

LNG as a ship fuel- A comparative analysis of the Netherlands and eastern Baltic



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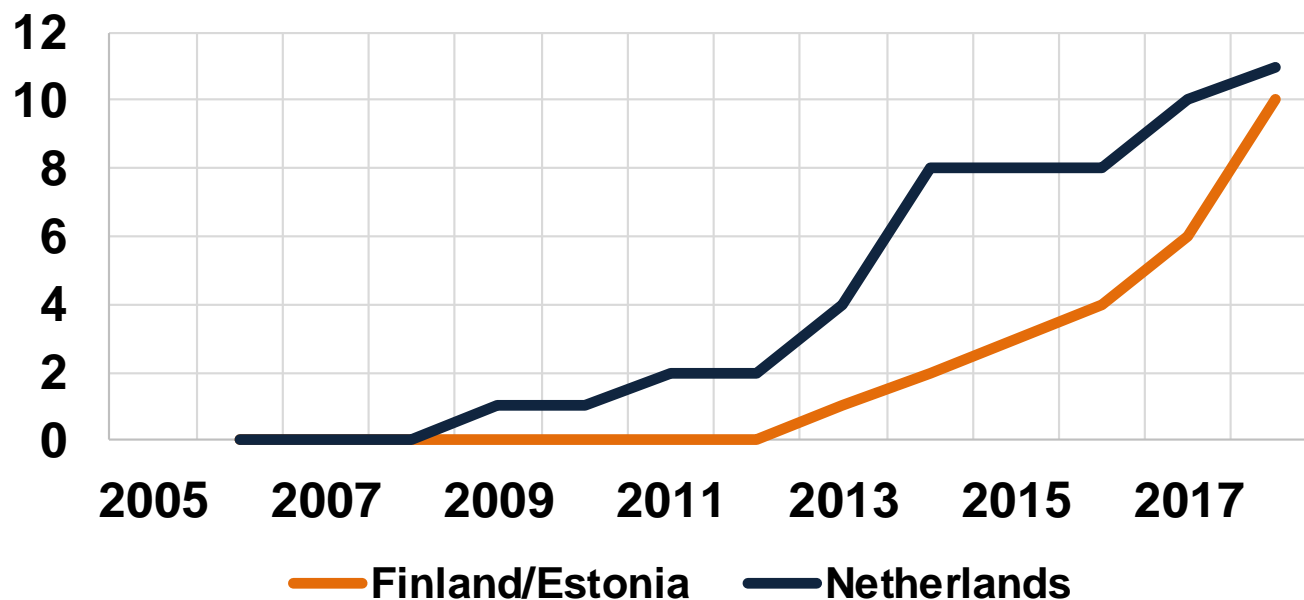


LNG as a marine fuel

- Used in LNG carrier industry for decades (as BOG)
- In 2000, 'Glutra' ferry constructed, first non-LNG carrying vessels to use LNG as a fuel – Norway
- 2000s- LNG spread in coastal ferries, PSVs, dredges and other niches in Norway – supported by Norwegian NOx fund
- Late 2000s- LNG spread to other Scandinavian and North Sea countries – supported by high oil prices, ECA areas and EU funding
- 2010s- economic crisis and fall in oil price contributed to slower than expected spread of LNG – however still growing

Small, but growing LNG fuelled fleets...

Total flagged LNG ships*



- Same overall number
- Finland/Estonia variety of niches: ro-pax ferries, coast guard vessel, containerships, ice-breaker, etc.
- Netherlands: LNG bunkering/feeders, LPG tankers

*Excludes conventional LNG carriers, own research, based on documentary research

LNG in Netherlands and eastern Baltic

SIMILARITIES

- Background in 1990s
- First developments/vessels in late 2000s
- Coincides with LNG terminal construction
- Developed for niche applications

DIFFERENCES

- Different vessels use it
- Finland shows more diversity in applications
- Finland has domestic engine producer
- Netherlands has inland shipping
- Netherlands has strong international port

The research aim

Role of ‘technology advocates’ (Kern et al, 2014) in development of ‘protective spaces’ for marine LNG developments in the Netherlands and Estonia/Finland.

