- CAN FLOATING AND FIXED LNG TERMINALS OPEN NEW MARKET WITH SMALLER AND MORE FLEXIBLE PROJECTS?
- LNG DEVELOPMENTS IN NEW MARKETS: HOW WILL THIS IMPACT EUROPEAN DEMAND AND SUPPLY?

FLNG global - Amsterdam
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J. Giessen, Neptune Energy Ltd.

NEPTUNE ENERGY

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- NEPTUNE HAS A PARTICIPATION IN SNOHVIT/ HAMMERFEST LNG NORWAY (EQUINOR OPER.) , JANGKRIK INDONESIA (GAS LIQUEFIED AT BONTANG), AND IS OPERATOR OF THE BONAPARTE PROJECT (PETREL GASFIELD) AUSTRALIA
- *The business had production of 162,000 net barrels of oil equivalent per day during 2018 and 2P reserves at 31st December 2018 of 638 million barrels of oil equivalent. The Company, founded by Sam Laidlaw, is backed by CIC and funds advised by Carlyle Group and CVC Capital Partners.*

Cygnus Platform complex UK (photo: Polar Media)

Jangkrik ENI/ Neptune energy , Indonesia

Hammerfest LNG (Image courtesy of Equinor/Helge Hansen)

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- Gas demand and relation to renewables in Europe
- Gas network roll out and Regas capacity developments
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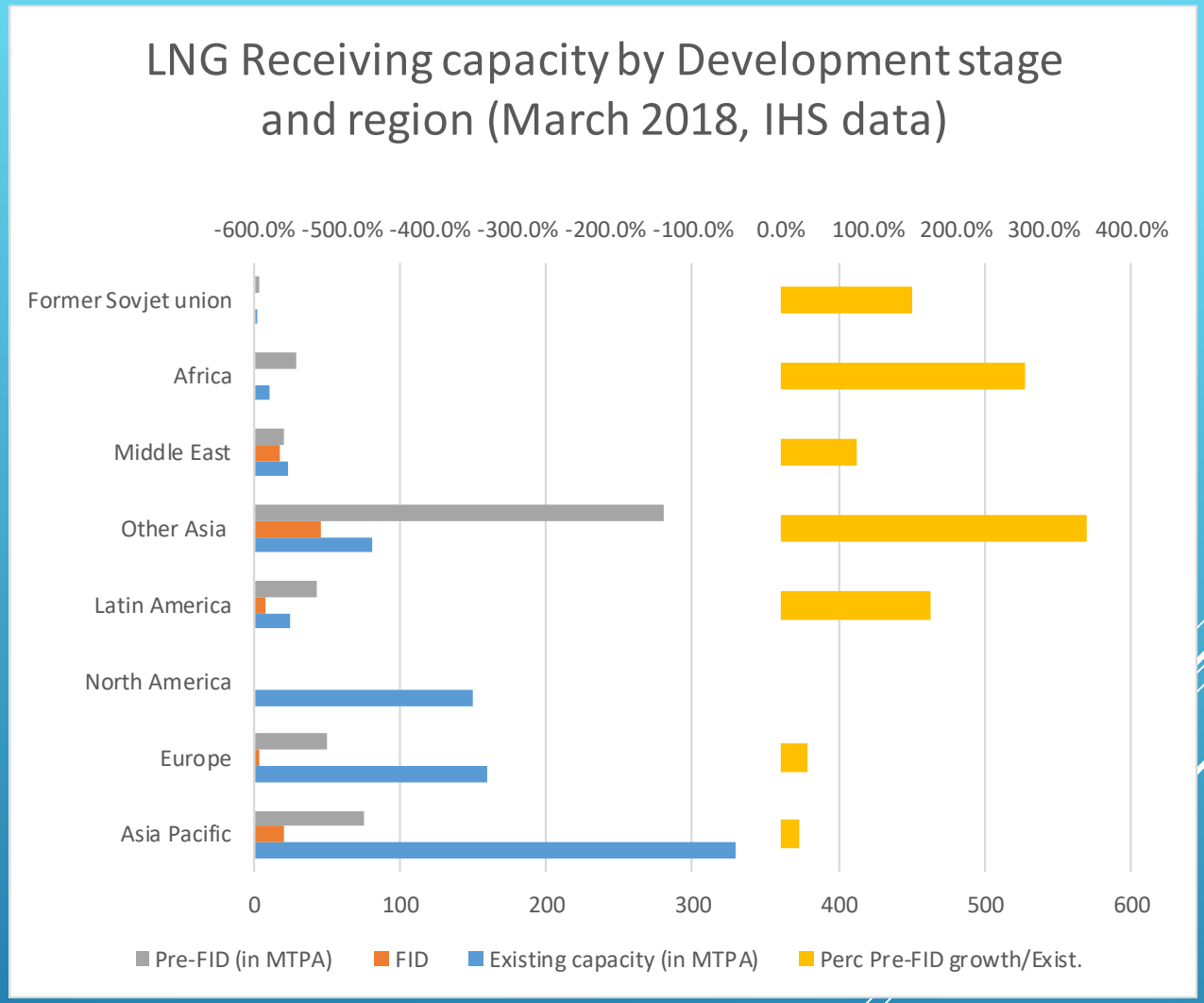
  - Dependence on storage & imports
- The potential of small scale LNG and growth of LNG in transport
  - The case for LNG : Emission factors
  - LNG in road and maritime transport,
- Conclusions for LNG import facilities in EU



- Capacity and Growth in LNG receiving capacity in Asia Pacific and Asia is significant with growth upto 350%
- Europe experiences growth OF LNG receiving capacity of 30%

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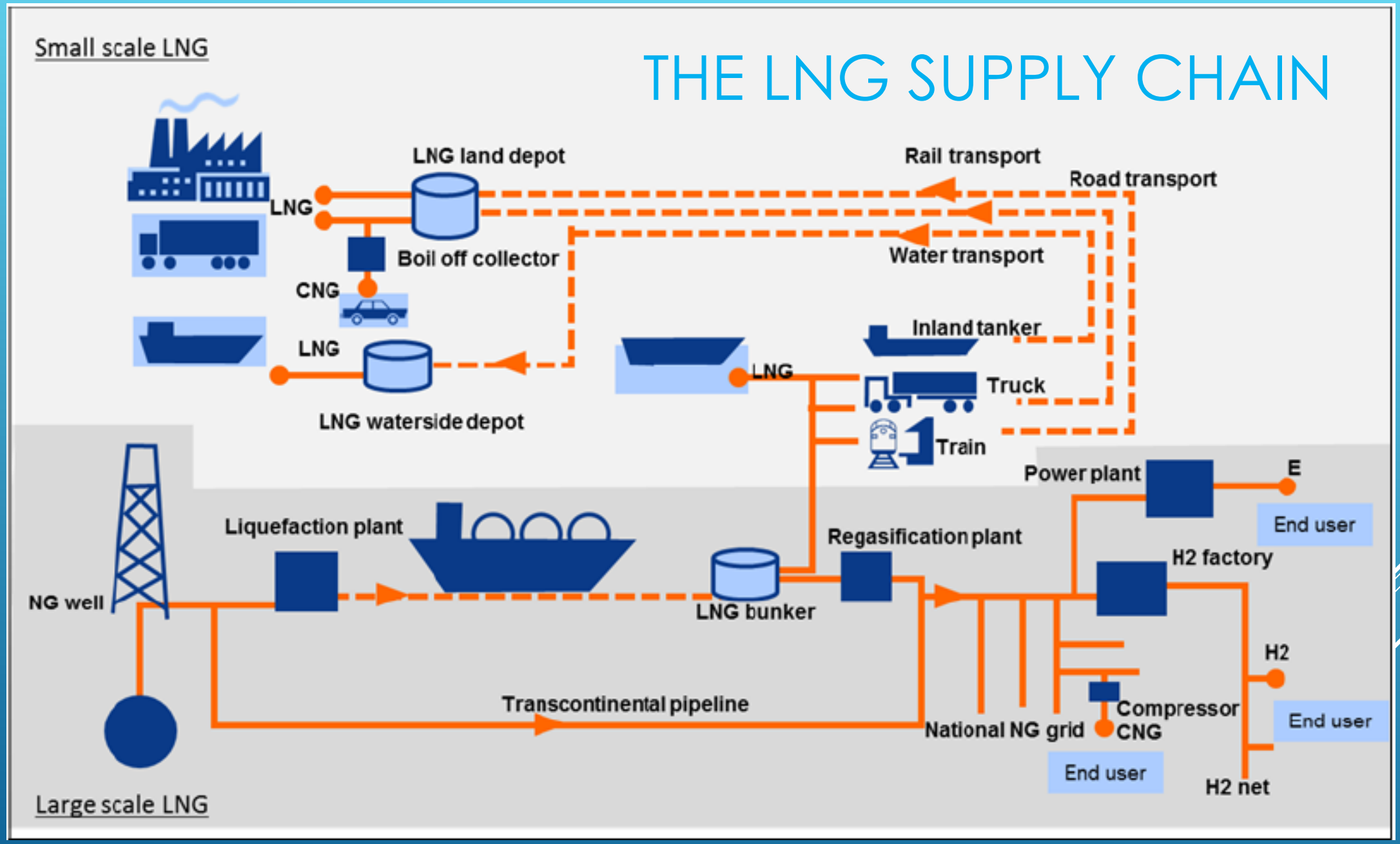
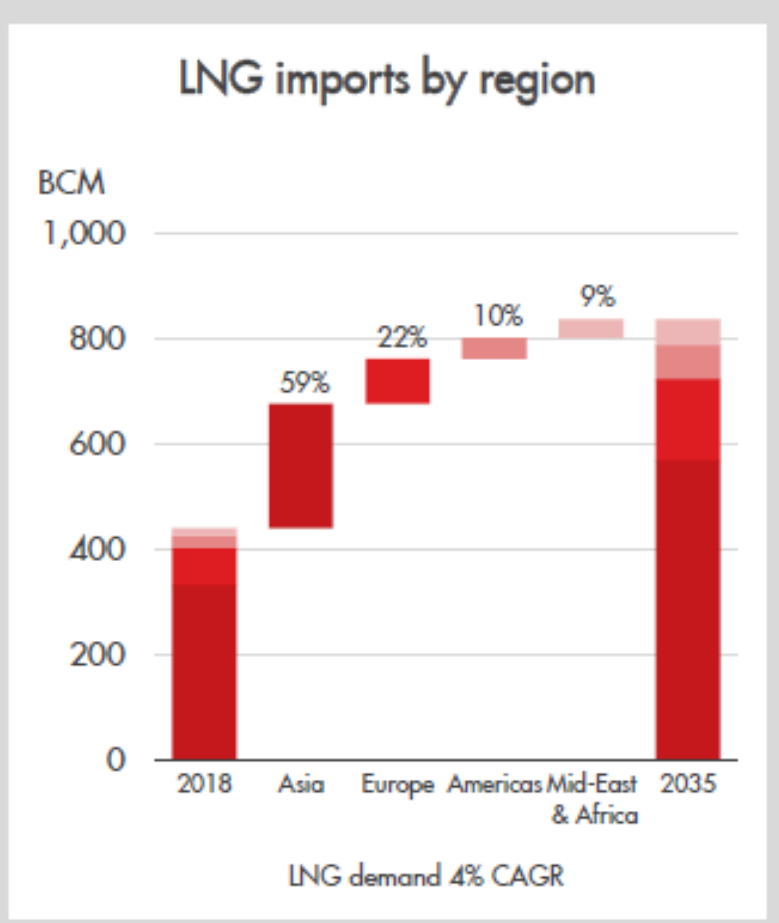
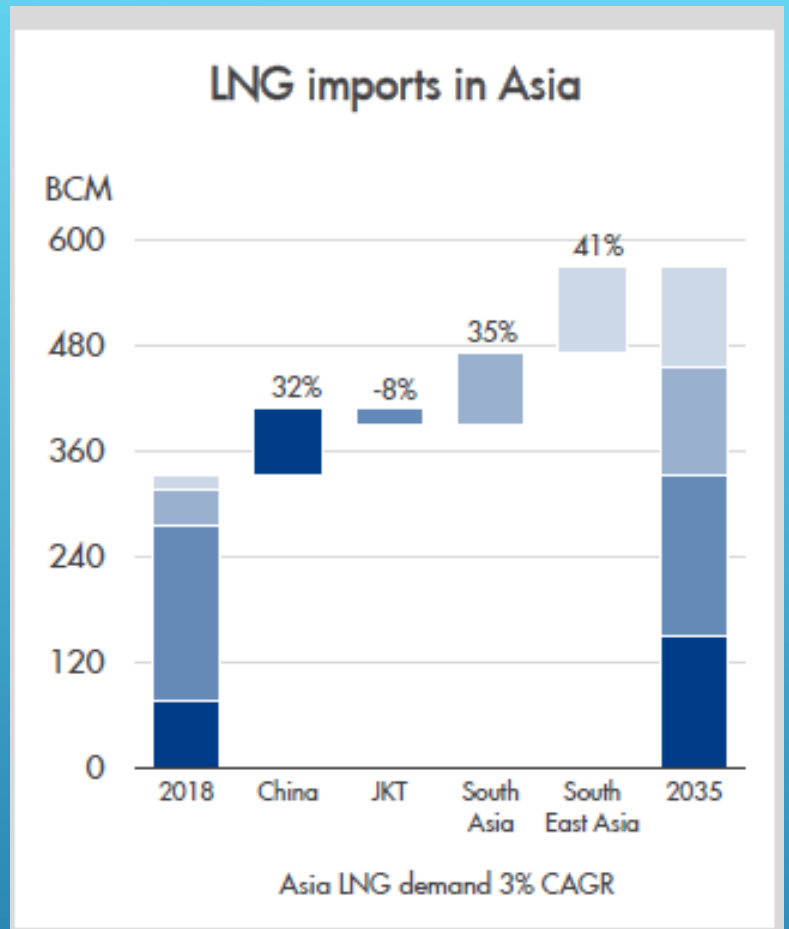
THE LNG SUPPLY CHAIN







