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POLICY BRIEF

Towards Bottom-Up Approach to European Green Deal: Lessons Learned from the Baltic Gas Market

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Highlights[1]

- Positive effects of the EU gas market liberalisation on price and on liquidity now spill over to the Baltic area – a region formerly defined as EU's 'energy island' because no gas infrastructure links then existed between the Baltic States and Finland with the rest of Europe. Technological improvements in off-grid gas supplies will further contribute to market liquidity and competitiveness. At the same time, the Baltic experience reveals that multi-speed gas markets reflect the current modus operandi of the EU Gas Directive implementation.
- The European Green Deal will have to entail bottom-up policy approaches – primarily involving national and regional action plans - for the successful implementation of the EU decarbonisation strategy by 2050. Regional, economic and cognitive disparities regarding the speed and the magnitude of the ongoing energy transition to carbon-free economy form part of the controversies that will continue to take central stage in the years to come.
- Growing pressure from society at large to take steps to mitigate greenhouse gas emissions has engendered a reassessment of conventional approaches to the EU's natural gas sector. Gas industry will need to adapt to new realities and integrate new technological solutions in line with the path towards decarbonisation. However, a question arises about the relevance of previous efforts in building competitive gas markets and interconnections across Europe. Depending on national and regional specificities, natural gas can most likely be considered as one of the options for the energy transition towards carbon-free economy.

1. The present Policy Brief was initiated by discussions surrounding a study produced by Andrei Belyi for the International Centre for Defense and Security (ICDS) entitled 'Stepping on the Gas: Future-Proofing Estonia's Energy Market and Security', published in May 2019. The report with policy options for Estonia gained relevance for EU level policy options as it was highlighted by the FSR webinar discussion of 03 October 2019.

Introduction

The European Green Deal has created a paradigm shift for the EU energy and climate policies. This shift is now occurring in the face of an ever-growing critique of EU Member States' usage of natural gas, mostly because of its environmental footprint. Evidence shows that a substantial part of the global methane emissions results from extracting, processing and shipping natural gas. These methane emissions could further compromise the industry's environmental benefits stemming from the lower carbon intensity in combustion, compared to that of other fossil fuels[1]. Given that the viability of natural gas in the energy transition is becoming more controversial, the question arising nowadays is whether a focus on natural gas markets and interconnectors contributes to or, contrarily, inhibits the decarbonisation agenda announced by the European Green Deal.

In light of the emerging controversy, this Policy Brief will outline a need for a *bottom-up approach in addressing the compatibility between natural gas markets and the EU decarbonisation strategy*. In other words, the experience of the Baltic region may provide useful insights about *possible multi-speed paths to attaining EU energy and climate objectives*. This analysis will attempt to demonstrate that gas will play a pivotal role in the energy transition and, depending on regional contexts, policy support for the competitive natural gas market will be crucial for the decarbonisation agenda.

The discussion will be structured in three parts. The first part will contain a short description of the Baltic entry-exit zone between Estonia, Finland and Latvia by highlighting positive market trends and impediments to the broader geographic expansion of this zone. The second part will address the issue of social costs which may potentially arise with the new climate policy ambitions. The third part will point to economic and infrastructural specificities in the observed region relevant to GHG emissions reduction. Finally, the Brief will attempt to synthesise the three parts of the study into a comprehensive policy conclusion.

1. Multi-speed Path to the EU Gas Market

Experience in the Baltic region reveals the multi-speed process towards the EU single gas market at least at this stage of its development. The implementation of the EU Gas Market Directive[2] adopted in 2009 casts light on a need to facilitate cross-border gas flows in order to stimulate an integrated European gas market. Therefore, various policy documents, including the Gas Target Model of the Agency for the Cooperation of Energy Regulators (ACER), emphasise the possibility of developing regional agreements between Transmission System Operators (TSOs) on common transportation tariffs and on capacity booking within 'entry exit' zones[3]. Conversely, a large part of expertise in this field had expected that the EU Member States would achieve a common entry-exit zone comprising all the Member States and, subsequently, a single gas market.

