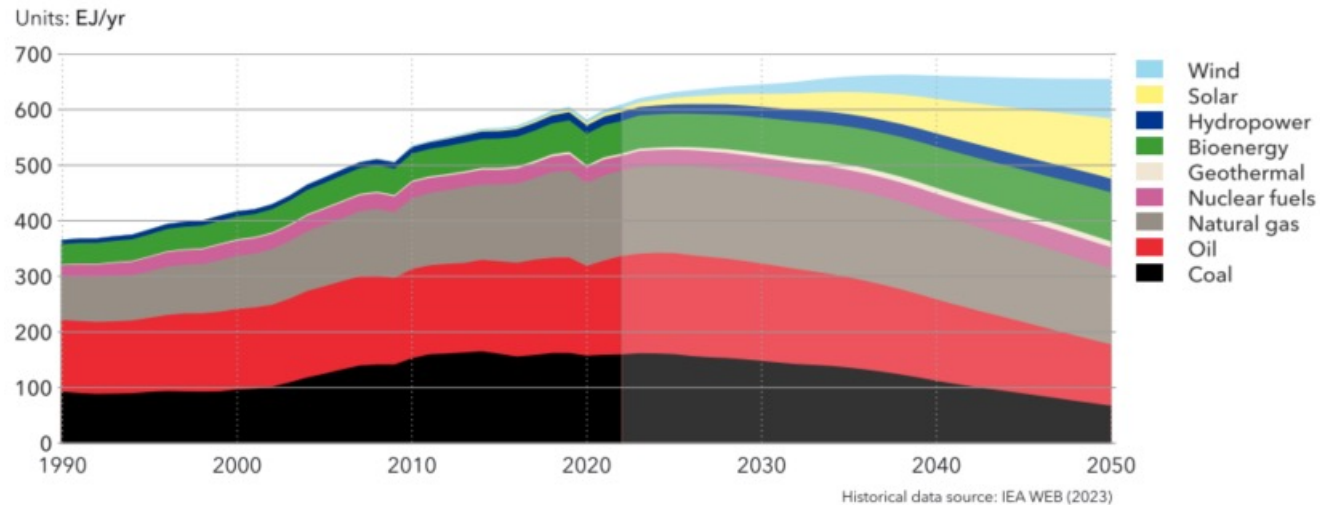
□ Inclusion of maritime emissions in the EU Emissions Trading System (ETS), starting from 2024.

WORLDWIDE ENERGY DEMAND



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World primary energy supply by source



World primary energy by source (EJ/yr)

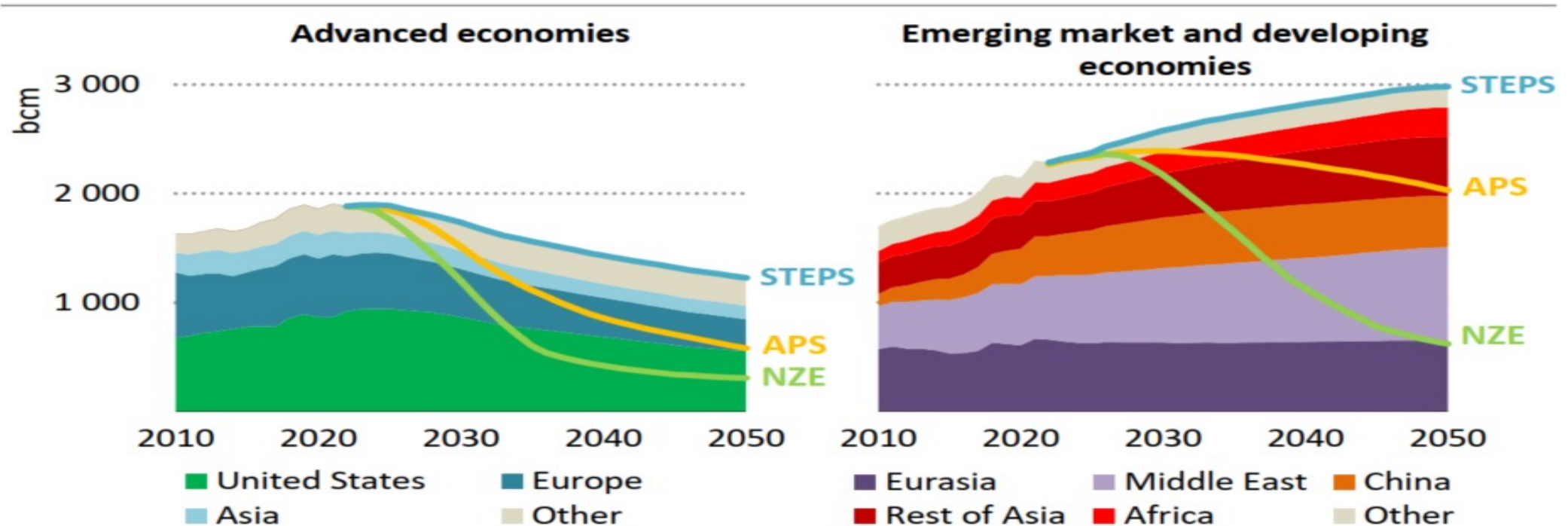
Source	2022	2030	2040	2050
Wind	7	17	42	71
Solar	7	23	62	109
Hydropower	16	19	24	25
Bioenergy	59	65	74	88
Geothermal	4	7	11	11
Nuclear	27	31	35	38
Natural gas	153	160	155	137
Oil	177	175	146	110
Coal	160	148	112	67
Total	610	645	661	656