- Position of LNG import Europe versus Asia
- Asia represents 59% of LNG import growth until 2035,
- While Europe represent only 22% of LNG growth
- Within Asia will China take 32% of LNG import growth, and South East Asia 41%.

From Shell LNG outlook 2019, based on Wood Mackenzie data

INTRO - LNG IMPORTS ON GLOBAL SCALE

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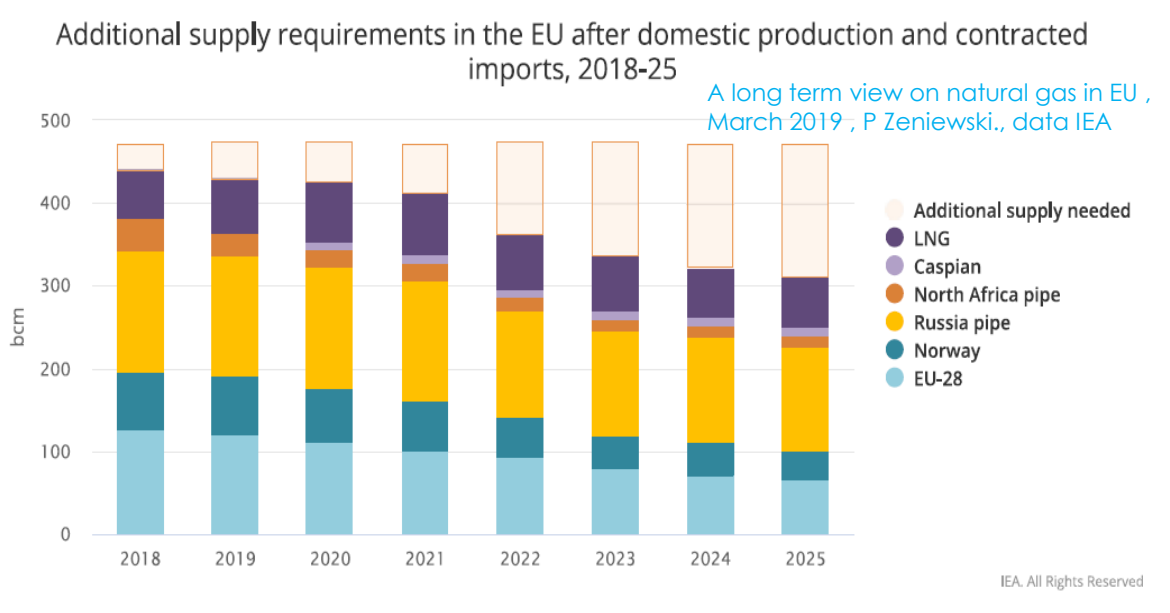
GAS DEMAND AND RELATION TO RENEWABLES EUROPE

EUROPE GAS IMPORT BALANCE

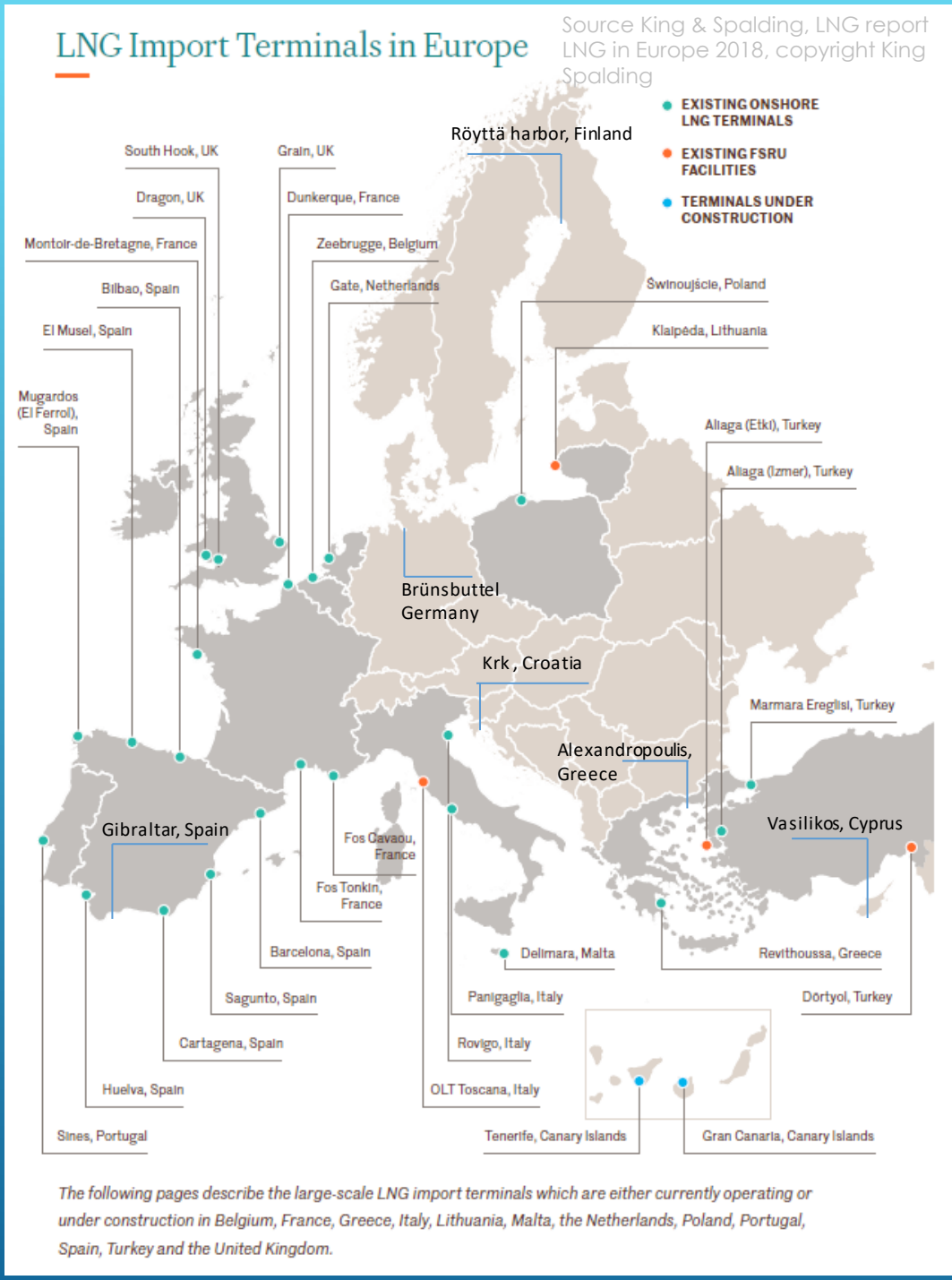


- The part of gas supply from new sources increases from 5% to33% between 2018 / 2025 (IEA)
- In Europe demand is growing 329, 374, 389 bcm, with import share growing 71%, 80%, 84% from year 2016, 25, 2040. (Source IEA app A)

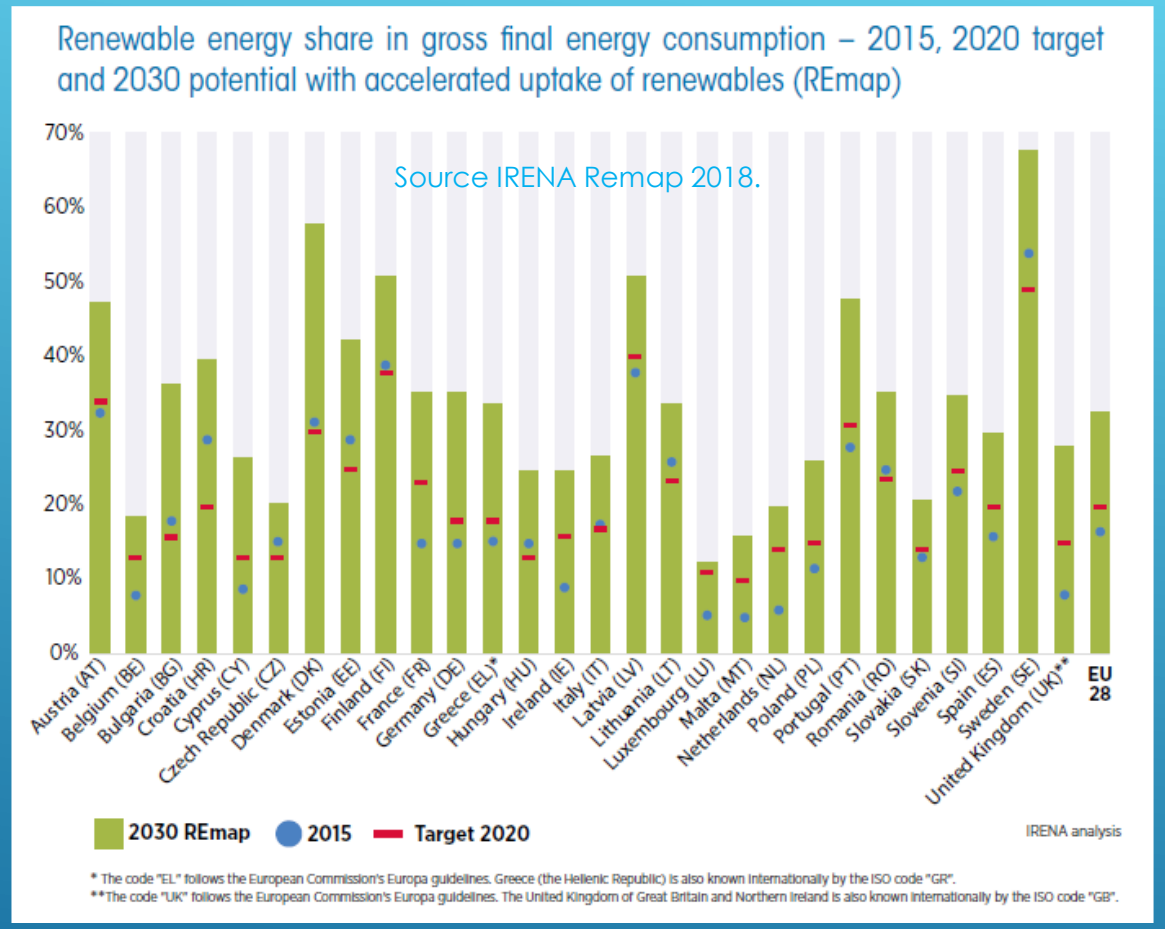
/ Most countries in EU have significant LNG import terminal capacity, however the LNG import is still a small part of total demand at about 17% in 2019

