

Perspectives for this decade's exhaust gas legislation; LNG as a "one-stop" compliance option

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Key driver - stricter environmental requirements

Existing fleets

Requirement

2010: SOx < 1,0% (ECA)
2015: SOx < 0,1% (ECA)
2020: SOx < 0,5% (global)

Compliance tech.

- HFO + scrubber
- Distillate fuels
- LNG, other fuels(?)

Newbuilds

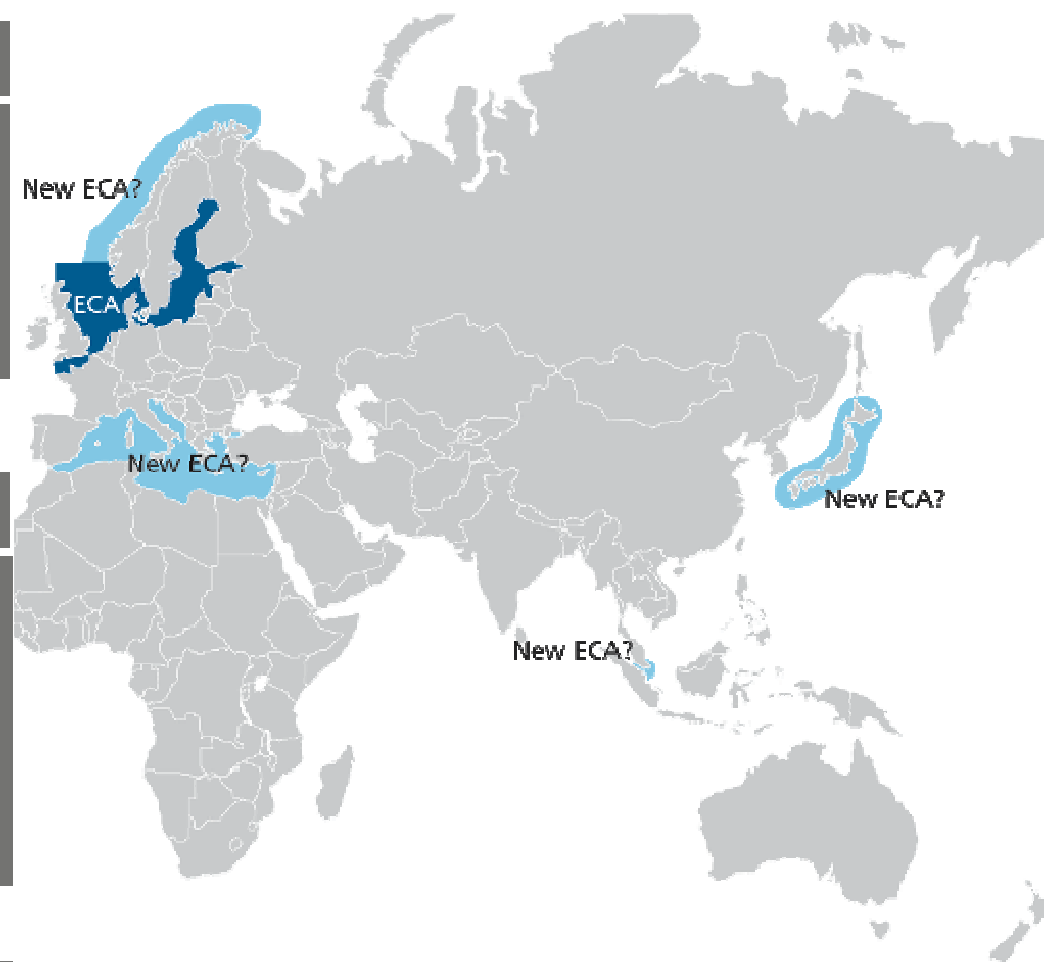
Requirement

2011: NOx Tier 2 (global)
2016: NOx Tier 3 (ECA)

Compliance tech.

