MARINE NH3

Ammonia as Marine Fuel

NH3 Fuel Conference

Niels de Vries - 31st Oct 2018

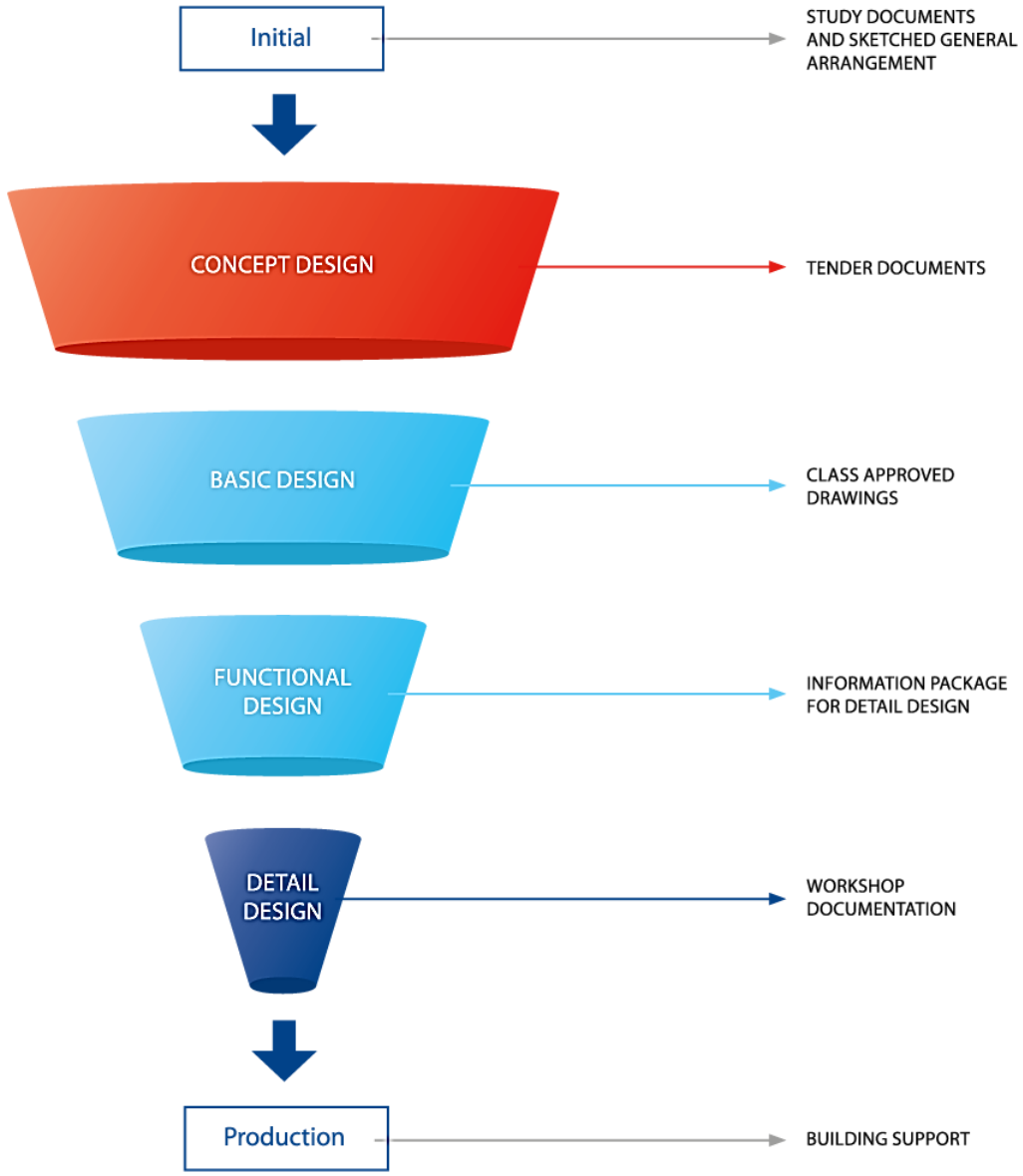
C-JOB

DEDICATED NAVAL ARCHITECTS

C-Job Naval Architects

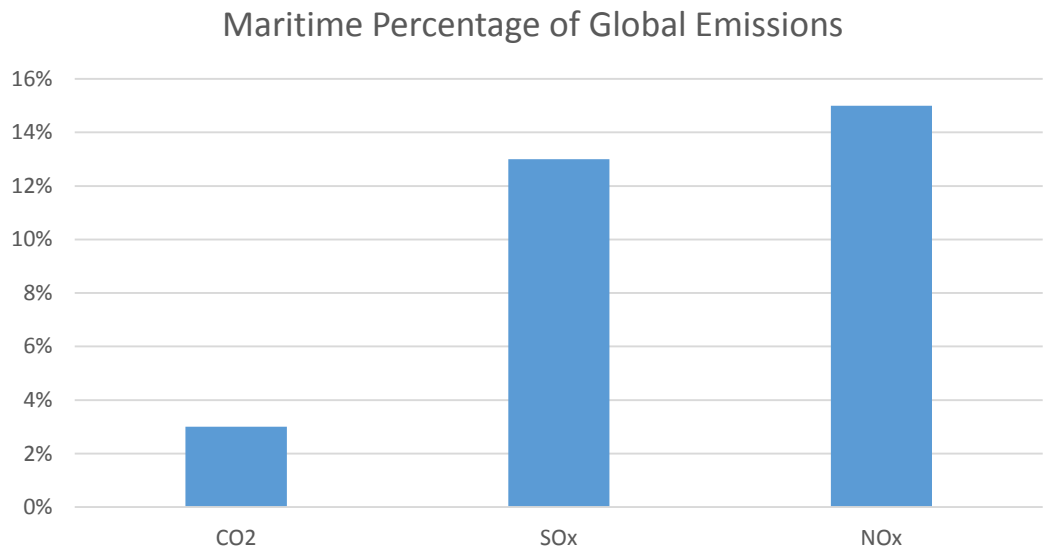
- Largest independent ship design & engineering company in the Netherlands