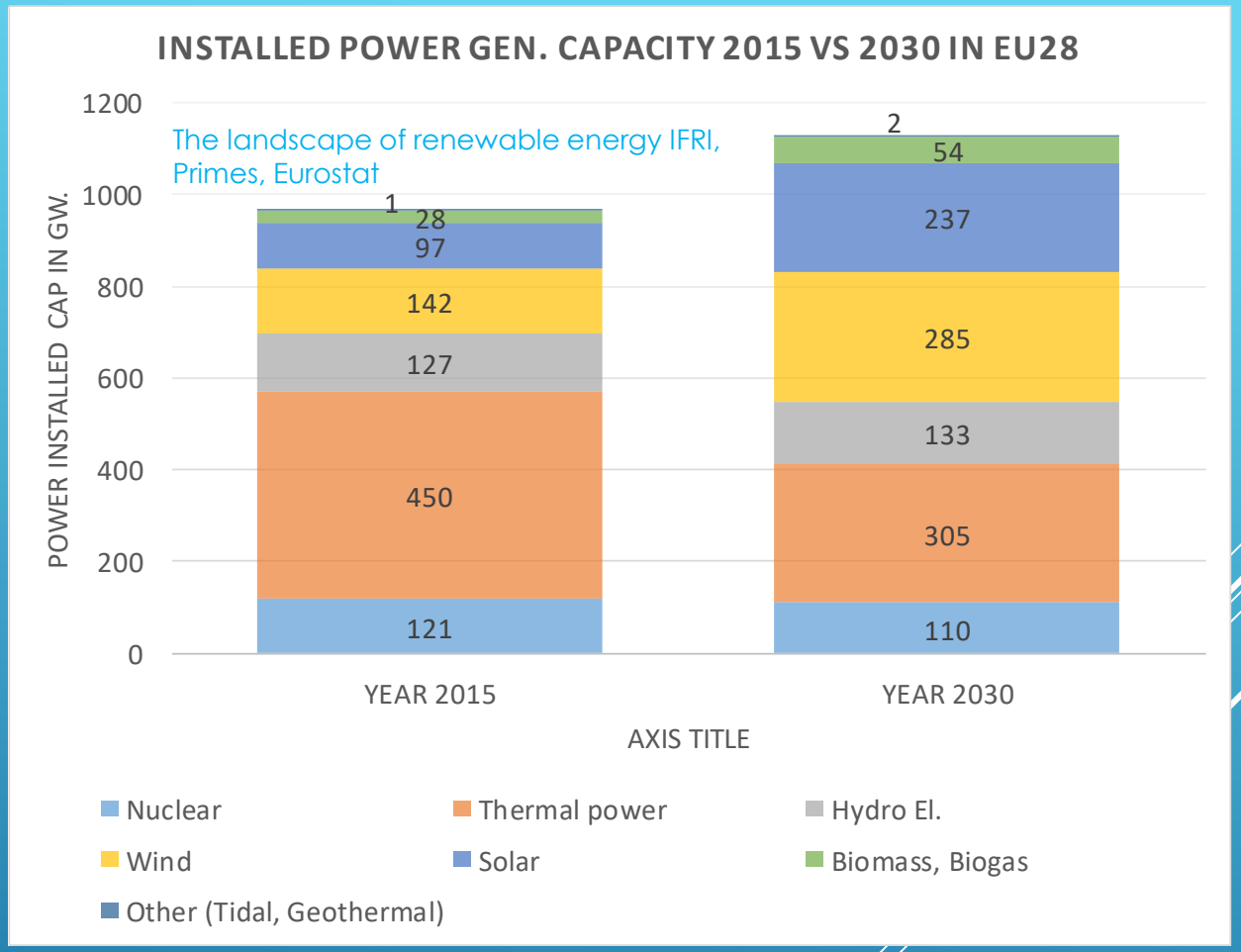
/ In addition the following countries have LNG terminals in construction/ planned (start-up date in brackets):

Croatia (FRSU in Krk, Cyprus FSRU Vasilikos (2019), Finland Manga LNG terminal in Röyttä Harbor (2018), Germany in Brünsbuttel (2022), Gibraltar (2018), Greece FSRU at Alexandroupolis (2020)



RENEWABLES VERSUS GAS IN EUROPE





- Target of EU is 40% cut in GHG and 27% share of renewables by 2030 (primary energy), above EU28 are planning to reach 20% renewable by 2020. (from EC Europe 2030 Energy strategy)
- According Primes, EU policy of 27% target from renewables in 2030 , would still lead to 20 - 25% gas share of primary energy in EU
- In power generation acc. Primes, Renewable to grow to 63% and Thermal power still 27% in 2030 in EU28, while the cost to support renewables are growing to 22% of generation cost, which requires more than 100% increase wind and solar. If renewables are 63% Thermal power 27% is there sufficient back up for a back up for a dark winter day?

NEPTUNE ENERGY

GAS NETWORK ROLL OUT AND REGAS TERMINAL DEVELOPMENTS

Well established LNG receiving terminals in Norway

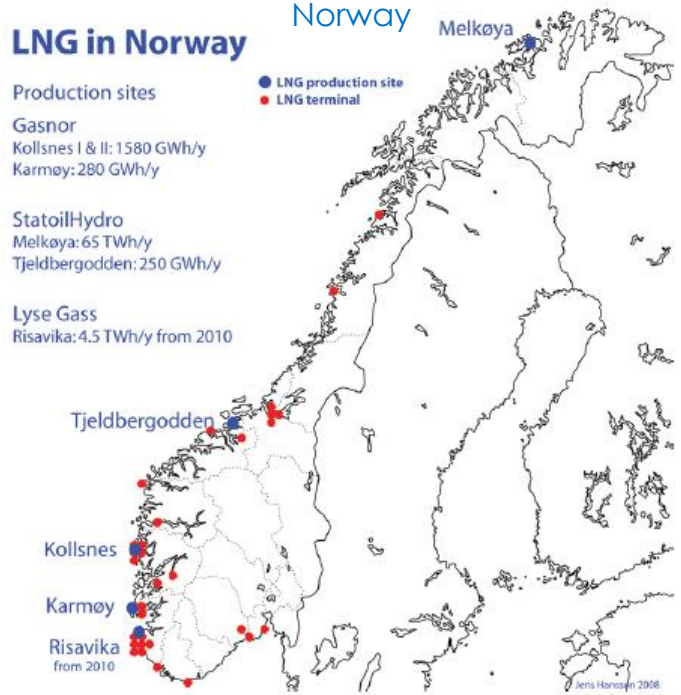
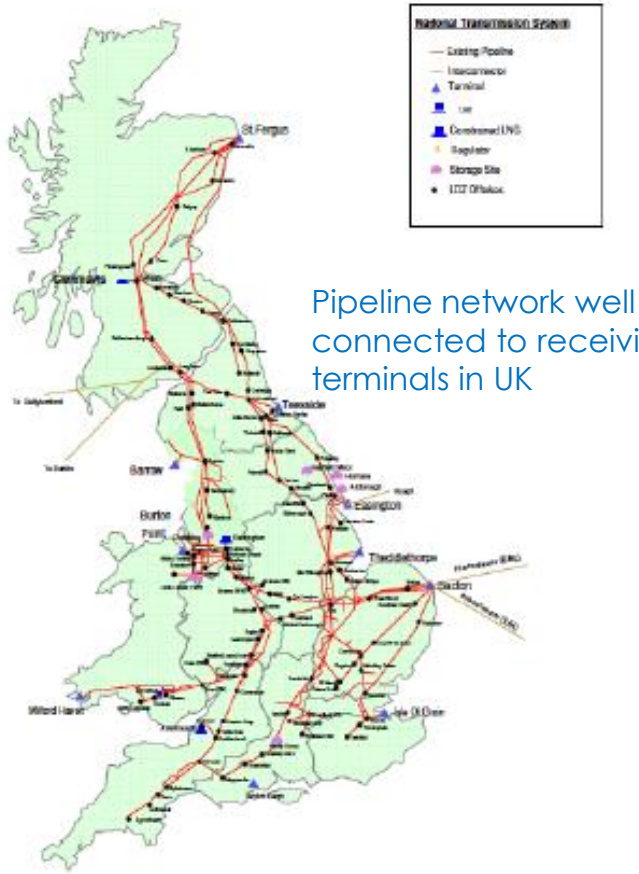


Figure 4: The Norwegian LNG production sites and receiving terminals

Figure 5: Map of key GB gas infrastructure showing terminals and storage facilities



Source: National Grid

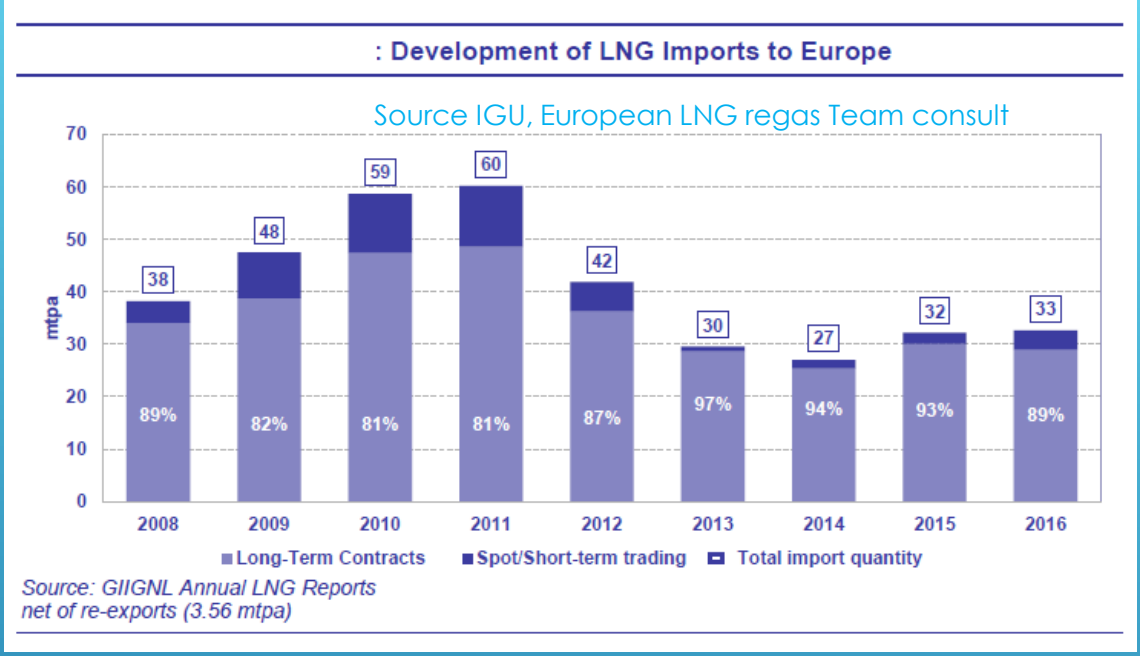
Pipeline network well connected to receiving terminals in UK