- Tuning, SCR, HAM, water emulsion, EGR, LNG, other fuels(?)

CO2 regulations on the way



Key driver – shrinking crude reserves, increasing prices



The “full” list of future fuel alternatives

- Heavy Fuel Oil (with exhaust cleaning)
- Distillate fuel oils
- LNG
- CNG
- LPG
- GTL (incl methanol)
- Biofuels / biogas and alcohols
- Hydrogen (as energy carrier)
- Batteries (as energy carrier)
- Nuclear



Our (safe?) bet is that
hydrocarbons will dominate
the future mix

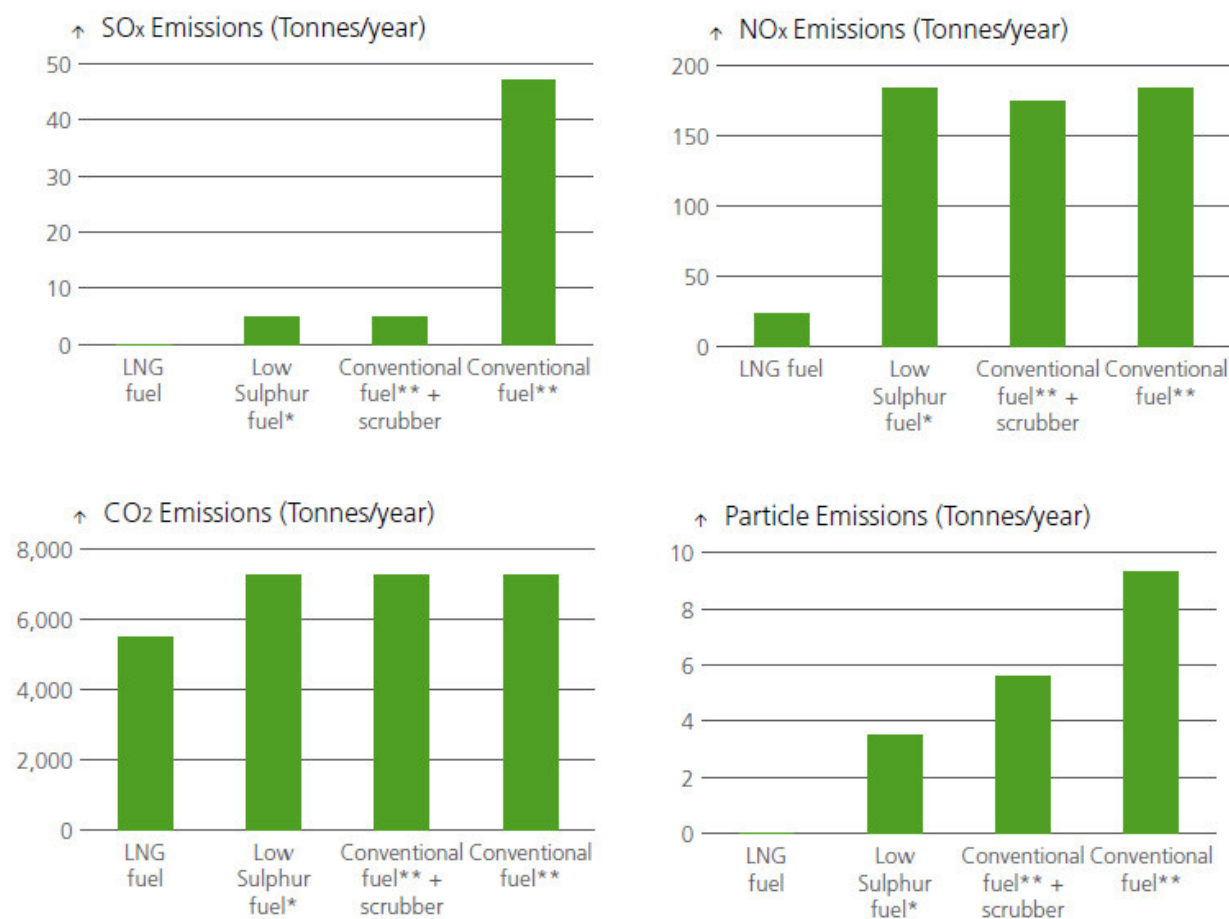
**We believe it boils down to
oil and natural gas**