- A passion for everything that floats
- 4 offices: Hoofddorp, Heervenveen, Rotterdam and Nikolayev
- >140 in-house engineers employed

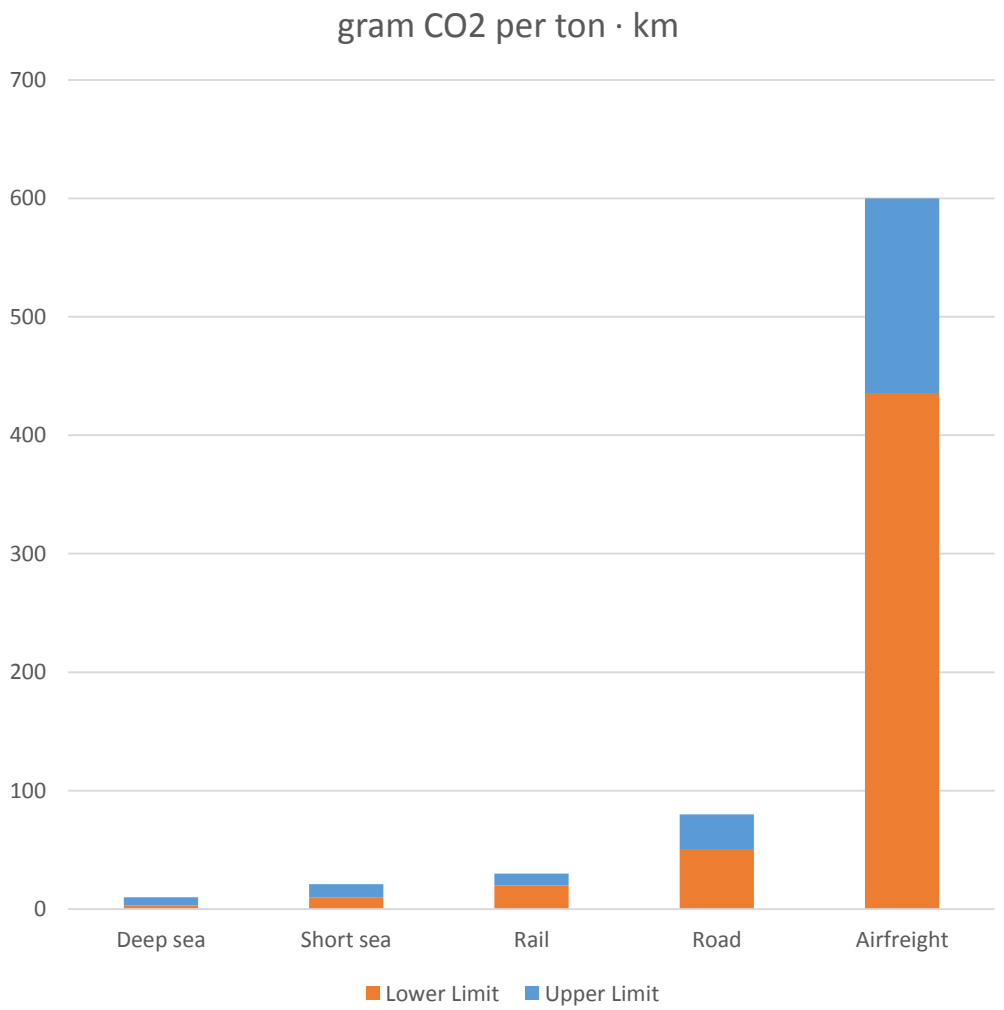
- Activities
  - Naval Architecture
  - Mechanical Engineering
  - Structural Engineering
  - Interior Engineering
  - Building Supervision