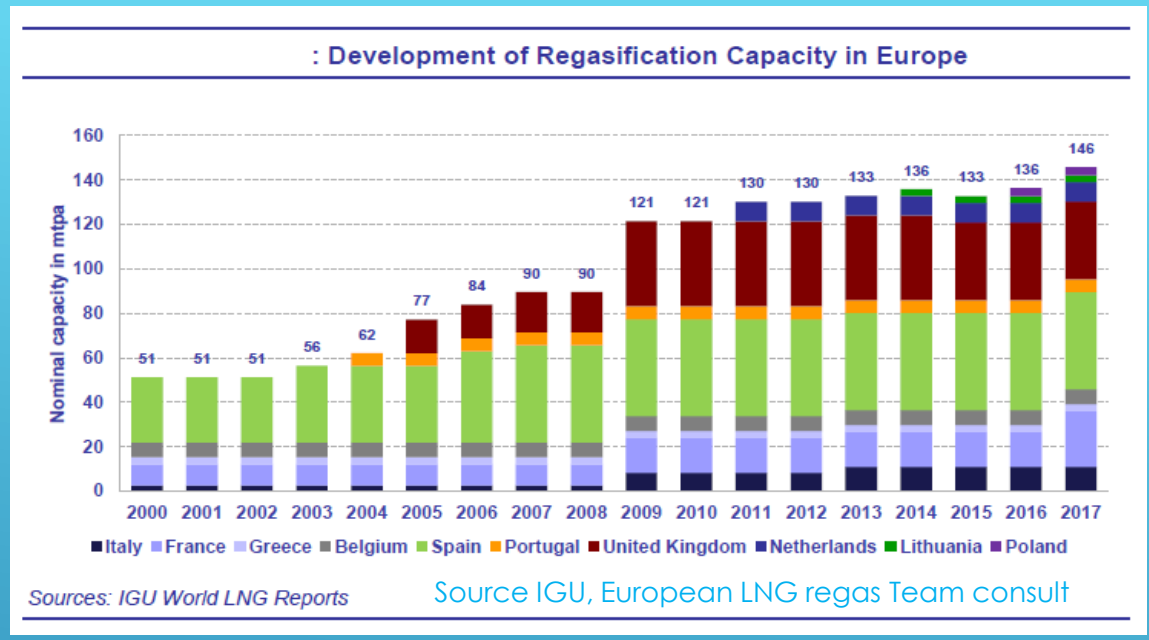
Sweden developing pipeline network, starting from main cities in the south

- Norway has a good number of LNG import terminals to cover the coastal regions from south to north
- UK has a good number of LNG import terminals at most ports, with extensive pipeline network to distribute the gas to all users.
- Sweden has had to build up the pipeline network in the last 10 years, as historically it did not have an well developed gas network.

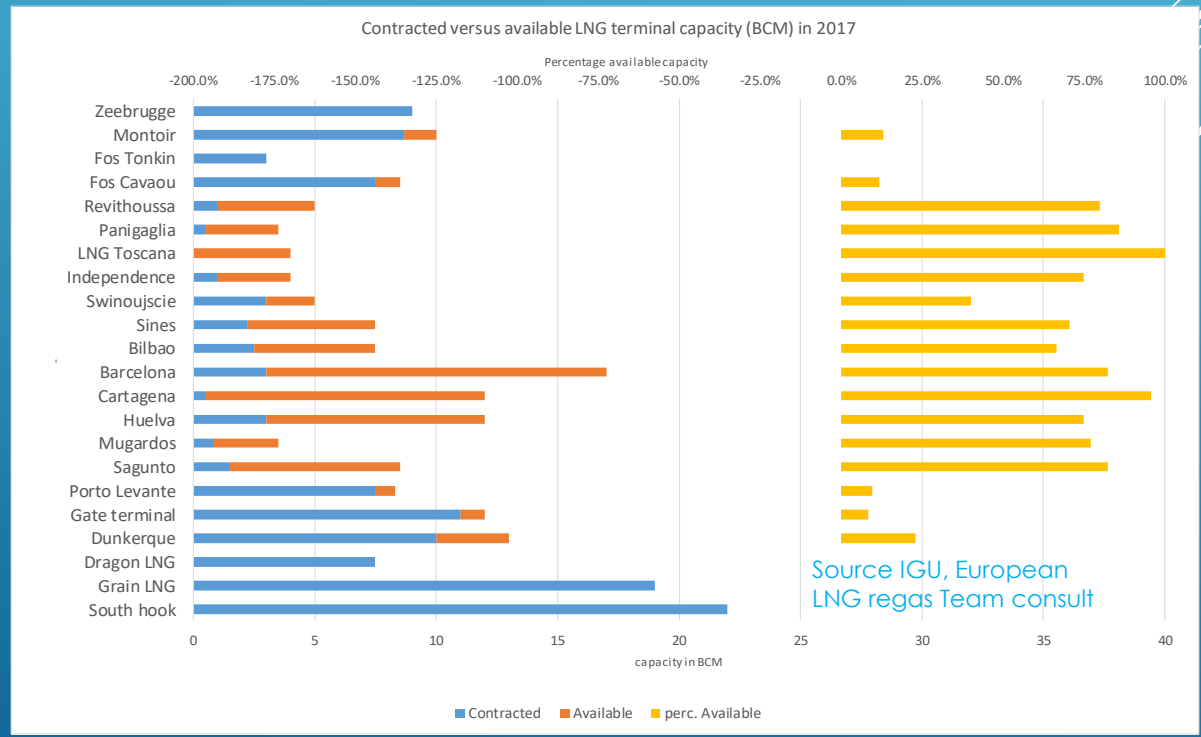
ROLL OUT OF A GAS NETWORK COMPARE SWEDEN AND NORWAY IN TERMS OF GAS AND LNG IMPORT NETWORK

Report LNG as alternative in Sweden SGC 197, 2008, an Oxford inst, report about Gr Britain

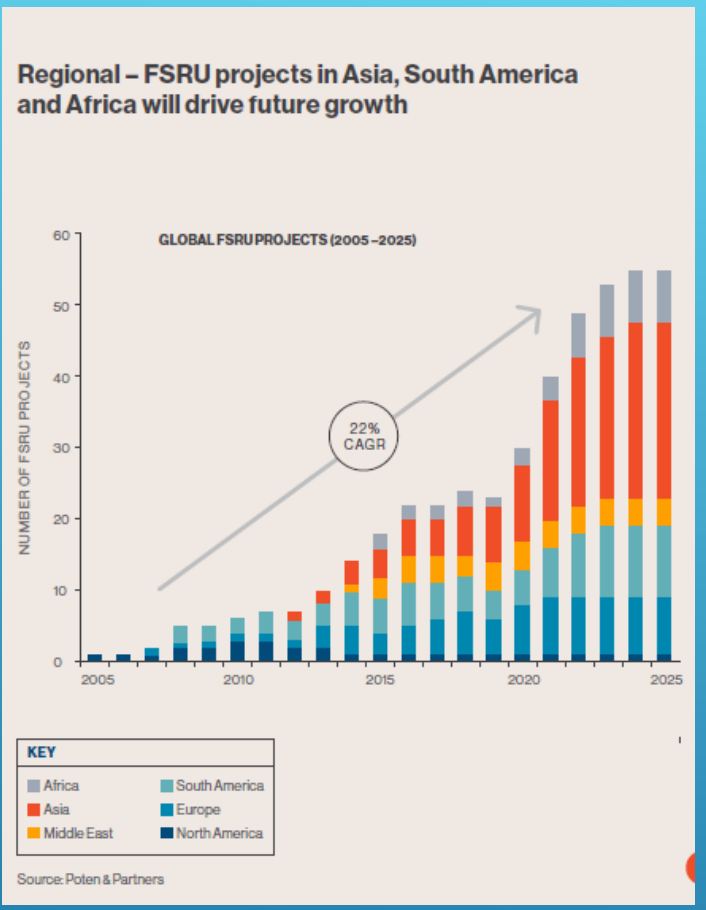


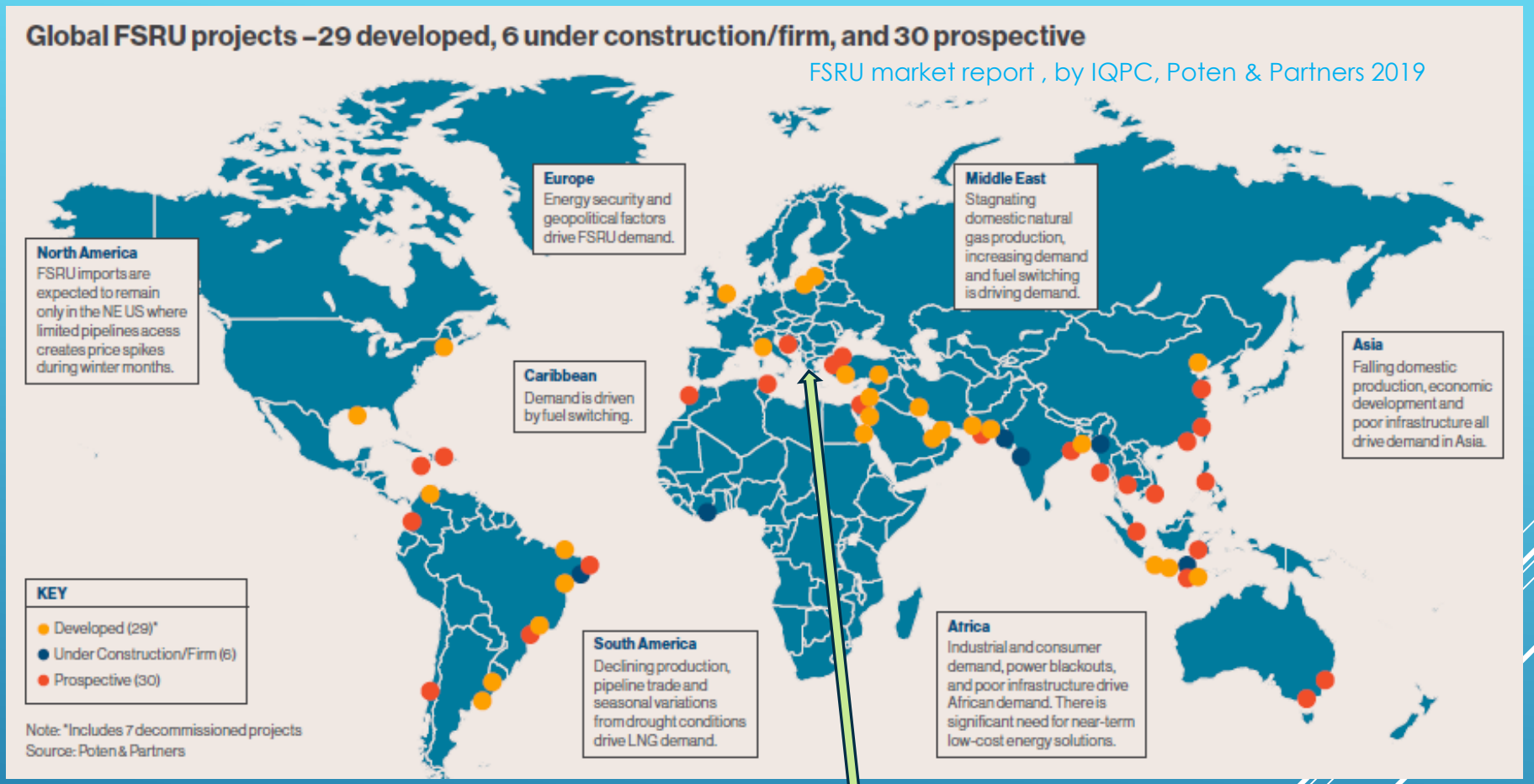


- The LNG import had a had a dip around 2013, 14 with mostly long term contracts, recently the share of short term contract was on the increase again,
- In last 10 years LNG regas capacity increased in France, Spain, UK, and Netherlands, most Western European countries have significant Regas capacity.
- The share of available capacity (40 to 60%) is largest in Spain, Italy and Lithuania
- Northern Europe has been growing most in Regas terminals last 10 years



REGAS CAPACITY AND UTILISATION IN EUROPE





- Most of the FSRU growth will be in Asia, South America and Africa until 2025
- Energy security are important factors to determine LNG import growth in Europe.
- (source: FSRU market report , by Poten & Partners 2019).