The reality has been rather different; *the advent of a EU-wide single entry-exit zone will not occur for some time even though regional competitive gas markets are already being shaped.* There are several inherent factors complicating the possibility of this achievement. Dynamics in gas markets – particularly in the trade liquidity and volumes – differ from one hub to another and therefore intra-European forces are very

1. IEA, *The Role of Gas in Today's Energy Transitions* (Paris: OECD, 2019).

2. Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC.

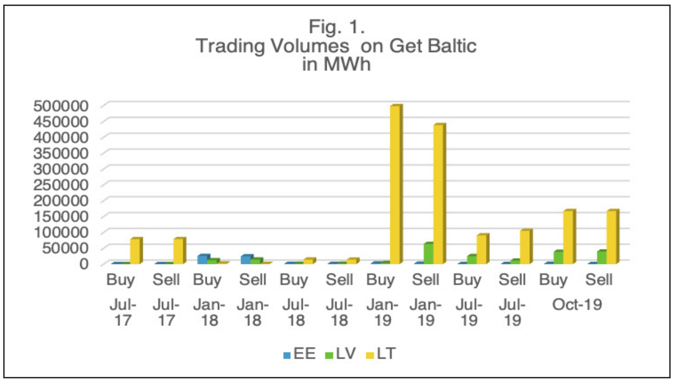
3. For more details, see European Commission, "Entry-Exit Regimes in Gas" (last accessed on 02.04.2019).

uneven[4]. Even the regulation of gas infrastructure is not uniform across EU Member States. For example, some States maintain dedicated transit pipelines, some need to regulate frequent congestion, while others lack market liquidity at entry points to pipelines[5]. The Baltic experience offers an interesting example of an attempt to formulate an entry-exit zone between a group of states that aims to increase cross-border gas flows between them. The impediments discovered here may well presage the complications and complexities involved in establishing a single EU-wide entry-exit zone.

1.1 Regional Gas Agreement: Positive Results Expected

In February 2019, Estonia, Finland and Latvia inked an agreement on their internal gas market coordinating transmission tariffs and revenues within their new common entry-exit zone. The three states are now engaged in creating a common balancing platform, first between Estonia and Latvia in 2020, with the inclusion of Finland by 2022. The agreement opens an opportunity for the Get Baltic platform, founded back in 2012, to serve gas trade between Estonia, Latvia and Lithuania, trade which will now expand to a larger Finnish market[6]. The Baltic Connector pipeline beneath the Baltic Sea has already started providing a link between Finland and one of the Europe's largest underground storage facilities located in the Latvian Inčukalns[7]. As a result, the capability of tapping into gas supplies by pipeline will be present at entry points and at the underground storage, whereas the trade will be cleared on a virtual trading platform.

It might be worth noting that the interest in such a trading platform has increased over the recent years. Although at the beginning of its operations Get Baltic services attracted only lukewarm interest among traders, a significant increase in trading activity has been observed since Winter 2018-2019 (Fig. 1). In March 2019, Get Baltic reported that a change of market regulation at Klaipeda LNG terminal in Lithuania contributed to higher market liquidity[8]. Then, during Summer 2019 traded volumes significantly increased compared to the same periods in 2017 and 2018. The experience reveals that appurtenances to a common trading area reinforce positive expectations about market liquidity and profits among traders.



Source: Get Baltic, 2020

Higher *liquidity resulted in more competitive pricing* (Fig 2). The average price in Summer 2019 decreased significantly compared to Summers 2017 and 2018. Although Winter prices are usually more sensitive to seasonal price hikes, a mid-term downward trend

4. For the state-of-the-situation on European Gas Hubs see Heather, P. "European traded gas hubs: an updated analysis on liquidity, maturity and barriers to market integration", Working Paper of the *Oxford Institute for Energy Studies*, 2017.

5. DNV KEMA, Study on Entry-Exit Regimes in Gas (Groningen: KEMA Nederland B.V., 2013).

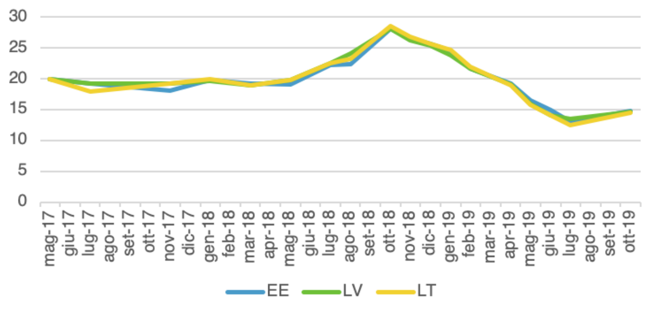
6. Get Baltic, 'Preparation for trading on Finnish market area', Online Newsletter 13.09.2019.