LNG environmental performance

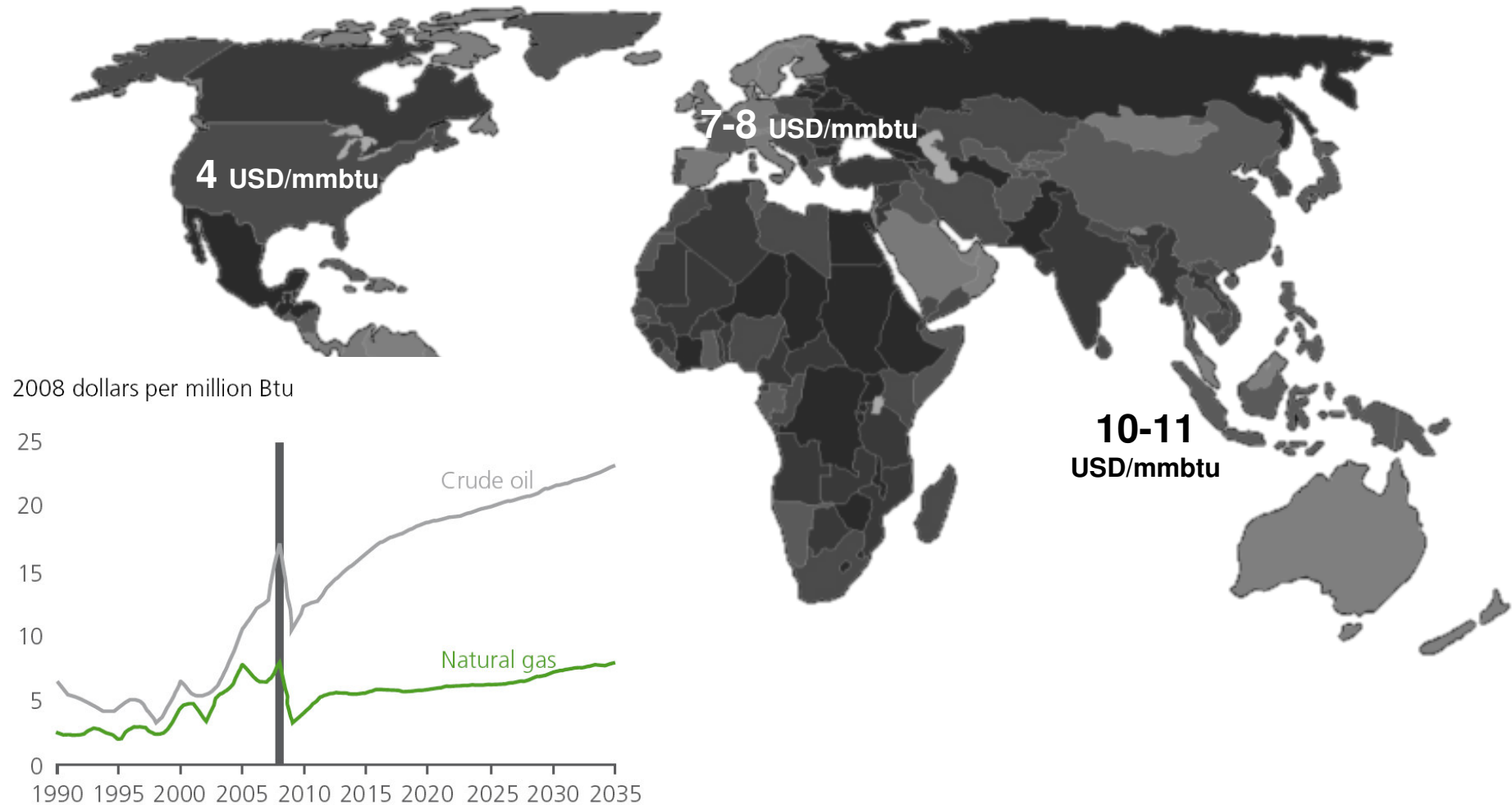
But what about methane slip???

