# LNG from renewable sources as an alternative fuel for maritime shipping?

Enerday 2019

Dresden, 12.04.2019

Prof. Dr. Andreas Seeliger

SWK E2 Institut für Energietechnik und Energiemanagement
der Hochschule Niederrhein - Krefeld

# Agenda

Hochschule Niederrhein
University of Applied Sciences
SWK E²

1 Introduction : Emissions, Ships, Fuels, Regulation

2 LNG for Maritime Shipping: Technical Issues, Environmental Impact, Survey

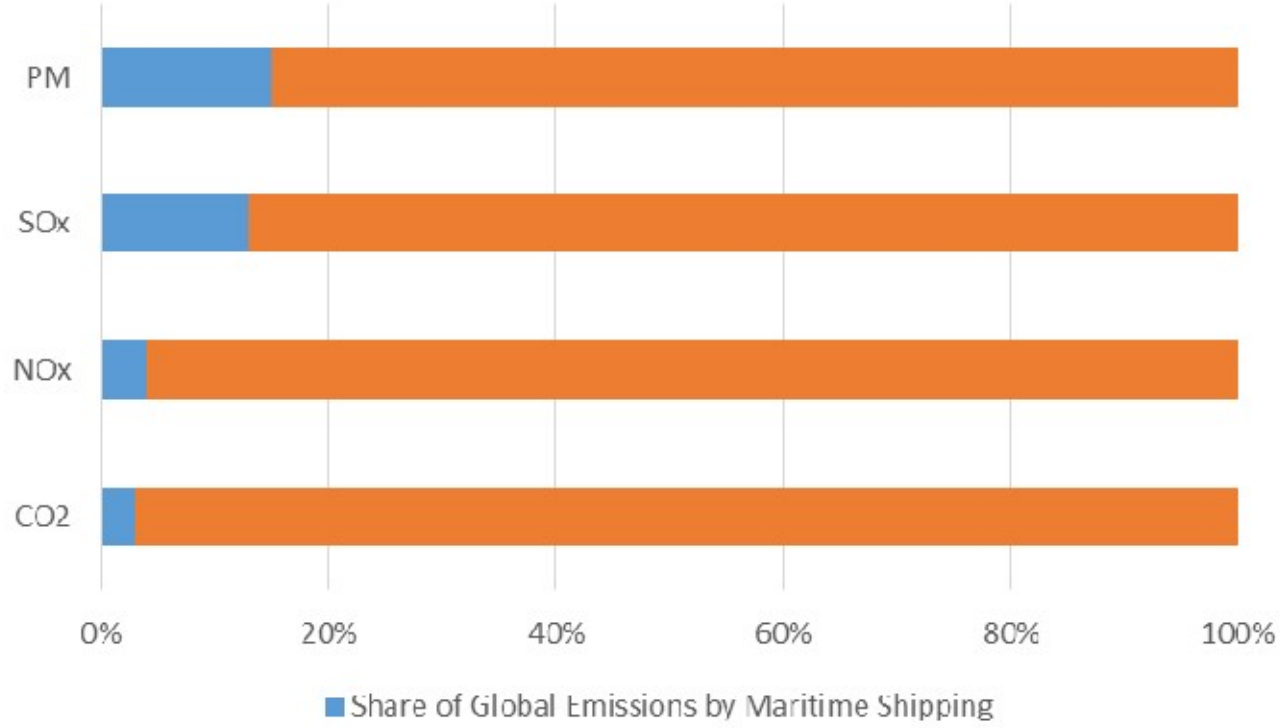
3 Outlook: Green Gas, Infrastructure

4 Conclusions

Note: Work in Progress
(Breuer/Seeliger (2019))

# Introduction

- Transport is one of the main source for various emissions (e.g. 18% of global $CO_2$ emissions)
- Within transport sector, few maritime ships (less than 100.000 worldwide) are responsible for high emissions