- Primary supply of energy from all energy sources
- Includes considerable losses in the global energy system of 100 EJ per year
 - Convert from one form to form to another
 - Coal to electricity
 - Transport of energy

WORLDWIDE NATURAL GAS DEMAND



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- ❑ Natural gas demand declines in advanced economies in each scenario; in emerging market and developing economies the difference between the outcomes is larger.
- ❑ Although natural gas is seen as a transition fuel it clearly will remain for decades.

MARINE TRANSPORT



318
LNG fueled vessels in operation



31
vessels supplying LNG as a fuel



532
LNG fueled vessels on order



98
Ports supplying LNG fuel



700
LNG carriers



40%
Cruise ships on order LNG powered

LNG FUEL for ANTHONY VEDER



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- ❑ AV core business is the transport for liquefied gasses
 - ❑ PETCHEM and LNG
- ❑ LNG is the cleanest fossil fuel
- ❑ Excellent infrastructure, which can be used for bio-LNG and future eLNG as well.
- ❑ LNG transport requires boil off gas (BOG) control from the cargo. DF engines run on BOG
- ❑ Transition fuel for many decades to go
- ❑ Concern is methane slip
 - ❑ Modern DF natural gas engines have methane slip of 0,16 – 0,81 – 2,02 % of mass fuel
 - ❑ Constant improvement and additional supporting methods are reducing methane slip
- ❑ CO2 capture on board seems a realistic scenario
 - ❑ 70 % capture rate on 8-9mW propulsion is realistic
 - ❑ In combination with bio – LNG zero emission or better is possible.

ETS cost on vessel Coral Energy 2027

- ETS: In 2023 the Coral Energy emitted 15,000 ton of CO₂ in European waters.
 - Having a carbon capture rate of 70% equals 10,500 ton of CO₂. In 2027 this would amount to abt 1,0 mEUR per year at EUR100/ton EUA prices.