7. Details about Inčukalns facilities can be found in Connexus Baltic Grid, Riga: Connexus, 2019.

8. Get Baltic, 'Gas Exchange Increases as the LNG Terminal Required Volume Realization Model Has Changed', Online Newsletter 15.03.2019.

in pricing was already apparent towards the end of 2019[9].

Fig. 2
Average Monthly Prices, Get Baltic, Spot, EUR/MWh



Source: Get Baltic, 2020

The emergence of competitive and liquid markets in the region - a region earlier considered to be a sort of 'dead area' for gas - indicates the path towards a successful implementation of the EU Gas Directive at multiple speeds. The favourable results of the gas market in the region have been consistently pointed out in experts' discussions[10], mostly because they demonstrate that cross-border gas trade constitutes an advantage both in terms of the overall regional competitiveness and with respect to security of supply.

1.2 Difficulties Inherent to inter-TSO Agreements

Difficulties inherent in the negotiation process should also be taken into account in order to estimate the general transaction costs of building a cross-border gas market. In fact, the conclusion of a deal between Transmission System Operators (TSO) was preceded by more than three years of negotiations, initially involving Lithuanian TSO as well[11]. In the end, Lithuania has not taken part in the regional entry-exit zone. One of the difficulties in reaching an agreement between states was that of consensus on the coordination of revenues between TSOs. The delay in attaining agreement may ultimately stimulate Lithuania to form another entry-exit zone with Poland, once the interconnector between those two countries is in place. Hence, a multiplicity of entry-exit zones is shaping the current trend related to European gas market integration.

Some regional stakeholders point out the difficulties surrounding Lithuania's state aid[12], which has been allocated to the floating storage and regasification unit (FSRU) in Klaipeda since 2015. This facility provides the largest volumes of LNG in all three Baltic states. In fact, Lithuania's state aid consists of a 'risk premium' paid by consumers for the diversification of gas supplies. Lithuanian stakeholders, particularly representatives of AmberGrid and Klaipeda LNG, consistently point out the need to ensure regional energy security and, therefore, to pay for diversification options. This approach, which entails a security premium charge to consumers, has not been endorsed by Estonian and Latvian stakeholders[13].

The controversy surrounding state-aid to the LNG terminal reveals a complex issue of long-term compatibility between national natural gas policy priorities. At this juncture, competition between LNG supplies and seasonal usage of underground storage may emerge, particularly in the context of continued

9. Updated price dynamic shows a downward trend in November 2019 with prices varying between 15 and 17 EUR/MWh, whereas the prices topped 20EUR/MWh in Summer 2018. For details see Get Baltic Official Website.

10. See for example FSR webinar discussion "European gas challenges through the developments in the Baltics", 2 October 2019.

11. National Commission for Energy and Price Control of the Republic of Lithuania, 9.11.2017.

12. According to the European Commission document: "the total budget for the scheme is EUR 276,703,731 covering the period 2016 to 2024. The total budget for the measure during the period 2016-2019 scheme is EUR 78,631,120", see European Commission, "State Aid SA.44678 (2018/N) – Lithuania - Modification of aid for LNG Terminal in Lithuania".

13. The disagreement on consumer premium was also pointed out by a representative of AmberGrid during FSR webinar on 03.10.2019.

technological progress associated with LNG deliveries by containers and truck tankers. Possibly, to ensure long-term competitiveness, *indirect policy support mechanisms to off-grid gas supply might prove itself more economically rational than capital-intensive investments in additional fixed infrastructure*. An examination of the role of off-grid supplies within regional markets will gain future attention in light of more liquid cross-border gas trade.

An observation of the Baltic experience in regional market formation reveals difficult choices concerning long-term priorities: choices *between policy support for the new LNG supply chains and for the fixed pipeline infrastructure*, which includes the use of underground storage.