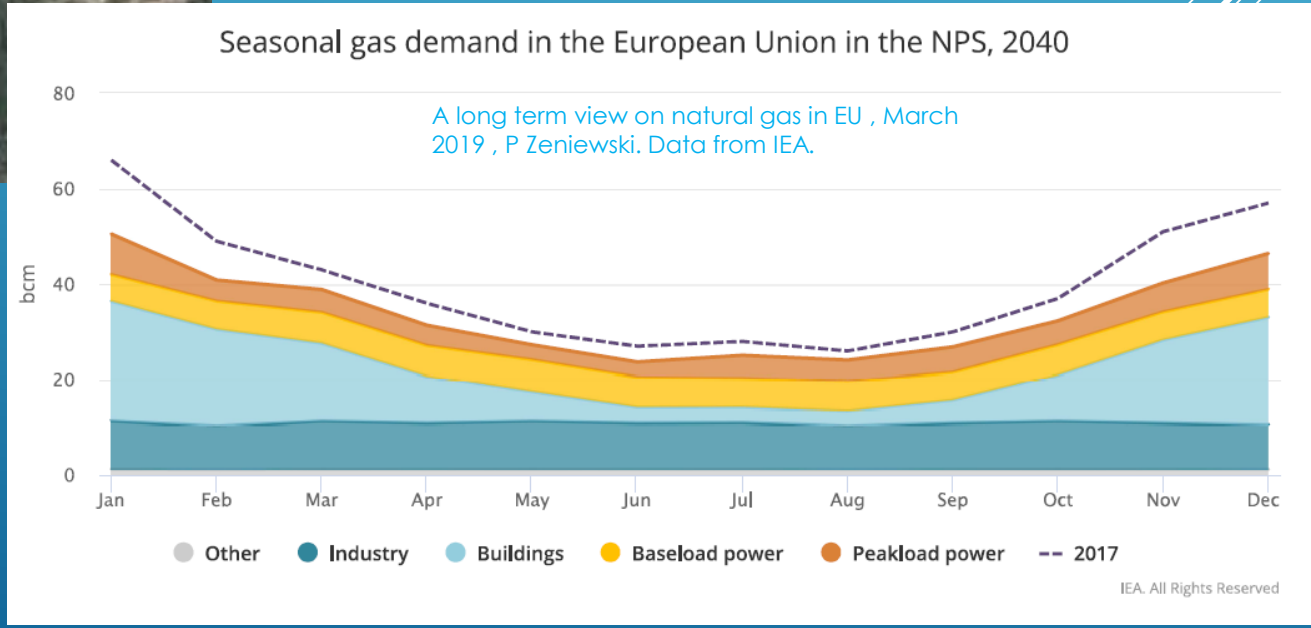
Most recent FSRU projects in Turkey and Italy, Croatia, Cyprus and Greece,

FSRU MARKET

Project developers of the Croatian FSRU facility, Island of Krk, LNG Hrvatska have issued Golar LNG with a notice to proceed with the conversion and subsequent purchase of 2005-built LNG carrier Golar Viking. Picture LNG Croatia.

NEPTUNE ENERGY

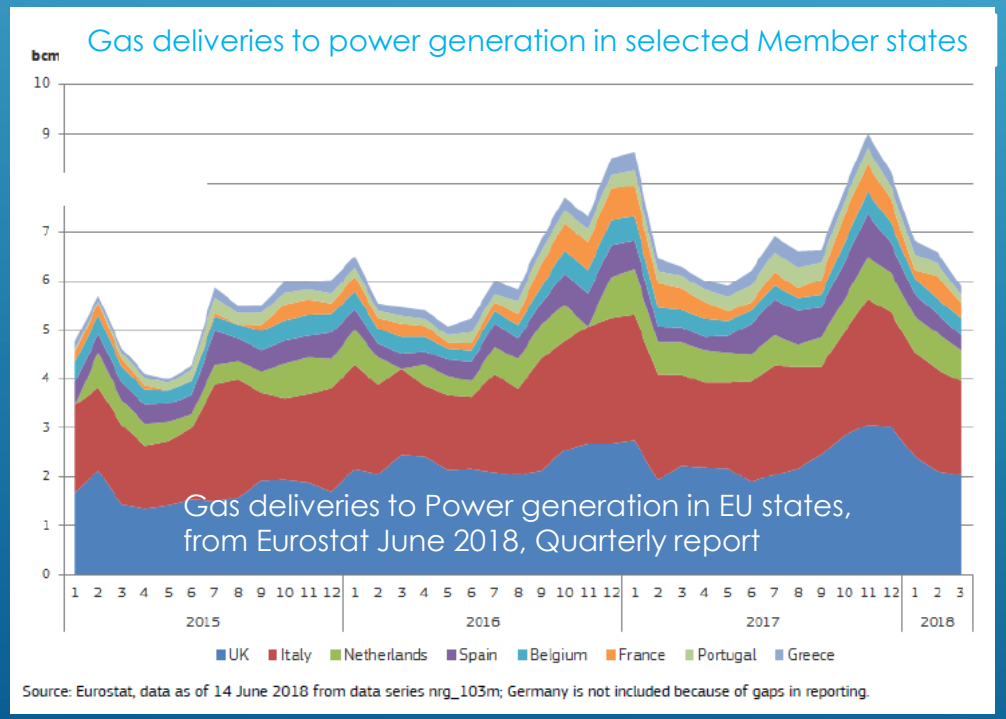
SEASONALITY OF DEMAND AND CRITICALITY OF STORAGE AND LNG IMPORTS FOR ENERGY SECURITY



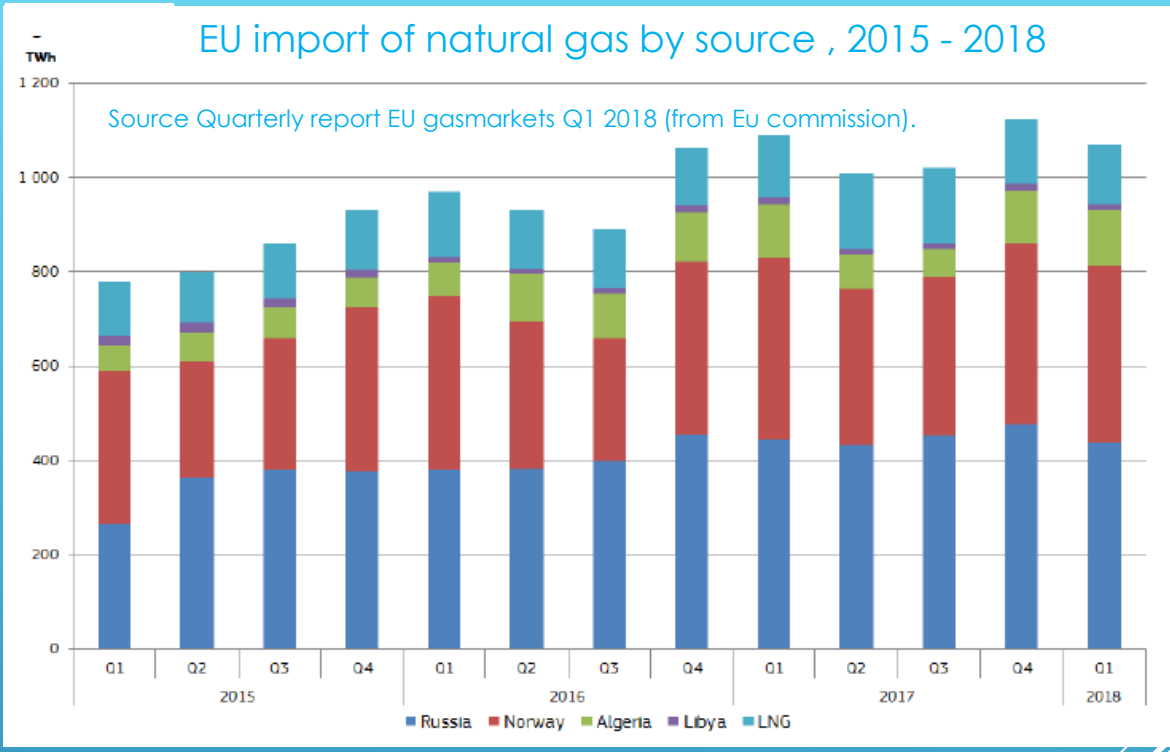
SEASONALITY GAS DEMAND AND PRICES

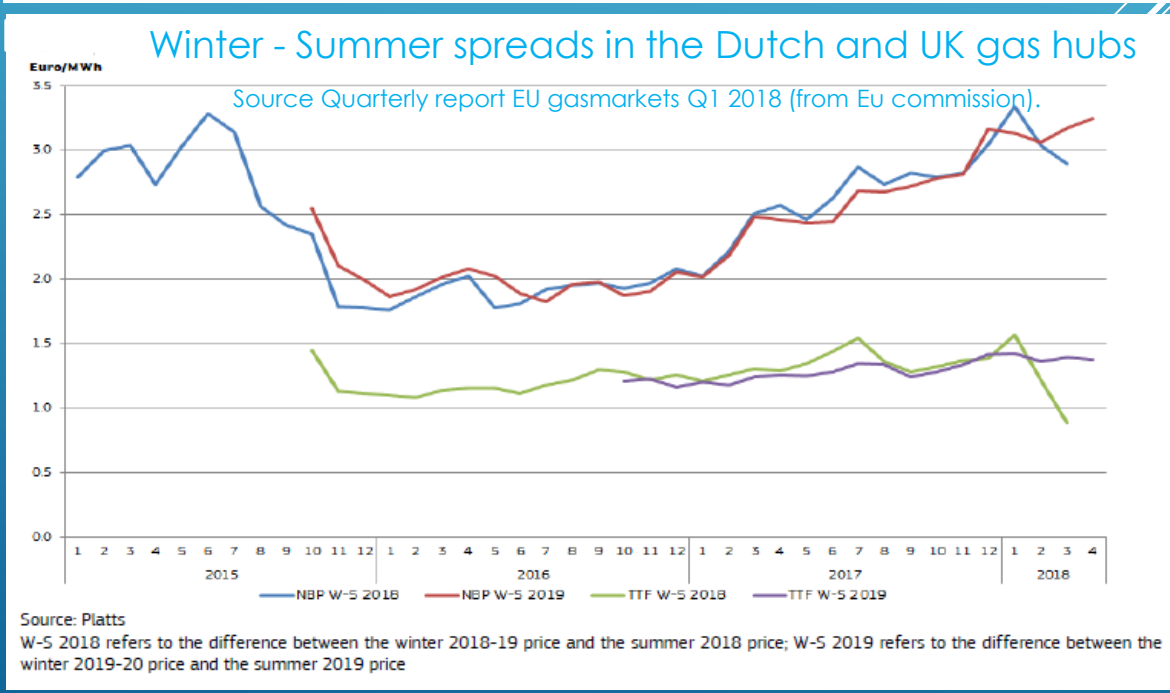
Note that imports in LNG were higher in summer than in winter of 2017/ 18, due to Asian demand

- LNG Imports represent approx. 12 to 16% of EU gas imports
- In UK increase in seasonal spread is seen, due to oversupply in summer, and tight market in winter.
- In winter a peak gas supply to power generation is experienced, due to periods with low wind. The tight market in winter offers opportunities for Gas & LNG import, (LNG could be counter-seasonal due to Asian prices)



Source: Eurostat, data as of 14 June 2018 from data series nrg_103m; Germany is not included because of gaps in reporting.