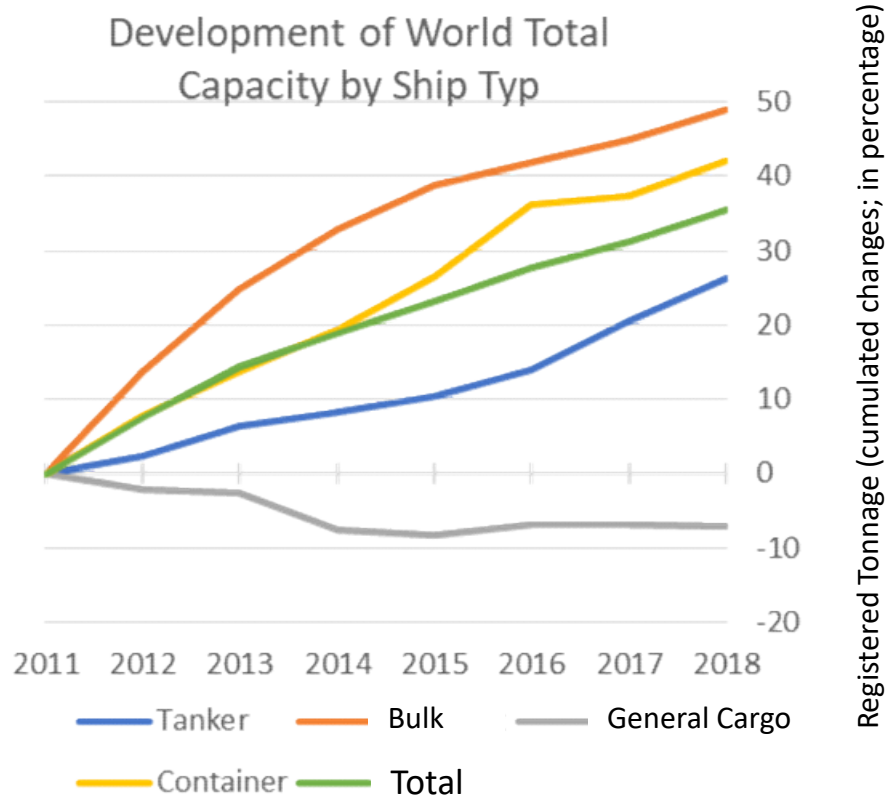



*Source: IMO; Olmer et al. (2017); Klimont et al. (2017)*

# World Shipping Inventory

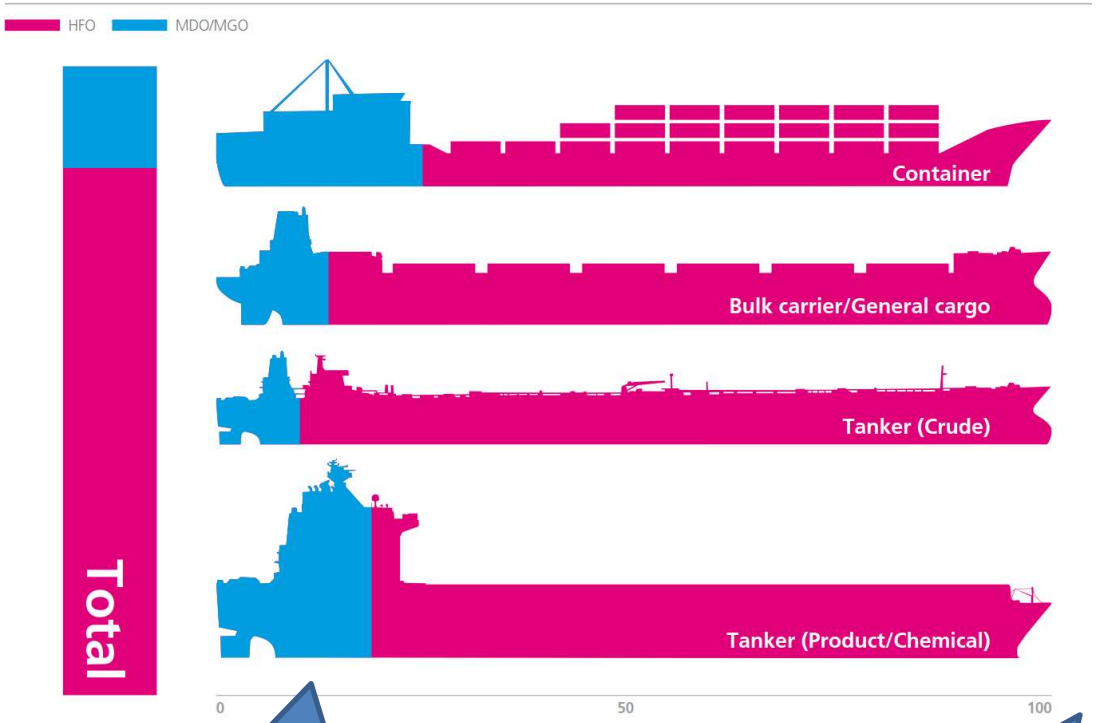
| | 2011 | 2018 |
|---|---|---|
| *Tanker* | 10,609 | 10,420 |
| *Bulk Carrier* | 8,228 | 11,125 |
| *General Cargo* | 21,090 | 19,613 |
| *Container* | 4,966 | 5,164 |
| *Others* | 38,390 | 47,847 |
| ***Total*** | **83,283** | **94,169** |