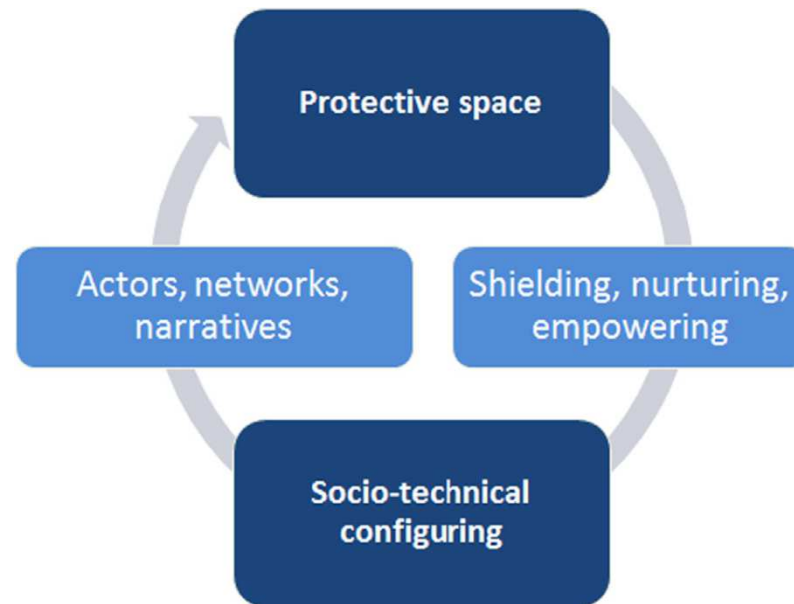
The aim of the research is to answer:

1. How did the creation and evolution of ‘protective spaces’ for marine LNG differ between Netherlands and Finland/Estonia?
2. How did these ‘protective spaces’ contribute to the observed difference in development of marine LNG between the Netherlands and Finland/Estonia?



Analytical Framework

- Sustainability transitions literature (Rip and Kemp, 1998; Geels, 2002; Smith et al., 2010)
- New innovations develop within niches or ‘protective spaces’ shielded from wider selective pressures (Kemp et al, 1998)



*Kern et al (2014)

Smith and Raven (2012), 'protective space dynamics', creation and development of niches requires:

1. **Shielding**- processes that 'hold at bay' selection pressures from mainstream selection environments (regulations, funding opportunities, niche customers), 'active' vs 'passive' shielding

2. **Nurturing**- development and assistance in learning processes, articulation of expectations (robust, high quality), building of complex networks (broad membership, substantial resources), higher order learning (change in conceptual frameworks)

3. **Empowering**-niche actors mobilise resources in the wider world for the purposes of building and expanding the niche, competitive under existing market rules (i.e. selective environment) ('fit and conform') or where selection environment is modified to better accommodate the new niche ('stretch and transform').



Methods

- Comparative case study approach between two regions
- Empirical approach developed by Kern et al (2014) to study offshore wind in UK:
 1. Analysis of relevant LNG literature (Lloyds list, Annual Reports, regulatory documentation, white papers, Motorship, news).
 2. 11 in-depth semi-structure interviews with relevant LNG stakeholders in Netherlands, Estonia and Finland- transcribed, coded and analysed.
 3. 'Process tracing' method used to outline main causal mechanisms relevant to research questions (Geroge and Bennet, 2005).