2. Balancing Ambition with Economic Realities and Social Costs

Decarbonisation is the key energy policy objective justified by the urgent problems of growing climate change. At the same time, a large part of scholarly literature highlights the need to relate climate projection scenarios to complex socio-economic realities on the ground[14]. Ongoing scientific debates note possible social costs associated with ambitious climate action. In this regard, regional specificities are important in order to find an equilibrated approach to the decarbonisation policy. This would ensure its successful result and secure social acceptance of necessary climate actions. At this juncture, a relevance of a bottom-up approach – where states and interstate regions form a departing point in policy formulation – should be reiterated.

2.1 Objective: Decarbonisation-Decentralisation-Digitalisation

The path to decarbonisation requires a complex approach to technology promotion comprising a support to decentralised solutions and digital technologies. The examples of Estonia and Finland demonstrate the significance of software's technological progress which has positively affected energy sector performance in terms of carbon emissions reduction[15]. In this context, the concept of smart city,[16] *referring to an economic and social progress associated with decarbonisation and digitalisation,* has gained relevance.

In an ideal smart city, energy applications – such as wind and solar – would form a basis for decentralised, peer-to-peer electricity trading, based on blockchain platforms which already exist in the market. As an example, a Blockchain platform, #wepower, was recently introduced by Estonian developers for peer-to-peer power trade. Furthermore, E-mobility implies an electrification of road transport with a penetration of new cars into the markets and new software solutions related to the electric vehicle usage. As a result, smart cities would be characterised by a supply system nicknamed '3Ds', after the *decentralisation-decarbonisation-digitalisation* which would shape the future energy world.

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14. Cf. Asayama, S., Bellamy, R., Geden, O., Pearce, W. and Hulme, M., "Why setting a climate deadline is dangerous", *Nature Climate Change*, 9, 2019, pp. 570-74; Carrier, M., Lenhard, J., "Climate Models: How to Assess Their Reliability", *International Studies in the Philosophy of Science*, pre-print publication on 08.08.2019; as well as a recent discussion on Nature's forum by Kevin Anderson, a Professor in Energy and Climate Change, wrote about IPCC projection models:
Behind a veneer of objectivity, the use of these leviathan computer models has professionalised the analysis of climate-change mitigation by substituting messy and contextual politics with non-contextual mathematical formalism. Within these professional boundaries, Impact Assessment Models synthesise simple climate models, with a belief in how finance works and technologies change, buttressed by an economic interpretation of human behavior. See quote in Nature News and Views Forum, *Debating the bedrock of climate-change mitigation scenarios,* September 2019.

15. See research on the topic, VTT, *Smart City: Research Highlights*, Kuopio, 2015; Eremia, M., Toma, L., and Sanduleac, M., "The Smart City Concept in the 21st Century", *Procedia Engineering*, 2018, Vol. 181, pp. 12-19.

16. For example, presentation by Tuominen, P., *Smart City*, at Innovation Game Day, Tallinn, 01.10.2019.

There is no doubt that a transition towards smart cities would provide an alternative to a hypothetical GHG emission reduction via a de-industrialisation approach that is detrimental to socio-economic development. Partly, this model of energy transition is driven by consumers' preference for cleaner and, in the longer term, cheaper and more reliable energy. However, an integration of such a 3D energy supply system is both a lengthy and costly process, which should not be driven uniformly through the European Union on a top-down basis. *Technological processes would not adapt to deadlines, even with the pivotal policy stimulation in place.*

2.2 Pointing to Economic and Social Costs

The European Green Deal implies an emphasis on extensive transition within the power sector and subsequent electrification of various economic areas. Already prior to the European Green Deal announcement, the European Commission's Communication entitled *'A Clean Planet for All'*[17] issued various projections for electricity sector's role in European economies and suggested a significant increase in direct electricity use in final energy consumption in order to stimulate decarbonisation of economy. To achieve this, the EU Member States may need to double power generation capacity, to massively invest in electricity transmission and distribution networks, and to significantly increase direct electricity consumption in their final energy demand by 2050 [18].