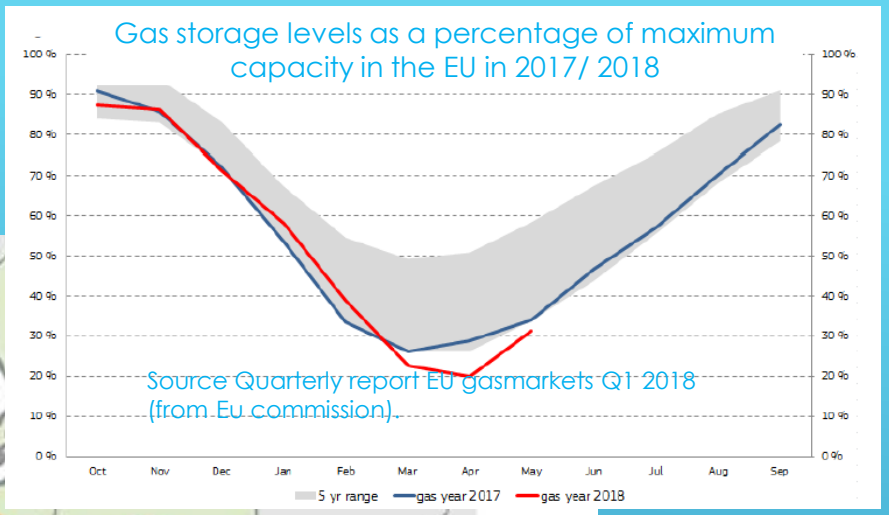


Source: Platts

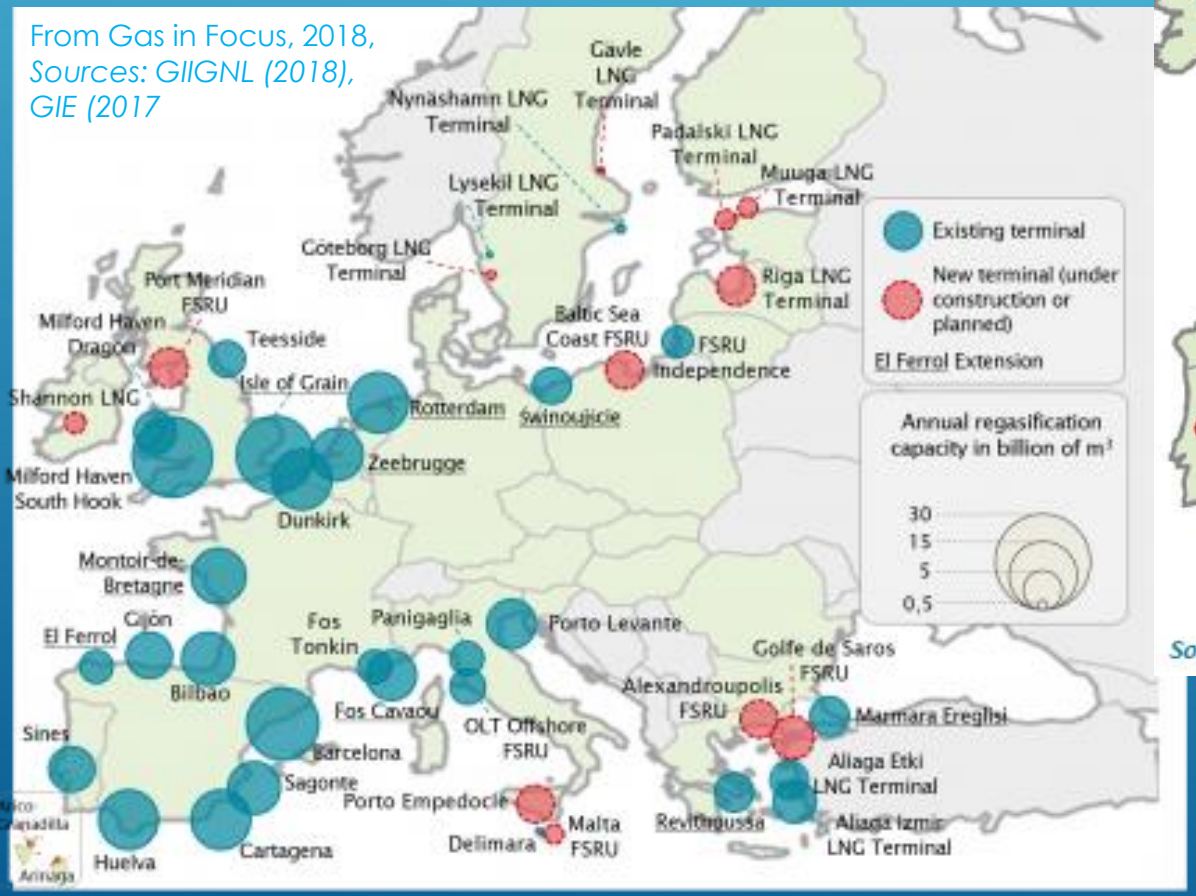
W-S 2018 refers to the difference between the winter 2018-19 price and the summer 2018 price; W-S 2019 refers to the difference between the winter 2019-20 price and the summer 2019 price

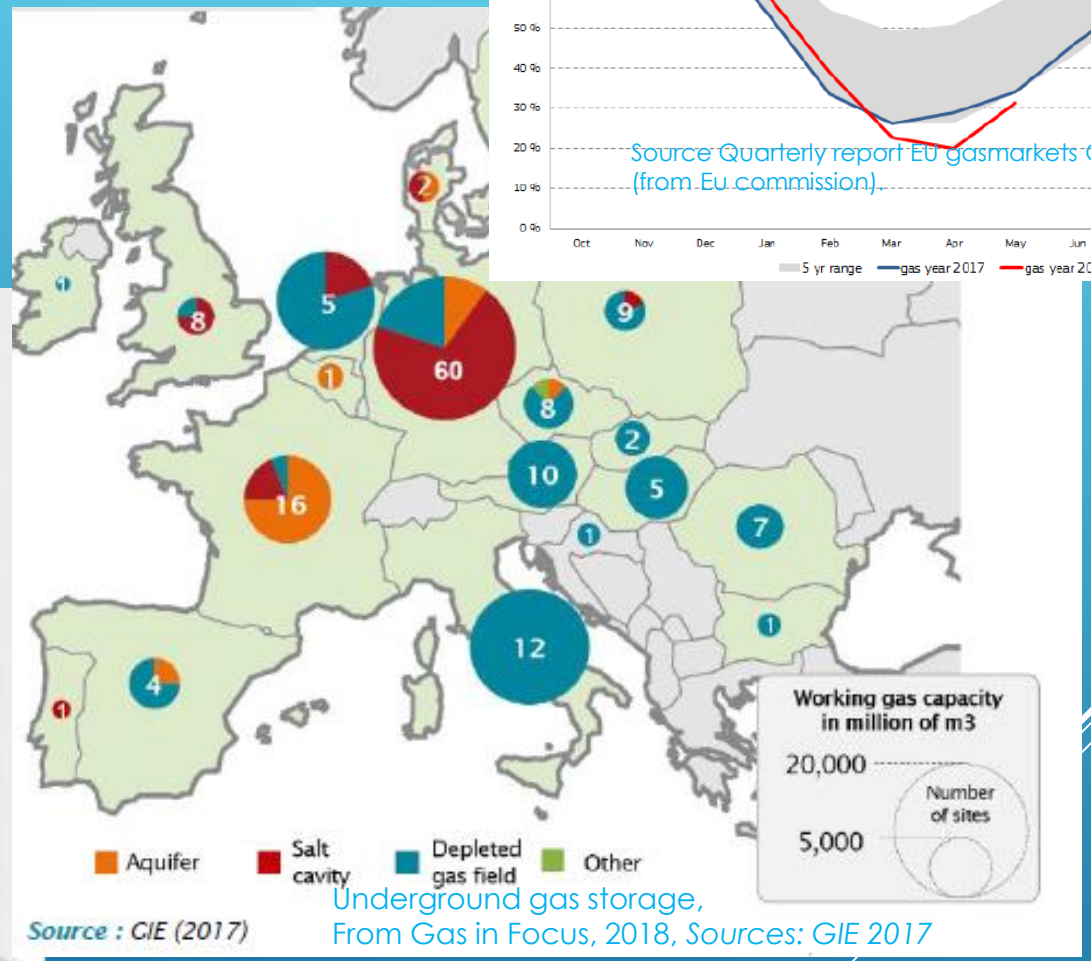
THE CASE FOR LNG AND GAS STORAGE AS A BACKUP SOURCE, LNG AND UG GAS COMPARE IN PURPOSE BUT DIFFERENT PRICE AND AVAILABILITY

- Germany, Netherlands, France, Italy have significant underground storage, while Spain and UK are more dependent on LNG terminals for short term interruptions.
- Gas storage drops in spring to 20 to 40% of the capacity.



From Gas in Focus, 2018, *Sources: GIIGNL (2018), GIE (2017*



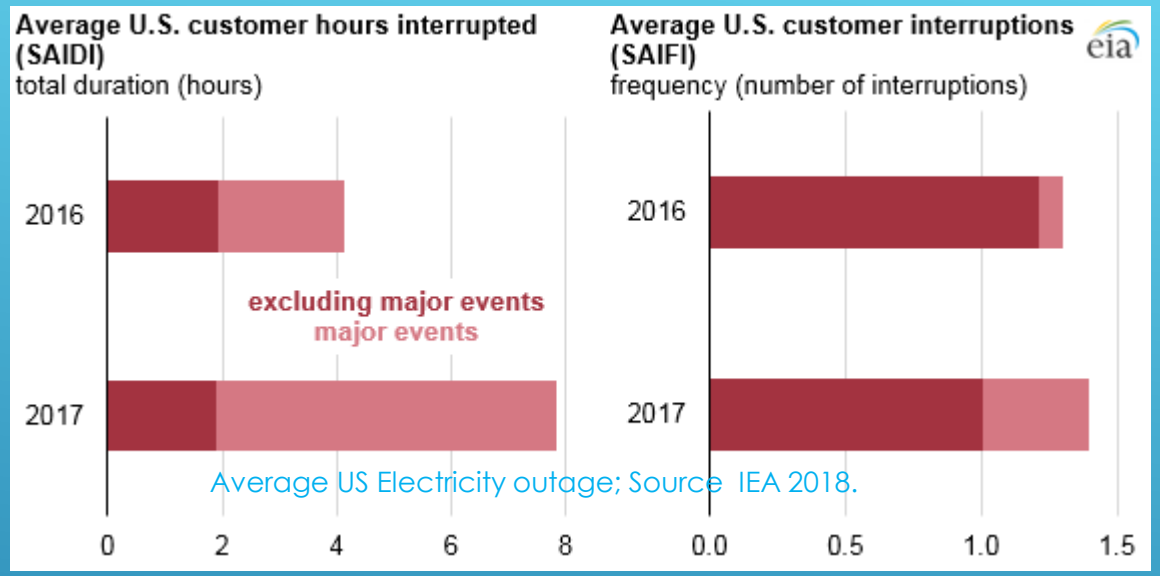


Source : GIE (2017)