Emissions Maritime Industry

- International shipping responsible for +/- 90% of the world trade
- Shipping and aviation not included in Paris agreement



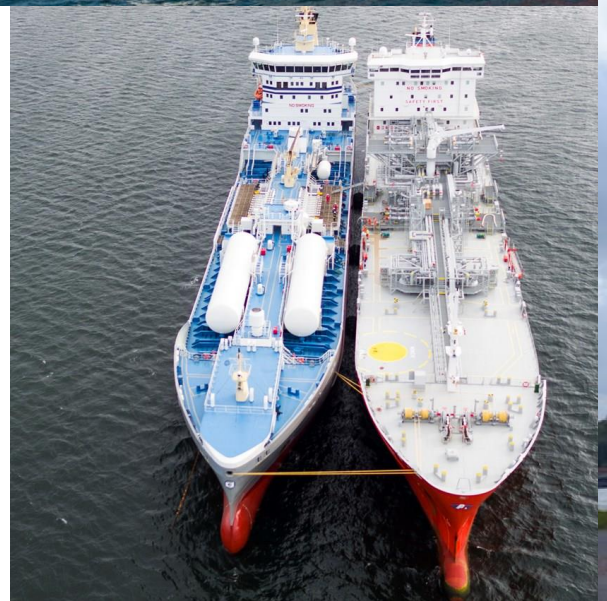


Regulations

- SOx: Sulphur cap
  - 0.5% Global 2020
  - 0.1% ECA
- NOx: IMO Tier III (Global pending)
  - Tier II Global
  - Tier III ECA
- CO2: Energy Efficiency Design Index

ECA: Environmental Control Area

Natural Gas & Exhaust Gas Treatment Movement



IMO Goals

- IMO: reducing overall carbon intensity of the cargo transported per kilometer by at least:
  - 40% by 2030
  - 70% by 2050

  (compared to 2008)

- IMO: reduce total annual GHG emissions by at least 50% by 2050 (compared to 2008)
  - Pursuing efforts towards phasing them out entirely

INTERNATIONAL MARITIME ORGANIZATION

Renewable Fuel Momentum

- Exhaust gas treament and application of natural gas insufficient to meet IMO goals
- Upcoming momentum for renewable fuels
- Challenges
  - Capacity renewable energy production
  - Economic viability
    - Ship & Cargo owner
    - Emission taxation