Ultimately, electrification of economic sectors might become an additional burden for energy-consuming sectors. To note, the transition of energy-intensive industrial processes to full electric option may hinder competitiveness leading to price hikes and job losses. A shift to electricity in residential sectors will imply additional social costs for economic development and lifestyle. Considering wide intra-EU divergences in electricity cost per average hourly wage (Fig. 3), the impact of electrification will be unevenly felt across Europe. For example, a noticeable difference between electricity consumption costs for Finland on one hand, and those of Latvia and Lithuania, on another hand, is clearly illustrated in the chart below. Estonia's position on the chart falls between the other named countries, mostly because of Estonia's over-capacity in electricity generation based on carbon-intensive oil shale processing[19]. However, a current switch from a national generation to more expensive imports suggests that Estonia's position on the chart may soon move further to the left.

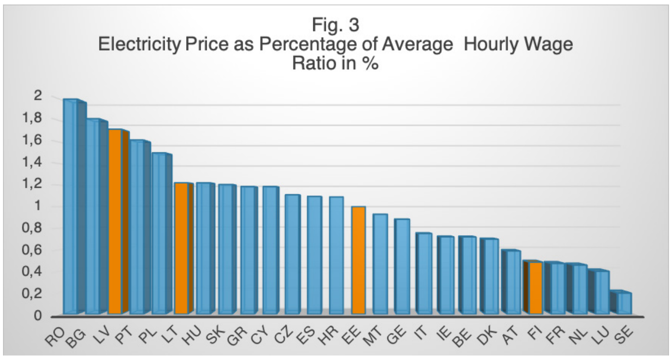


Fig. 3
Electricity Price as Percentage of Average Hourly Wage
Ratio in %

Source: authors' calculation, statistics on electricity price and on average wage from Eurostat, 2019[20]

17. European Commission, *A Clean Planet for All: A European Strategic long-term vision for prosperous, modern, competitive and climate neutral economy*, Communication to the European Parliament, the European Council, the European Economic and Social Committee, the Committee of Regions and the European Investment Bank, Com (2018)773 of 28.11.2018.

18. For details on power sector projections in the contect of electrification, see Zappa, W., Junginger, M., and Van den Broek M., "Is a 100% renewable European power system feasible by 2050?", *Applied Energy*, Vol. 233-234, Jan 2019, pp. 1027-1050; Kustova, I. and Egenhoffer, C., "The EU Electricity Sector Will Need Reform, Again", *Intereconomics*, Pre-print available on URL: https://link.springer.com/article/10.1007/s10272-019-0849-5

19. For details about the long-term plan for Estonia's security of electricity supply see Veskimägi, T., Estonian Electricity System Security of Supply Report, Tallinn: Elering: 2019.

20. See Eurostat "Electricity price for Household Consumers", 2018 and Eurostat "Wages and Labor Costs", 2018.

3. Economic and Infrastructural Specificities

The selected region comprising the three Baltic States and Finland represent only a minor share of entire EU emissions levels (Table 1).

Table 1. Selected National GHG Emissions Compared, Data of 2017

Country/ emissions	Million tonnes	Proportion from EU level, %
Estonia	21.1	0.47
Finland	57.5	1.28
Latvia	11.8	0.26
Lithuania	20.7	0.46
EU: Total	4483	100

Source, European Commission, Energy in Figures, 2019

Per sector analysis of greenhouse gas emissions (Table 2) reveals an important share of emissions from onshore transport sector, whereas combustion processes in the energy sector overwhelm sources for greenhouse gas emissions in both Estonia[21] and Finland[22]. Adding to that, Finland is the most industrialised country of the four and therefore possesses an industrial sector with important emissions outside combustion processes. The case of Lithuania shows that non-combustion processes dominate emission sources, particularly because of elevated emissions from agriculture. By contrast, residential sectors across the region are amongst the least emissions-intensive areas of that country's economy.

Table 2.a GHG Emissions from Combustion processes

	Energy and mining	Transport (onshore)	Resi-dential, including district heating	Energy-intensive Industry	Agri-culture, forestry, fishery
EE	14.7	2.4	0.3	0.6	0.3
FI	17.6	11.5	1.4	6.9	1.4
LV	1.5	3.3	0.6	0.7	0.5
LT	2.6	5.8	0.9	1.2	0.2

Table 2.b GHG Emissions outside combustion processes

	Industry	Agriculture	Waste	Indirect GHG emissions
EE	0.6	1.4	0.3	0
FI	5.9	6.5	1.9	0.1
LV	0.7	2.8	0.6	0
LT	3.6	4.4	1	0

Source: European Commission, Energy in Figures, 2018

For a complete picture, in addition to the national emissions briefly sketched above, emissions from the Baltic maritime sector[23] need to be considered in light of general efforts for decarbonisation. Maritime transport in the Baltic Sea area in general is a major source of GHG emissions, which include carbon dioxide, nitrogen oxide, and sulphur oxide. To illustrate the scale of this problem, figures reveal that carbon dioxide emissions from Baltic maritime transport attained 14,7 million tonnes in 2016. The figure is higher than, for example, Latvia's total national carbon dioxide emissions[24].