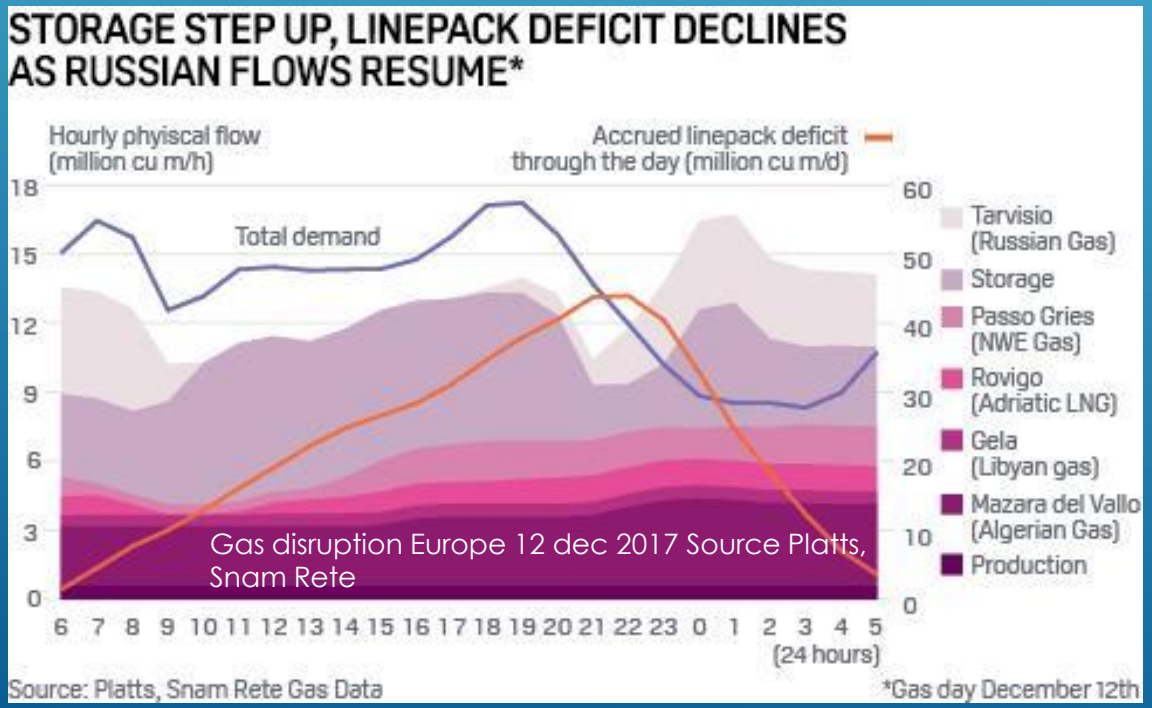
Underground gas storage, From Gas in Focus, 2018, *Sources: GIE 2017*

- LNG terminals Existing and new under construction & LNG fuelled ships
- Spain, UK, Belgium, Italy and Greece have significant LNG Regas terminal capacity

DEPENDENCY ON GAS IMPORTS & DISRUPTIONS

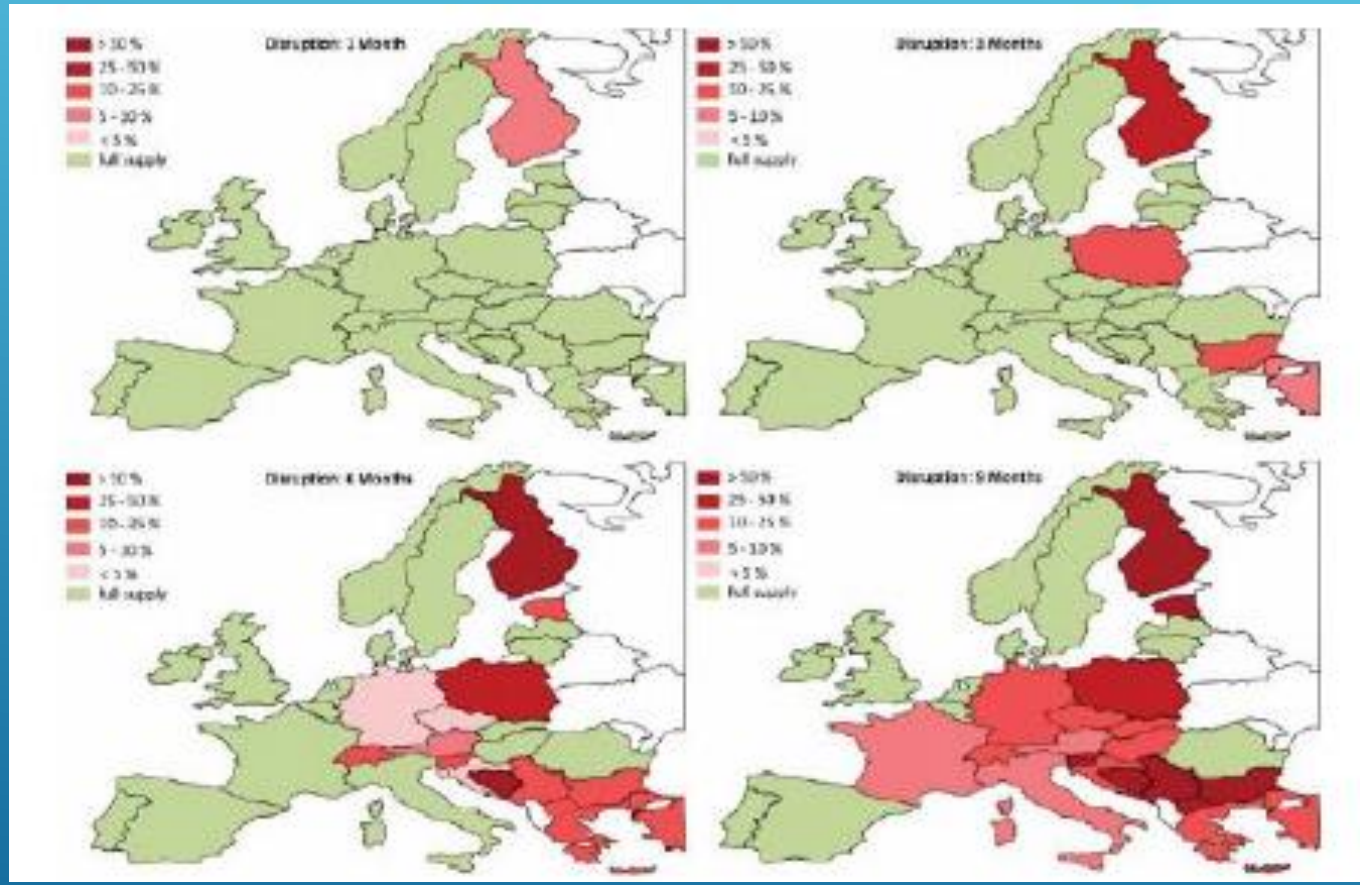


Average US Electricity outage; Source IEA 2018.



Gas disruption Europe 12 dec 2017 Source Platts, Snam Rete

- "Ukrainian crisis underscored the importance for the EU to diversify its energy sources". Dependency on gas import , supply disruption scenarios lasting 1,3, 6,9 months; (Refer gas disruption in 2009)
- <u>This shows criticality of gas and LNG storage as a back up.</u>



Source Mico 2014, "EU seeks alternatives to Russian Gas, University of Cologne report LNG Regas terminals S. Quirijns 2015.

The 8,000 dwt E-Class Thun Evolve has been built at the Dutch Ferus Smit shipyard for Thun Tankers and is capable of running on LNG and biogas as fuel.

Dutch dredging specialist Van Oord said its LNG-powered vessel Werkendam started work on its first project. The world's first LNG-powered crane vessel is carrying out maintenance work in the port of Rotterdam, Van Oord said in a statement.

Example A consortium named Bio-LNG EuroNet, comprising Shell, Disa, Scania, Osomo and Iveco has been formed to support LNG as fuel, with a goal of 2000 more LNG trucks and 39 LNG filling stations, and construction of a 3000 tpy BIOLNG production plant.

THE POTENTIAL OF SMALL SCALE LNG AND GROWTH OF LNG IN TRANSPORT

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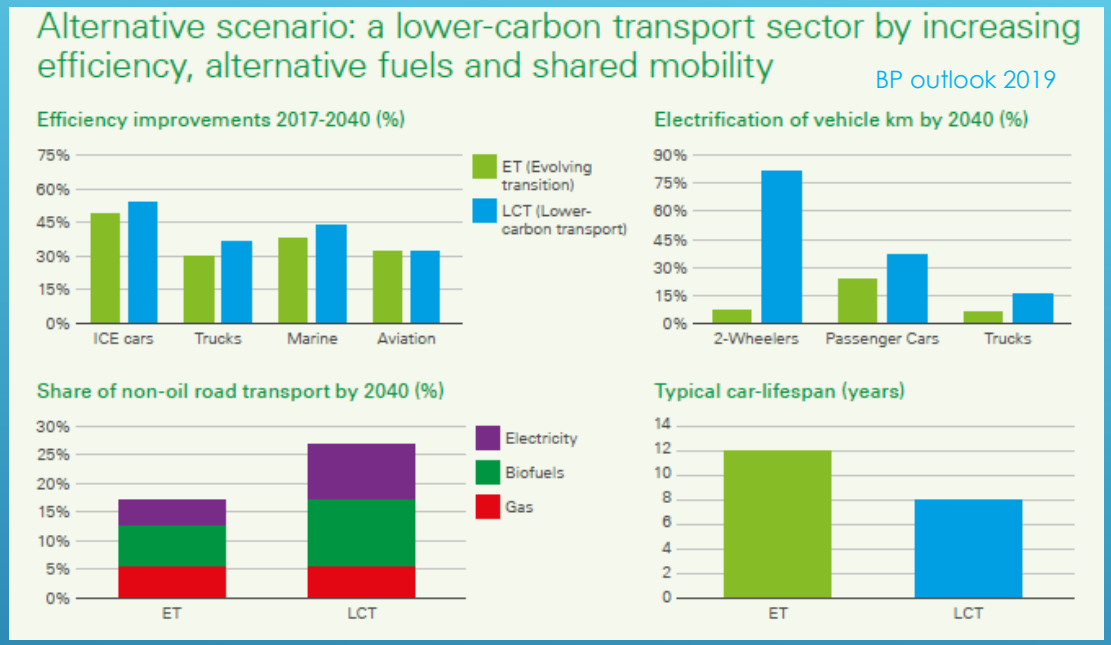
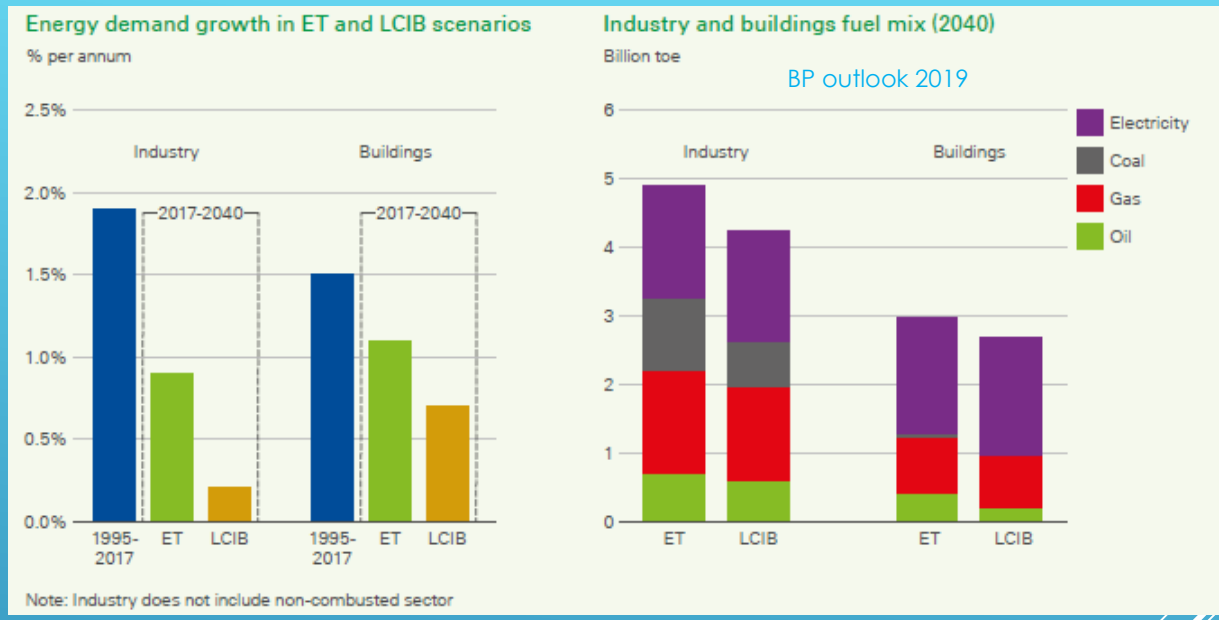
THE CASE FOR LNG AS A FUEL / SMALL SCALE LNG OPPORTUNITIES

While moving towards lower emissions, % of electric trucks, will be limited and LNG could be needed for heavy transport & shipping





LNG shows a huge step in lowering of emissions incl PM.