„Others“ include 314 cruise ships




*Source: UNCTADSTAT (2018)*

# Fuel Mix




*Source: Lloyd's/UCL (2014), S. 32*

*Source: Courtesy of AIDA Cruises*

Status Quo:
80% Heavy Fuel Oil
20% Marine Diesel Oil
approx. 0,2% Alternative Fuels

End of 2018:
Only 144 maritime ships
worldwide using LNG

# Environmental Regulations

- International waters: regulation by IMO
- Sulfur content fuel oil: max. 3,5% (2020: 0,5%)
- NOx: limited in relation to engine power (max. 14 g/kWh)
- Emission Control Areas (ECA) : higher environmental standards (e.g. 0,1% sulfur, 3 g/kWh $NO_x$)
- No $CO_2$-regulation so far by IMO (but roadmap for 2050 published with -50% target)
- National regulations within 12 mile zone (e.g. sulfur EU outside ECA: 1,5%; China 0,5%)
- Additional penalties or incentives in various harbours

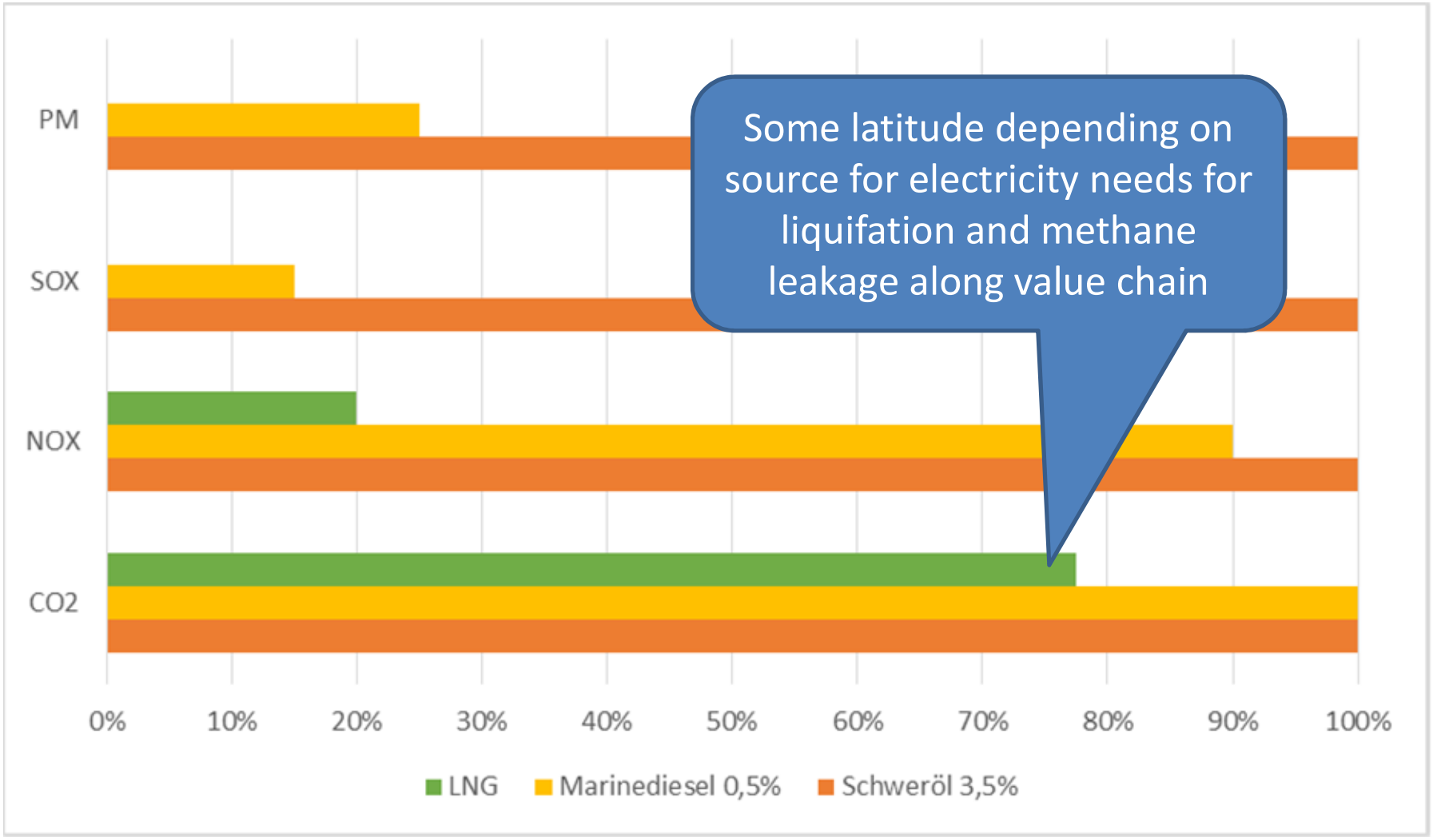

*Source: ICIS (2018)*

2

# Technical Background LNG

- Established engine technology (single or dual fuel)
- Cryo tank needed => compared to MDO tank: more expansive, more space requirement, fuel boil off 0,15%/d
- High safety standards for fuelling process
- Fuelling:
  - Shore-to-Ship: harbour needs regasification terminal or large scale cryo tank (e.g. AIDAnova 3.500 $m^3$; new CMA GGN 18.000 $m^3$)
  - Truck-to-Ship: capacity of truck approx. 22 $m^3$
  - Ship-to-Ship: bunker ship with capacity of approx. 7.500 $m^3$ (2020: new bunker ship generation with up to 19.000 $m^3$)