21. Republic of Estonia, Ministry of Environment, Greenhouse Gas Emissions in Estonia 1990-2017 National Inventory Report, 2010.

22. Republic of Finland, Government Publications, "Finland, a land of solutions. Strategic programme of prime minister Juha Sipilä's government", 12/2015.

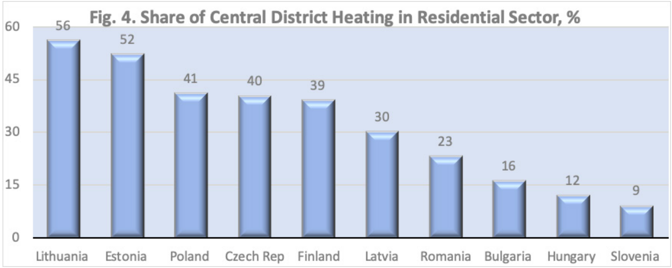
23. Here all the Baltic Sea basin is considered including transport flows beyond the countries analysed in the Policy Brief, Baltic Marine Environment Protection Commission, October 2017.

24. Here all the Baltic Sea basin is considered including transport flows beyond the countries analysed in the Policy Brief, Baltic Marine Environment Protection Commission, October 2017.

A focus on infrastructural specificities in the Baltic region, and in the Baltic basin in general, might be helpful in assessing the potential for multi-speed decarbonisation based on regional specificities. It can be observed that *the development of a competitive cross-border natural gas market would allow the phasing out of oil shale in Estonia and coal in Finland, as well as the shift from marine oil to LNG in maritime transport*. The bottom-up approach demonstrates that, in some cases, the pivotal importance of natural gas needs to be emphasised in accordance with existing local and regional realities.

3.1 Central District Heating: Advantage for the Energy Transition

Supplying energy to the district heating sector represents one the most challenging areas for a transition to decarbonised energy supply. Across the EU, the share of central district heating in final energy consumption is reported to be higher in the eastern part of Europe than elsewhere in the EU (Fig 4). Low profitability for utilities caused by the need for extensive infrastructures often reduces the incentives for funding of renovation, whereas funding for restructuring of the heating system has been a slow and socially-sensitive process[25].



Source: Euroheat, 2019[26]

According to various accounts in general, the introduction of decentralised wind and solar generators in urban areas dominated by central district heating becomes extremely challenging because of high intermittence and the difficulty of storing electricity[27]. By contrast, an interesting technological solution is now being crafted in Helsinki, (Finland), incorporating hot water storage facilities using oil tanks[28]. Storing hot water for heating is reported to increase energy efficiency and decrease greenhouse gas emissions in district heating[29] and therefore can be considered as an important partial answer to meeting decarbonisation targets in the residential sector.

3.2 Gas vs Wood Pellets: Broader Concerns of Sustainability

Biomass use in district heating has oftentimes been considered as the most cost-effective and immediate

25. Among successful projects, a modernisation of buildings was conducted in order to improve energy efficiency. For example, the city of Tartu in Estonia introduced a programme 'Smartovka' directed to renovate 18 Soviet-style buildings nicknamed 'Khrushchevka' by integrating more efficient energy system and smart metering. However, the implementation of the programme revealed that the rebuilding of the whole residential areas constituted an expensive task difficult to carry without attracting additional European funds. The renovation did not decouple the modernised buildings from the central district heating.

26. Euroheat, "Country Profiles", 2018.

27. Analysis given by researchers from VTT – technological centre of Finland – at the *Energy Innovation Game* in Tallinn, 01.10.2019, however some models demonstrate a possibility of a co-existence between the modernised district heating and limited use of renewable energy sources, see Volkova, A., Masatin, V., Siirde, A., "Methodology for evaluating the transition process dynamics towards 4th generation district heating networks", *Energy*, Vol. 150 (1), 2018, pp. 253-261.