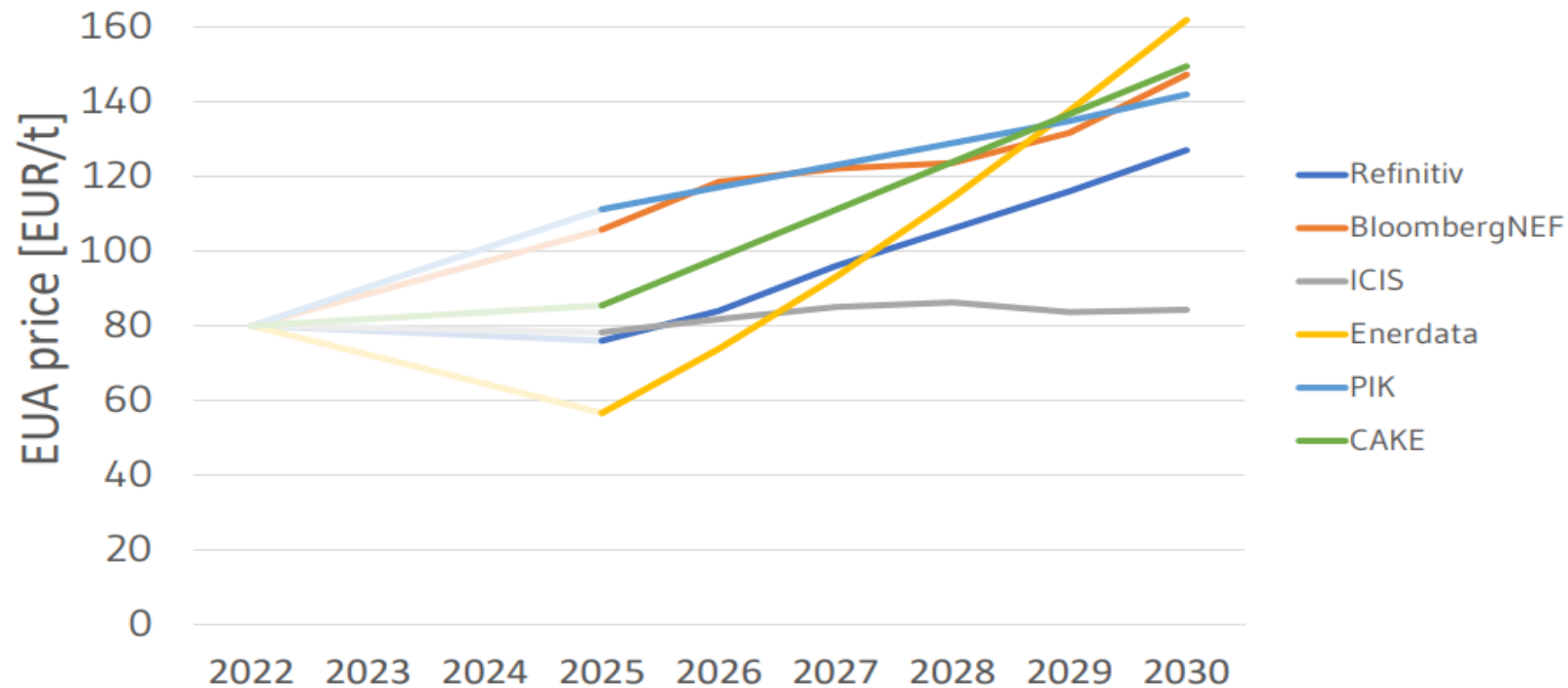


Figure : EUA prices in default “Green Deal/FF55 COM” scenarios [Notes: (a) Refinitiv and BloombergNEF prices are nominal; remaining prices are real and were harmonized to EUR2022 using EUROSTAT inflation rates. (b) E3M did not provide prices.]

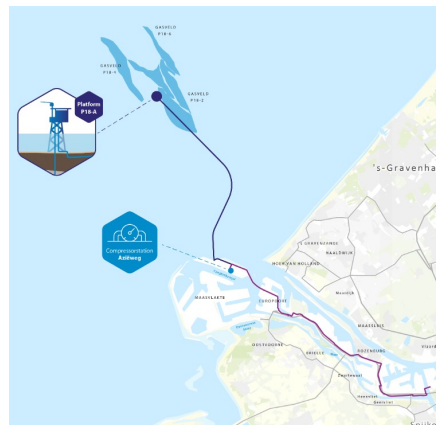
[Source: ETS Workshop Bruxelles, December 2022](#)

CHALLENGES FOR CCS



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- ❑ Certified storage and associated cost
- ❑ Smaller CO2 hubs under development
- ❑ Long term CO2 possible as feedstock for e fuels
- ❑ Business case highly depends on CO2 logistics and permanent storage cost. Current estimated figures are based on 2030 and large volumes of CO2 storage



REALISATION of CCS



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Anthony Veder is consortium partner in EverLoNG

European industry consortium with the aim of demonstration of onboard carbon capture & storage at LNG fuelled vessel, including downstream processing/storage.



Anthony Veder is consortium partner in LNG ZERO

One of the pillars in the Dutch-government initiated Maritime Masterplan, which is a public-private cooperation aimed at energy transition and decarbonization in the shipping sector. LNG-ZERO is a research project aimed at achieving net zero emissions from an LNG fuelled engine by applying onboard carbon capture and storage and drop-in biofuels.



Anthony Veder is highly interested in demonstration project MMP II

Subsidy will be available for net zero vessels for hydrogen, methanol fuelled vessels and LNG fuelled vessels in combination with carbon capture. A consortium will be required, and Anthony Veder is already in close contact with VDL. As VDL is also involved in EverLong and LNGZero.

Navigating the Future