Emission (IMO)	HFO	MDO	LNG
SOx	0.049	0.003	trace
CO2	3.114	3.206	2.750
CH4	trace	trace	0.051
NOx	0.093	0.087	0.008
Particulate matter	0.007	0.001	trace

Electric cars and bio-fuels present a reduction in GHG emission of 30 to 70% compared to diesel cars

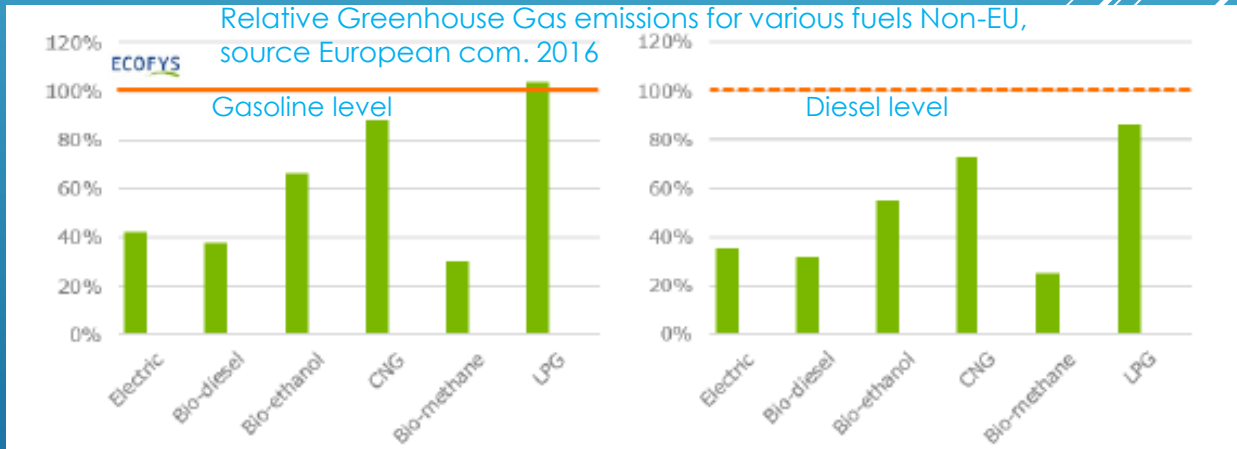
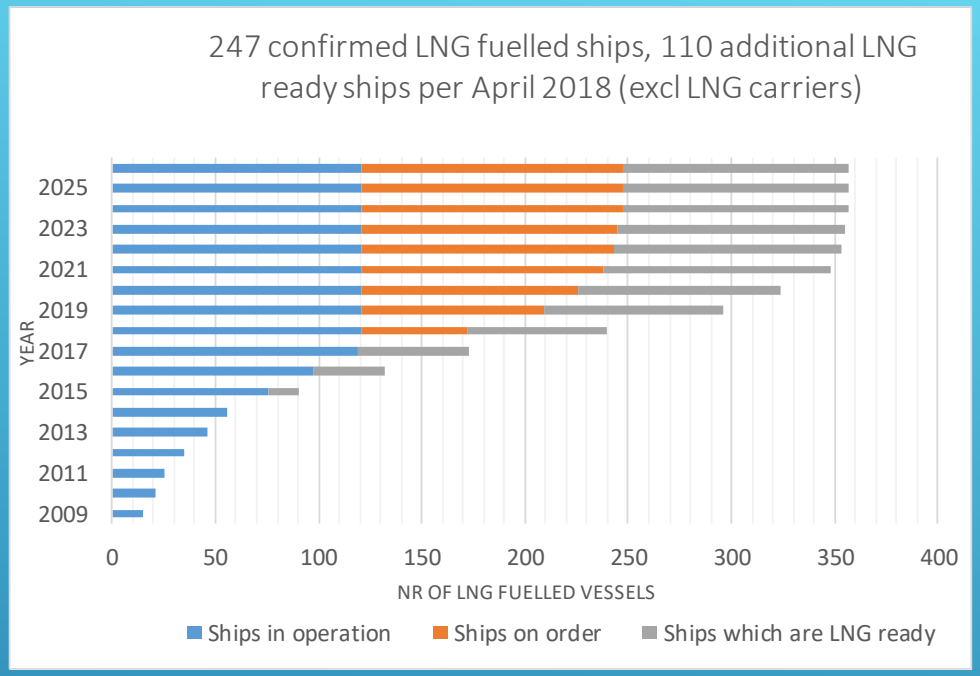


Figure 1: Well to Wheel greenhouse gas emissions for different fuel types for passenger cars relative to diesel (left) and gasoline (right), using current average emission factors (source: www.fuelswitch.nl compiled from many sources from 2002-2011)

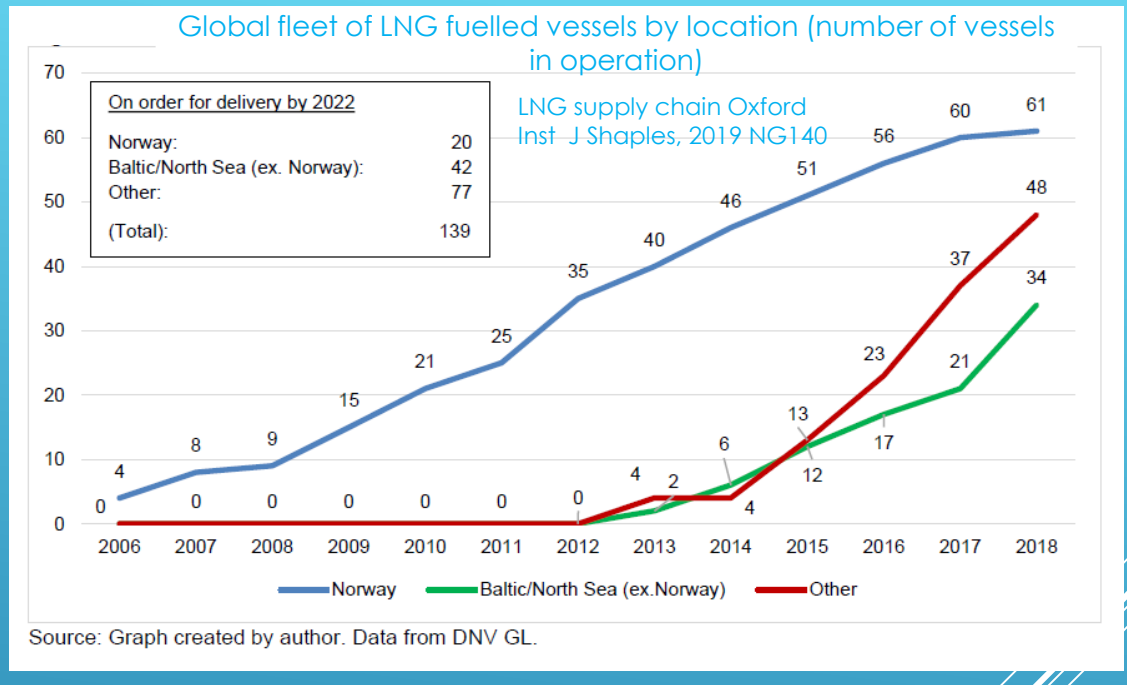
The case for LNG as fuel : From Oxford inst A review of demand prospects June 2018, C.N. le Fevre

FUNCTION OF SMALL/ MEDIUM SCALE LNG AS FUEL
THE POTENTIAL OF LNG IN TRANSPORT

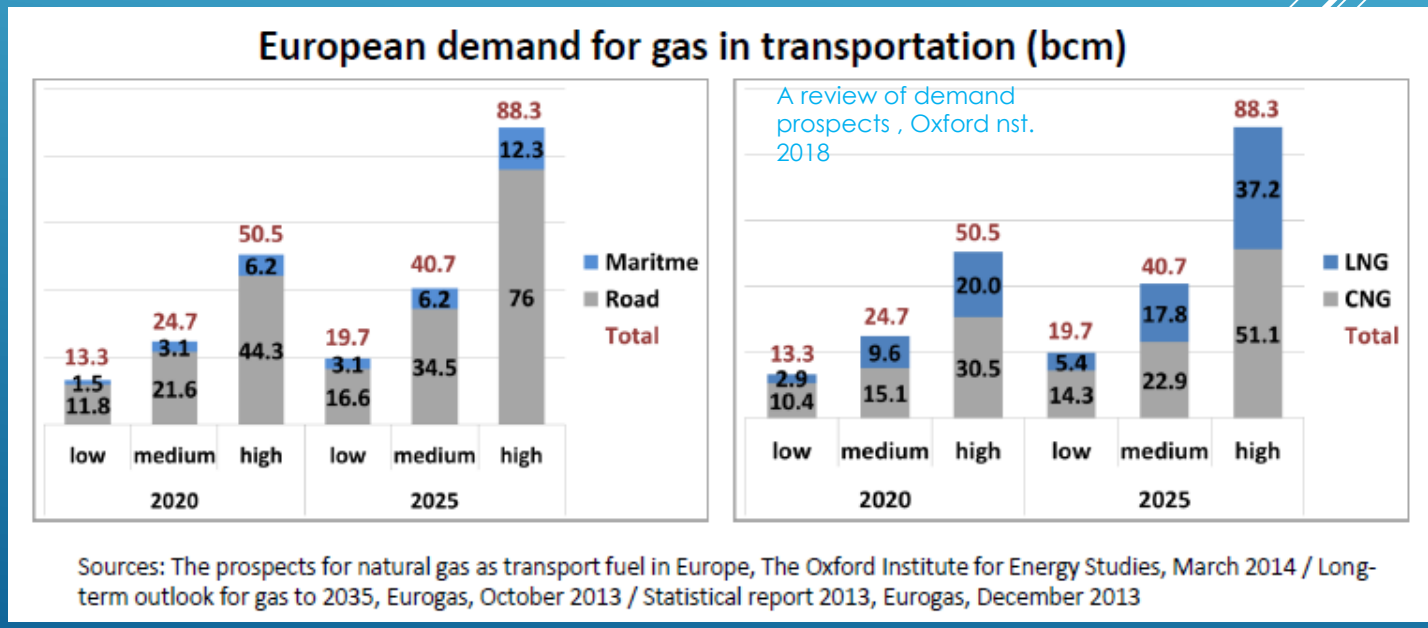


DNV Ole Nilsen, LNG regulatory

- Growth in LNG fuelled ships, Norway leading the way, and rest of Europe increase 25 to 50% annually
- Maritime takes about 12% of LNG as fuel, road transport 88%.
- Gas in transport is expected to increase 60% in next 5 years, with LNG representing 40% of gas in transport.



Source: Graph created by author. Data from DNV GL.



Sources: The prospects for natural gas as transport fuel in Europe, The Oxford Institute for Energy Studies, March 2014 / Long-term outlook for gas to 2035, Eurogas, October 2013 / Statistical report 2013, Eurogas, December 2013

CONCLUSIONS FOR FLOATING AND FIXED LNG IMPORT FACILITIES IN EU

- Even if EU-Target growth in renewables of 27% could be achievable, the gas share will still be approx. 20 to 25% in 2030.
- With tightness in Gas/ LNG demand in winter and high uptime of terminals in some EU countries the potential for new LNG terminals and FSRU for new LNG import is good, while Asian market has impact on EU prices.
- LNG in transport is growing on a global level, with Europe in a leading role, LNG is a valid alternative for Trucks and Shipping, due to its energy density. (Electricity is not yet playing a role)
- LNG as fuel is making its way in various sectors (shipping, Trucks, Power) in progressive manner, supporting the market.
- Mid-scale and Small (F)LNG terminals along with gas storage have an important function for energy security in EU (back-up in emergency or seasonal effects and FSRU are suitable for short term solutions less than 10 years (ref. Enagas)