A short history of LNG as a marine fuel in Netherlands

1990s-2000s: Increased prominence of environmental issues and changing energy landscape

- 1988, the Dutch parliament adopted the National Environmental Policy Plan (NEPP) (NEPP, 1988)
- 1987, at the North Sea Ministers Conference, agreed at a 50% reduction of emissions of nitrogen and phosphorus compared to 1985
- 1990s-2000s Fleet modernization of Dutch shipping
- 1997- Creation of 'Dutch Maritime Network' – higher concentration of industry around maritime clusters and sub-clusters

2000s-2010s: LNG import terminal opens and first movers use it in shipping

- 2005- MARPOL Annex 6- enters into force in 2005
- 2005- Decision to build Rotterdam GATE LNG import terminal
- 2008 Neste Oil and Port of Rotterdam start construction of biofuels plant , with sea jetty with option of future production of bioLNG
- 2008- Anthony Veder completed Coral Methane for Gasnor, obtaining innovation award from KVNR
- 2009- Decision by Deen Shipping to build vessel operating on LNG

2010s-PRESENT: Building of small scale bunkering and spread to inland shipping

- 2011- GATE Terminal in Port of Rotterdam completed
- 2012- 'Coral Energy' first DF direct driven LNG carrier
- 2013- Shell funds first LNG inland barge 'Greenstream'
- 2012-2015- GATE Terminal transformed into LNG bunkering 'hub'. EUR 46 million LNG break bulk facility
- 2014- Establishment of Dutch National LNG Platform (linked to 'Rhine and Wadden Green Deal')
- 2017 Shell delivers Cardissa, LNG bunkering vessel to Rotterdam
- 2017 'Coralius' LNG bunker/feeder delivered to Skangas

A short history of LNG as a marine fuel in Finland/Estonia

1990s-2000s: Development of domestic DF engines

- 1990-2002 Wartsila continues developing its first dual-fuel DF engines (i.e., 20 DF, 46 DF, 50 DF)
- 1990s Finnish shipping crisis and lowering of freight rates
- 1990s Specialization of shipping to niches (ferries, wood)
- 1991-2005 Estonian shipping market liberalizes
- 1993-1997 HELCOM discussions over eutrophication of Baltic Sea and designation of Baltic Sea ECA

2000s-2010s: Marine LNG innovation hub grows further

- 2002- Finnish tonnage taxation Law
- 2003- Wartsila develops design and engines for Eidesvik PSV in Norway (chartered by Statoil)- first application of the 32DF engine
- 2003- DNV GL initiates FelloSHIP project with Eidesvik and Wartsila to develop fuel cell technology for 'Viking Lady', delivered in 2009 (promoted at COP19)
- 2006- LNG Carrier industry change to DF from BOG engines intensifies, first delivery of Wartsila 50DF engine to LNG Carrier
- 2006- Estonian Tallink acquires main competitor, Finnish SiljaLine
- 2008-2010 Concerns in Finland/Estonia about energy security

2010s-PRESENT: Marine LNG adaption grows and diversifies

- 2010- LNG production facility opens in Porvoo Finland, also produces LBG
- 2011- Wartsila completes first LNG conversion of chemical tanker 'Bit Viking' for Norwegian Tarbit Shipping – first project where Wartsila delivers entire fuel system
- 2011 'Make a difference' EU TEN-T EUR 2.5 million project awarded to Sweden-Estonia partnership for LNG bunkering
- 2013 'Viking Grace' delivered, first large scale passenger ferry to use LNG
- 2014 Twin Port 2 EUR 29 million project awarded to Helsinki-Tallinn, includes development of LNG bunkering expertise
- 2014 Finnish Gasum acquires 51% stake in Norwegian Skangas
- 2016 LNG import terminal in Pori Finland completed
- 2016-'Turva' completed for Finnish Coast Guard
- 2017- 'Megastar' delivered, 'Polaris' icebreaker completed

| | Main Actors | Main Networks | Main Regulations | Main funding | Inspirations /Narratives |
|------------------------|--|--|--|---|---|
| Netherlands | Port of Rotterdam Shell GATE Terminal | National LNG Plattform SGMF Informal Networks | National Bunkering Guidelines Inland Bunkering Guidelines | | bioLNG transition Norway |
| Finland/Estonia | Wartsilla Viking Line Skargas/Gasum Finnish Transport Agency Finnish Coast Guard | BPO Project Local knwoledge sharing Acquisition of companies | Noise regulations | Agentschap NL European Regional Development Fund | clean fuel better than scrubbers solution for short-sea |
| Both | Local Ship-Owners | Business relationships SEA LNG IMO | MARPOL Annex 6 - SECA, NECA EU Alternative Fuels Directive | EU TEN-T, CEF | deals with SOx,NOx |