In short; a real issue, but effective improvements are being made

Environmental emissions for alternative concepts for a typical baltic sea cargo ship



LNG can be great from an economic perspective – but price differential is crucial



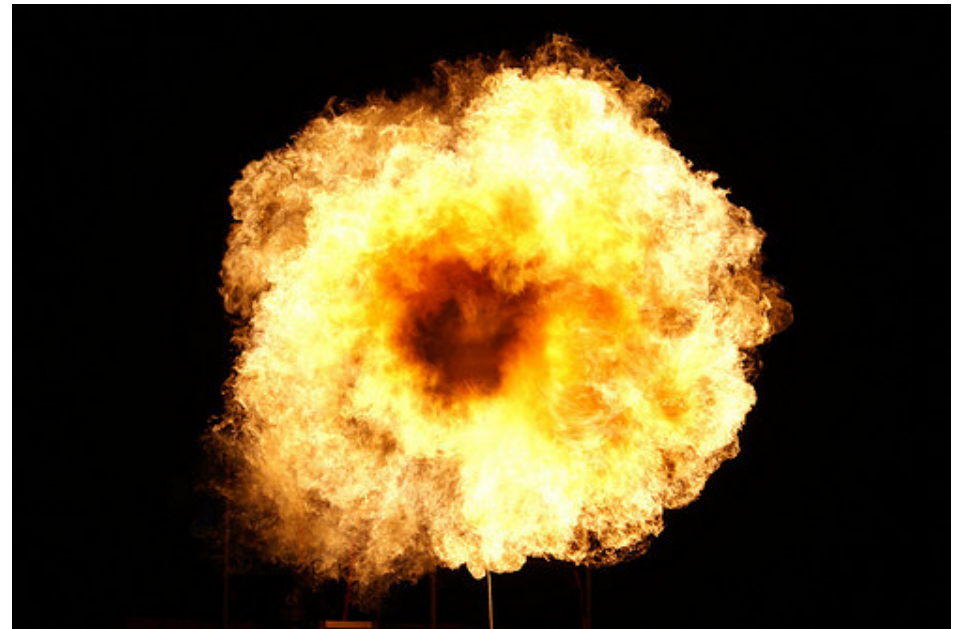
Ref. U.S. Energy Information Administration (EIA)

LNG is safe

- Two main areas of difference from other fuels:
 - Cryogenic effects
 - Forms gas clouds

- LNG has a strong track record
 - No significant incidents with ships
 - Very few incidents on land

- ***But, this performance is due to:***
 - ***Stricter requirements***
 - ***Good safety behaviour***



LNG is a real option for ship propulsion

Ships in operation

Year	Type of vessel	Owner	Class
2000	Car/passenger ferry	Fjord1	DNV
2003	PSV	Simon Møkster	DNV
2003	PSV	Eidesvik	DNV
2006	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2008	PSV	Eidesvik Shipping	DNV
2009	PSV	Eidesvik Shipping	DNV
2009	Car/passenger ferry	Tide Sjø AS	DNV
2009	Car/passenger ferry	Tide Sjø AS	DNV
2009	Car/passenger ferry	Tide Sjø AS	DNV
2009	Patrol vessel	REM	DNV
2009	Car/passenger ferry	Fjord1	DNV
2010	Patrol vessel	REM	DNV
2010	Car/passenger ferry	Fjord1	DNV
2010	Tug	Wuhan Ferry Company	
2010	Patrol vessel	REM	DNV
2010	Car/passenger ferry	Fjord1	DNV
2010	Car/passenger ferry	Fjord1	DNV
2010	Car/passenger ferry	Fosen Namsos Sjø	DNV