# Environmental Impact of LNG



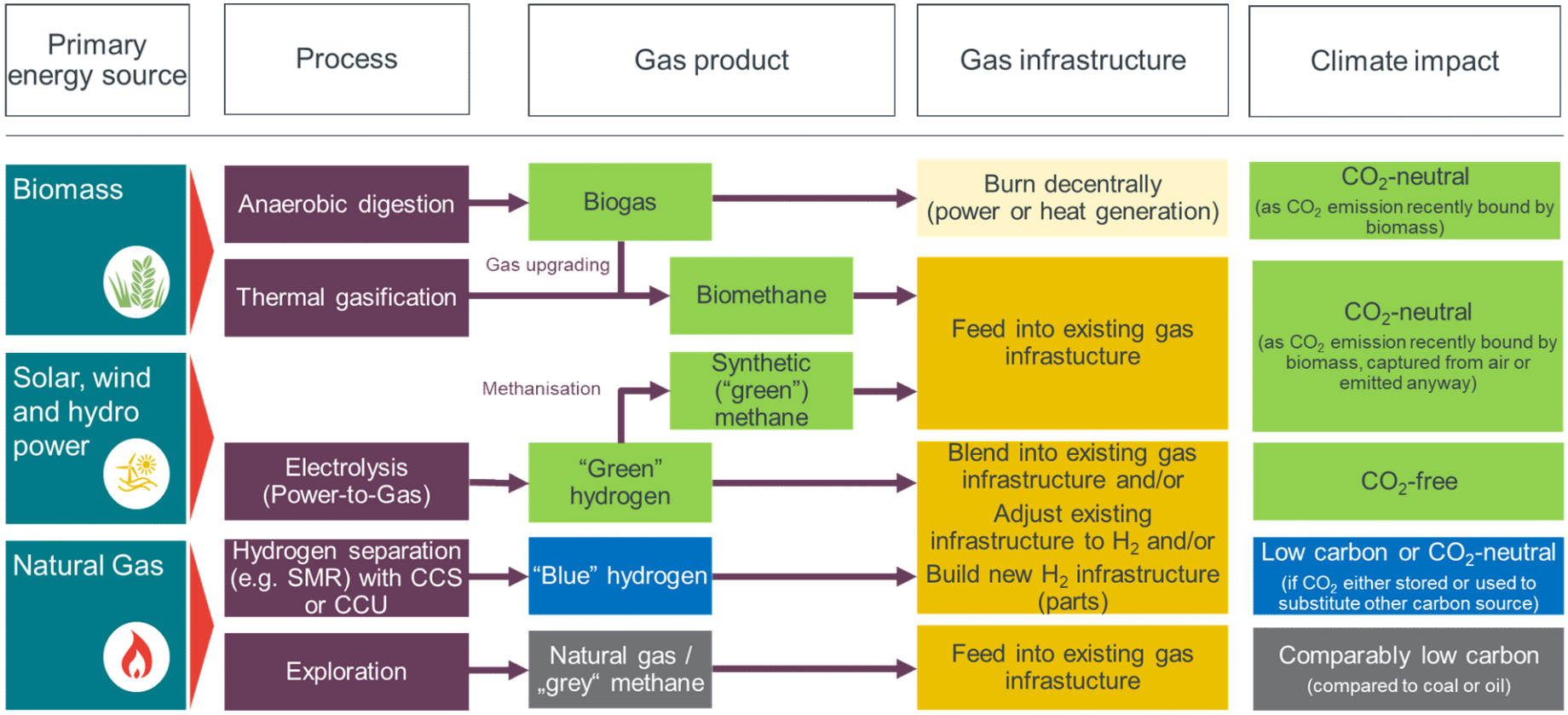

*Source: own estimations based on various sources*

2

# Industry‘s View

- Survey in Q4/2018
- Questionaire sent to 62 stakeholders (shipping companies, energy supplier, harbour operators, dockyards, associations etc.)
- 13 returns plus 7 personal interviews
- Some results:
  - Nearly all see natural gas as an important source in general as well as for transport (general) and shipping
  - Prefered fuel (multiple mentions): 9 LNG, 5 Marine Diesel, 1 Electric, 0 Hydrogen
  - Methan leakage no issue in practice (contrary to literature)
  - Main problem for LNG expansion: unsuitable legal framework and local harbour requirements

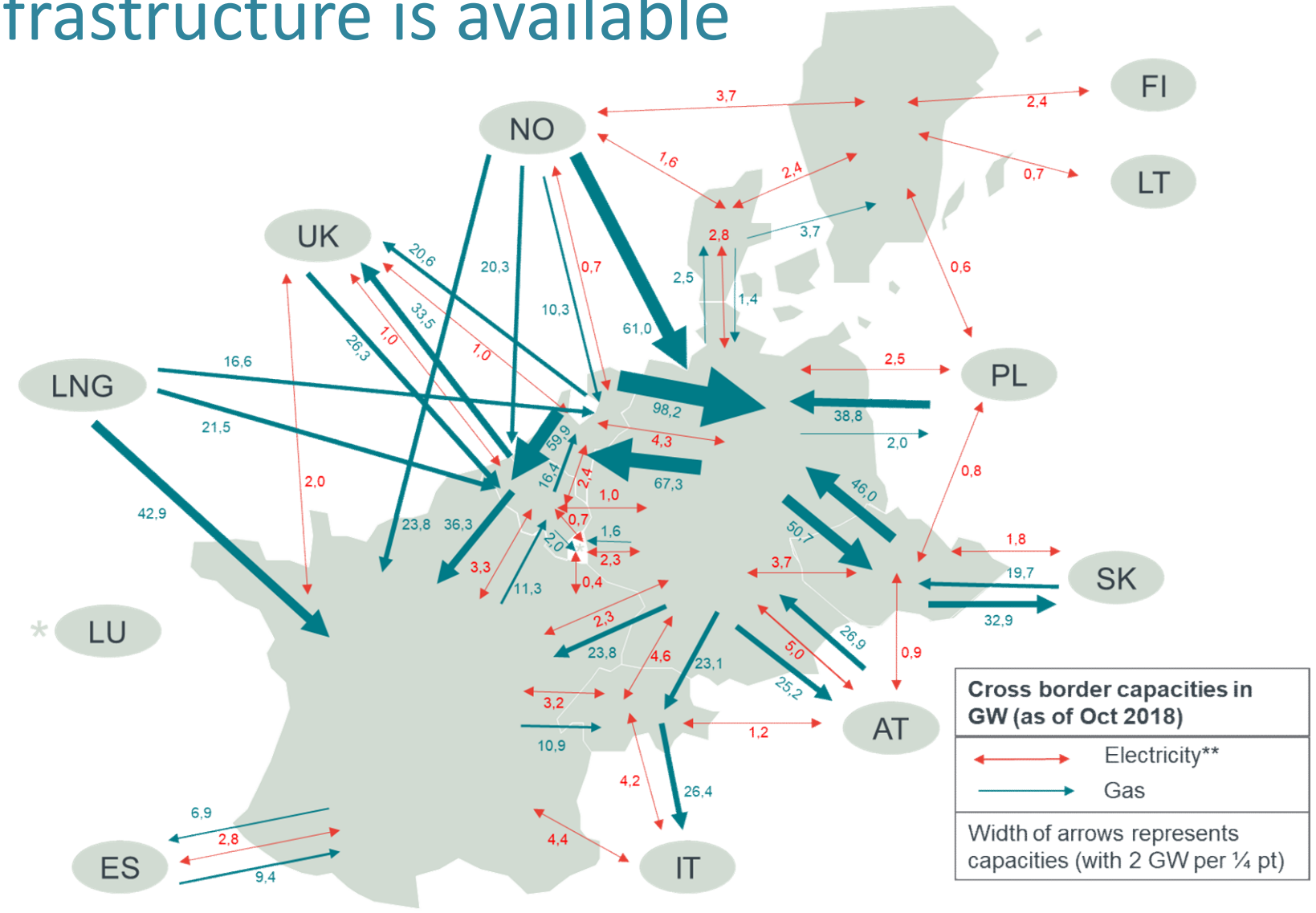
# Next Step: LNG from renewable sources („Green Gas“)