Protective space dynamics

Shielding- Netherlands

- Anthony Veder – indirect shielding – Norwegian NOx fund, funding from Norwegian gas major Skangas and Gasnor (Shell)
- Agentschap NL (Dutch national funding for sustainable projects) and the European Regional Development Fund -‘Argonon’
- TEN-T and CEF funds – LNG Masterplan and EU Alternative Fuels Directive
- Port of Rotterdam - Environmental Ship Index, LNG Bunkering Incentive that

Shielding – Finland/Estonia

- NOx fund support for the development of some initial projects in Norway
- EU funding (TEN-T) – i.e. conversion and early projects – Bit Viking
- Direct funding by Finnish Government (Finnish Border Guard and Finnish Maritime Transport Agency) – Polaris and Turva
- CEF funding and environmental values (promotion) – Viking Line and Tallink

Nurturing - Netherlands

- No domestic engine manufacturers, difficult to mobilize local resources and government involvement in early years
- Learning from first movers (Deen Shipping, Anthony Veder) and through knowledge exchange with Norwegian actors
- Local natural gas knowledge base – North Sea gas production
- Dutch National LNG Network- knowledge exchange
- LNG Masterplan- EU project for LNG bunkering facilitated knowledge exchange
- COP21- Change in expectations of LNG, growth in LBG

Changing expectations of LNG

- LNG from 'alternative fuel' to 'transitional fuel', strongly felt in the Netherlands
- KVNR – 2014 Annual Report- only mentions GHGs in terms of opposition to unilateral EU MRV, 2015 Annual Report mentions 'regret' shipping not included in COP21
- Senior KVNR representative: *"LNG has an advantage depending on the methane slip discussion,I think the perception on LNG is slipping and now it is being looked at much more as a transitional fuel instead of the fuel of the future and I think back in 2010, LNG was the fuel of the future for shipping but it is not anymore now. I think that has changed completely due to COP21..."*
- Former Dutch Ministry of Transport representative: *"I think if you came now to ask for funds for LNG fuelled ships, and said it has these emission benefits, it would be hard to sell, due to methane slip etc., it was different before"*

LNG as a step toward LBG

- Pressure from NGOs that LNG is ‘not sustainable’ tackled by presenting it as a step to ‘sustainable bioLNG’ (Interviewees from port of Rotterdam, local LNG ship-owners, KVNR).
- Port of Rotterdam representative: *“In the start NGOs were glad about LNG because it was still a discussion about air quality and for air quality LNG is perfect, ... They were very glad with the opportunity to change to the cleaner fuel, At that time there was a high oil price, so LNG was still very attractive. I’ve seen in 2012, starting time...” “later, now we promote LNG here, because it’s good for air quality, we see it being helpful in supporting the introduction of more sustainable bio LNG, that’s important. Although introduction of bio LNG”*

LNG as a step toward LBG

- Dutch national LNG bunkering guidelines(PGS 33-2:2014):*“Natural gas and primarily LNG play a crucial part in improving the local air quality and the transition to more sustainable mobility. The construction of an LNG infrastructure lays the basis for driving and running on LNG and liquefied biomethane (LBM).”*