28. Project start for Finland's largest underground heat storage facility.

29. Hast, A., Rinne, S., Syri S., and Kiviluoma, J., "The role of heat storages in facilitating the adaptation of district heating systems to large amount of variable renewable electricity", *Energy*, 2017, Vol. 137 (15), pp. 755-788.

solution for introducing renewable energy into the national district heating systems[30]. Partly for these reasons, an increase in decentralised renewable applications for district heating and co-generation in the Baltic States and Finland has resulted in an increase in wood pellets usage in heat and power co-generation. As a result, some old combined heat and power stations were modernised in order to integrate a fuel mix between natural gas and wood pellets. Apart from the reduced greenhouse gas emissions, some municipalities also felt a positive economic effect from this modernisation[31].

Nevertheless, the use of wood pellets as such might become more controversial in the longer-term, because of emerging social and environmental concerns regarding the preservation of sustainable forestry. At this juncture, it might be worth pointing to scholarly studies, which demonstrate that *protection of forests and lands plays an equally important role in mitigating climate change* than does the reduction of greenhouse gas emissions[32].

3.3 Impetus by CNG and LNG: Shift to Low Carbon Transport

Decarbonisation of the transport sector remains one of the most challenging tasks, particularly in regions with slow rates of transport electrification[33]. For onshore transport, an important case for urgent greenhouse gas emissions reduction within fossil fuels lies in the promotion of Compressed Natural Gas (CNG) in engines. Introduction of CNG in engines is particularly important for road trucks, which emit up to 6% of the EU-wide carbon dioxide gas while using conventional heavy oil products. Moreover, road truck emissions tend to increase because of the ever-growing use of trucks in economic transactions. A switch from diesel-based road trucks to CNG vehicles may decrease sectoral emissions between 15-25% in accordance with different estimates[34]. This translates into carbon dioxide reduction by almost 6 million tonnes in Finland and the three Baltic States – a figure which outstrips current emissions from residential district heating of the aforementioned states combined. The Baltic countries already provide a good example of the penetration of CNG in the transport sector.

Furthermore, LNG as a cryogenic fuel has proved to be more attractive than CNG since it contains purified natural gas through a liquefaction process. Notably, a switch from heavy marine oil to LNG has been widely considered as the optimal way to reduce emissions in the maritime sector[35]. It might be worth noting that a transition from heavier marine oil to LNG annihilates sulphur emissions and significantly contributes to carbon dioxide emissions reduction. For example, if all the marine oil is replaced by LNG in ferries and tankers, carbon dioxide emissions can provide a potential to decrease emissions from

30. Hast, A., Syri, S., Lekavičius, V., Galinis, A., “District heating in cities as a part of low-carbon energy system”, *Energy,* 2018 Vol. 152 (1), pp. 627-639.

31. ERR News Estonia.

32. On complexity of climate systems see Lucarini, V., “Modelling Complexity: the case of Climate Science”, Paper based on Conference Proceeding Hamburg, 2010, published in Archv.org by Cornell University.

33. Economic and environmental barriers for electric vehicle market in the Baltic area was discussed by Belyi, A., “Stepping on the Gas: Future-Proofing Estonia’s Energy Market and Security”, Policy Brief for the International Centre for Defense and Security, May 2019.

34. Stettler, M., Achurra Gonzalez, P., Woo, M., Ainalis, D., Cooper J. and Speirs J., *Can Natural Gas Reduce Emissions from Transport?*, Sustainable Gas Institute of the University College London, 2019.

35. LeFevre, C., “A Review of Demand Prospects for LNG as a Marine Fuel”, Working paper for Oxford Institute for Energy Studies, NG 133, 2018.

the current 14 million tonnes to 9 million tonnes at cost-effective rates and over a realistic time period[36]. Unlike onshore transport, such a switch to LNG in maritime transport would require coordination between the coastal states of the Baltic basin to ensure wider use of LNG and supporting offshore LNG bunkering for vessels.