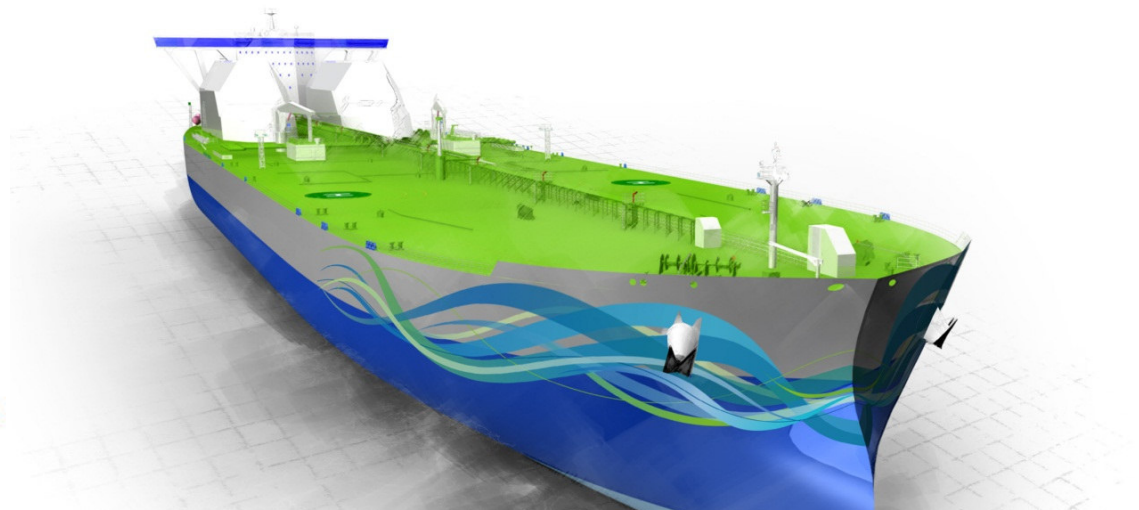
Confirmed orderbook

Year	Type of vessel	Owner	Class
2011	PSV	DOF ASA	DNV
2011	Ro-Ro	Sea-Cargo AS	DNV
2011	Ro-Ro	Sea-Cargo AS	DNV
2011	Car/passenger ferry	Fjord1	DNV
2011	PSV	Solstad Rederi AS	DNV
2011	General Cargo	Nordnorsk Shipping AS	DNV
2012	PSV	Olympic Shipping	DNV
2012	PSV	Eidesvik	DNV
2012	PSV	Eidesvik	DNV
2012	High speed RoPax		DNV
2012	PSV	Island Offshore	DNV
2012	PSV	Island Offshore	DNV
2013	Car/passenger ferry	Torghatten Nord	DNV
2013	Car/passenger ferry	Torghatten Nord	DNV
2013	Car/passenger ferry	Torghatten Nord	DNV
2013	Car/passenger ferry	Torghatten Nord	DNV
2013	RoPax	Viking Line	

Planned conversion

Year	Type of vessel	Owner	Class
2011	Car/passenger ferry	Fjord1	DNV
2011	Chemical tanker	Tarbit Shipping AB	GL