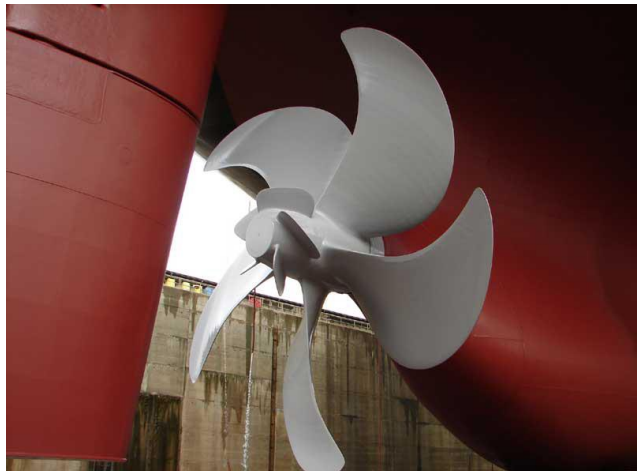
Renewable Fuel Options

Fuel type:	Energy density LHV [MJ/kg]	Volumetric energy density LHV [GJ/m3]	Renewable synthetic production cost [MJ/MJ]	Storage pressure [bar]	Storage temperature [°C]
Marine Gas Oil (reference)	42.8	36.6	Not applicable	1	20
Liquid Methane	50.0	23.4	2.3	1	-162
Ethanol	26.7	21.1	3.6	1	20
Methanol	19.9	15.8	2.6	1	20
Liquid Ammonia	18.6	12.7	1.8	1 or 10	-34 or 20
Liquid Hydrogen	120.0	8.5	1.8	1	-253
Compressed Hydrogen	120.0	7.5	1.7	700	20

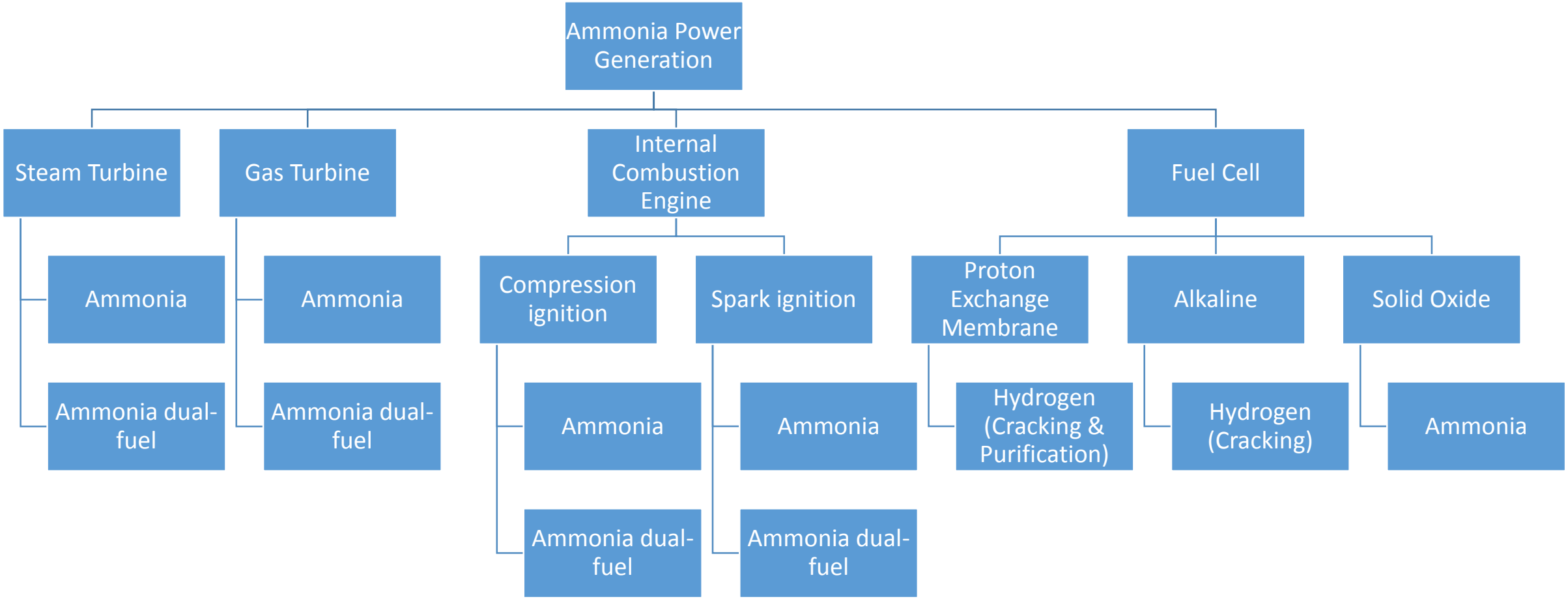
- Ammonia balanced solution
  - Volumetric energy density
  - Renewable synthetic production cost

Marine Power Generation

- Large scale
- Marine environment
- Dynamic behaviour/Load response
  - Experience natural gas
- Part load conditions
- Fuel direct & Fuel electric configurations
- Size, Mass, Efficiency and Emissions



Ammonia Power Generation



C-JOB

DEDICATED NAVAL ARCHITECTS

www.c-job.com

info@c-job.com

+31(0)880243700

Niels de Vries

n.devries@c-job.com