Nurturing- Finland/Estonia

- Wartsila- centre of Finnish maritime cluster- first mover on changing expectations on LNG through its flagship projects (Viking Energy, Bit Viking etc.)
- Wartsila- significant learning in understanding business operations and financial contracts
- Port of Helsinki- change in expectations of LNG bunkering through participation in EU LNG Baltic Sea Bunkering project
- Viking Energy and Tallink driven by perceptions of LNG as a marine fuel, most knowledge development seemed to happen in fuel system suppliers and bunkering providers
- Change in perspective of LNG as a transitional fuel from long term solution

Presenting LNG in a positive light (Megastar)



Empowering - Netherlands

- Port of Rotterdam – key actor in development of GATE terminal, later mobilizing resources for its small scale bunkering, and development of LNG bunkering guidelines, primary mover on development of Dutch National LNG platform
- Anthony Veder, Norway, Deen Shipping- first movers as inspiration, used agency to promote development of local regulations
- CCRN, after working closely and taking input from the Netherlands national LNG Platform and Port of Rotterdam amongst others adopted LNG bunkering guidelines that followed closely IAPH guidelines

Empowering Finland/Estonia

- Wartsila experts, sitting as members of Finnish delegation contributed evidence to a number of technical working groups for MARPOL Annex 6, SECA/NECA development
- Government agencies played crucial role in providing funds for first movers ('Polaris', 'Turva')
- Viking Line- assisted through TEN-T funding for bunkering vessel, company played crucial role in promoting LNG as a viable fuel, played role in convincing Tallink to follow suit
- Local environmental pressures in Port of Helsinki –convinced port to require more stringent noise and environmental regulations

Comparison

| | Netherlands | Finland/Estonia | Both |
|------------|--|---|---|
| SHIELDING | Presence of strong domestic natural gas industry, technology neutral funding, LBG support, port environmental guidelines, bunkerign guidelines | Strong local networks, willingness of government to fund, short-sea passenger ferries, security of supply issues | SECAs, NECAs, Environmental concerns, LNG terminals, regional and local concerns, EU subsidies |
| NURTURING | Strong local LNG network (national LNG platform), SGMF, SEA LNG, presence of netowrks with bioLG producers. Learning about new regulations. Changing expecations of LNG. | Limited change in LNG expectations. Innovation learning through experimentation, knwoledge developed and transferred by gas companies (i.e. Skangas). | Development of international networks, promotion by EU of networks, role of energy security in building expectations. |
| EMPOWERING | Port of Rotterdam and other local actors key in creating gudelines and pushing fuel forward. Role of small local agency of ship-owners. | Strong local innovation network, but limited outside netowrk formation. Some role of national governeemt agencies in supporting LNG. Role of competition and ferry operator/port dynamics in LNG take up. | LNG actors role in formation of SEA LNG, promoting LNG on global stage. |

Discussion

- Netherlands LNG developments, a study of developing fuel supply network for LNG
- Finland- a story of local innovation, adapted to some domestic uses
- Fuel suppliers (Shell, Skangas, Gasum) played important role in developing local infrastructure and convincing others of safety of technology
- Finland/Estonia protective spaces came through IMO, HELCOM, EU- regional and global environmental concerns leading to technology neutral shielding
- Netherlands – development of domestic and regional innovations pushed by local innovators.
- Importance of agency of ship-owners in choosing to present themselves as sustainable.

Conclusion

1. How did the creation and evolution of 'protective spaces' for marine LNG differ between Netherlands and Finland/Estonia?
 - Local vs Regional process
 - Importance of local actors, local environmental concerns
 - Role of Port of Rotterdam and role of Wartsila
 - Changes in perceptions of LNG and growth in LBG
 - Local citizens concerns (noise, pollution, other technologies)

Conclusion

2. How did these 'protective spaces' contribute to the observed difference in development of marine LNG between the Netherlands and Finland/Estonia?

- Specific to LNG vs technology neutral
- Supply of fuel vs development of innovation
- Government interest in innovation vs lack thereof
- Differences in local fleets (short sea passenger ferries, vs cargo)
- Social proximity to engine producer and competitors (client facing)



Thank you!

Questions?