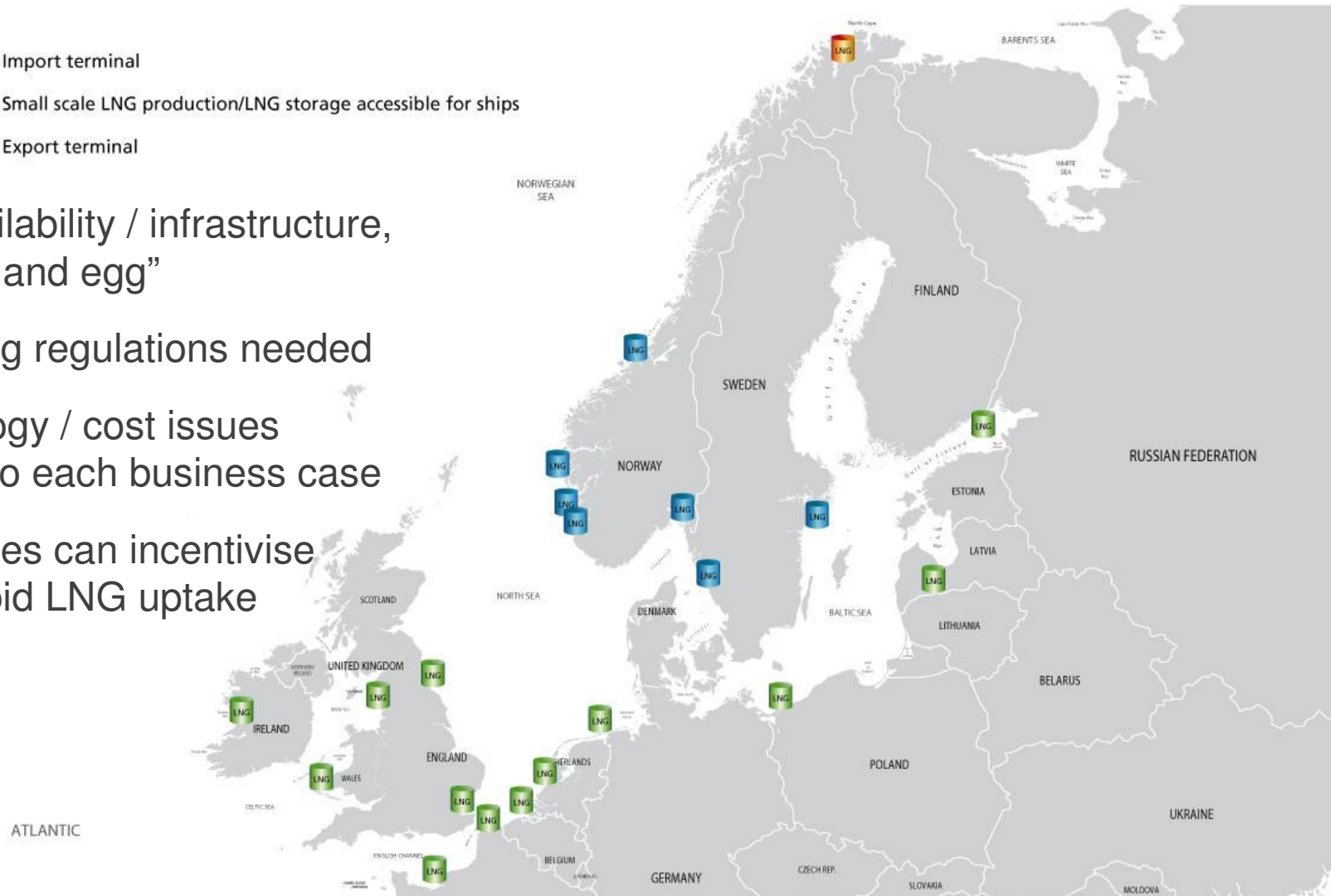
LNG - more than just small scale...



So why is LNG for ships developing so slowly?



- Fuel availability / infrastructure, “chicken and egg”
- Bunkering regulations needed
- Technology / cost issues specific to each business case
- Authorities can incentivise more rapid LNG uptake



Key take-aways

- LNG can ensure “one-stop” regulatory compliance
- Each business case is different – but LNG makes sense for a lot of them
- Bunkering regulations needed - but industry is now developing practices and standards
- Authority support and incentives required to incubate LNG growth – but we are seeing movement
- And finally; LNG is safe - ***because*** we are dealing with the risks!



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