*Source: Frontier Economics/IAEW (2019), p. 25*

# Backup: „Green Gas“ - Infrastructure is available

Hochschule Niederrhein
University of Applied Sciences
SWK E²




*Source: Frontier Economics/IAEW (2019), p. 21*

4

# Conclusions

- LNG with significant environmental improvements
  => even with „grey methane“
- Technical feasible (already now)
- No additional infrastucture needed on national level
  => but: local investments necessary
- Even further environmental improvements possible with various „green gas“ sources

- Critical issues:
  - Cost impacts (investment harbours, new ships, additional fuel costs)
  - Regulatory framework (incl. regulation and taxation of fuels, „(inter-) national gas strategy“)

# References


- Breuer, T./Seeliger, A. (2019): Umwelteffekte eines Einsatzes von LNG in der internationalen Seeschifffahrt (working title), forthcoming
- Frontier Economics/IAEW (2019): The Value of Gas Infrastructure in a Climate Neutral Europe. Cologne/Aachen
- IMO: http://www.imo.org
- ICIS (2018): Refiners, shippers face uncharted waters of low-sulphur 2020 rule. https://www.icis.com/explore/resources/news/2018/09/11/10258700/insight-refiners-shippers-face-uncharted-waters-of-low-sulphur-2020-rule/
- Klimont, Z. (2017): Global anthropogenic emissions of particulate matter including black carbon. https://doi.org/10.5194/acp-17-8681-2017
- Lloyd‘s/UCL (2014): Global Marine Fuel Trends 2030. London
- Olmer, N. et.al. (2017). Greenhouse Gas Emissions from Global Shipping. https://www.theicct.org/sites/default/files/publications/Global-shipping-GHG-emissions-2013-2015_ICCT-Report_17102017_vF.pdf
- UNCTADSTAT (2018): Merchant Fleet by flag of registration. http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx

# Contact

Hochschule Niederrhein
University of Applied Sciences
SWK E²

Hochschule Niederrhein
University of Applied Sciences
SWK E²
Institut für Energietechnik und Energiemanagement
Institute of Energy Technology and Energy Management


Prof. Dr. Andreas Seeliger

**Energiewirtschaft**

Raum: J 133
Telefon: +49 (0)2151 822-6664
Andreas.Seeliger(at)hs-niederrhein.de
Reinarzstr. 49
47839 Krefeld