3.4 Incremental Advantages of CNG and LNG Small Scale Deliveries

The recent decade has seen remarkable progress towards more flexible transportation methods of CNG and LNG across Europe with the introduction of off-grid supplies based on trucks and containers designed to ship these energies in small volumes to any area without the use of gas pipelines. Delivery of off-grid CNG and LNG supplies can be organised to any facility willing to exit from either diesel or coal in the industrial processing without a need to allocate expenses for an additional gas pipeline. An illustrative example is the case of northern Finland – where gas pipelines are non-existent. Eastman, a US chemical giant, decided to replace oil products with LNG for the company's feedstock at the facility located next to Oulu in Finland. LNG is first delivered to Tornio import terminal and then shipped by truck to the chemical facility[37]. Considering that emissions from feedstocks constitute one of the major issues in the chemical industry, a switch to LNG for feedstock contributes to a positive environmental impact[38]. Consequently, progress in CNG and LNG transportation methods directly contribute to the short-term GHG emissions reduction in industrial sectors.

3.5 Biomethane: Successful case for Alternative Gas to Natural Gas

In accordance with the new EU policy priorities, promotion of alternative gases constitutes an important task of the EU decarbonisation agenda. Thus far only biomethane has started to gain a certain competitiveness in the mix with CNG used in transport. In terms of market penetration, Sweden represents an example to follow: some 90% of national CNG vehicles already drive on biomethane[39]. Likewise, biomethane CNG usage has been increasing in Finland since 2013[40]. In Estonia, though the market for biomethane emerged only recently, the share of this renewable gas in the conventional CNG market already represented 40% of the total 90 GWh by 2018 and is prospected to grow further[41]. It might be worth noting, that biomethane is widely produced from biodegradable stocks and therefore its use in transport has a potential to reinforce circular economy objectives in the longer run.

Conclusion

The ongoing climate crisis requires steps that are simultaneously ambitious and economical in the quest to reduce greenhouse gas emissions. Today's legal and policy choices in this regard will significantly affect economic structures, social costs and broader EU economic prosperity for the decades

36. Estimates based on Le Fevre, C., Madden M., and White, N., *LNG in Transportation*, Rueil Malmaison: CEDIGAZ, 2014.

37. LNG Worlds News, 27 June 2019.

38. Bazzanella, A.M., Ausfelder, F., *Low carbon energy and feedstock for the European chemical industry*, Dechema e. V. on behalf of The European Chemical Industry Council, 2019.

39. BioEnergy International, 'Biomethane reaches 90% share in Swedish vehicle gas', Newsletters 20.08.2018.

40. One of the largest biomethane plants in Oulu in Finland produces equivalent of annual energy consumption for approximately 3000 vehicles, see NGV Global News, 14.06.2019.

41. Data provided by Alexela Group, May 2019, mentioned in Belyi, A., "Stepping on the Gas: Future-Proofing Estonia's Energy Market and Security", Policy Brief for the International Centre for Defense and Security, May 2019.

ahead. Our brief overview reveals that electrification of the economic sectors represents a difficult challenge which will be faced by the EU Member States. In this context, one may need to craft ways for reconciliation between the requirements of a competitive marketplace and arising social costs from ambitious decarbonisation programmes. In this context, competitive regional gas markets are designed to ensure economic competitiveness compatible with low-carbon solutions.

An accurate analysis of regional specificities, issues and technological opportunities points to the need of a bottom-up approach as the pivotal mechanism to achieve a single gas market alongside the decarbonisation agenda. The brief analysis of the Baltic experience reveals an indispensable need for regional task forces in identifying policy priorities for the most effective implementation of the European Green Deal.

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The Robert Schuman Centre for Advanced Studies, created in 1992 and directed by Professor Brigid Laffan, aims to develop inter-disciplinary and comparative research on the major issues facing the process of European integration, European societies and Europe's place in 21st century global politics. The Centre is home to a large post-doctoral programme and hosts major research programmes, projects and data sets, in addition to a range of working groups and ad hoc initiatives. The research agenda is organised around a set of core themes and is continuously evolving, reflecting the changing agenda of European integration, the expanding membership of the European Union, developments in Europe's neighbourhood and the wider world.

The Florence School of Regulation

The Florence School of Regulation (FSR) was founded in 2004 as a partnership between the Council of the European Energy Regulators (CEER) and the European University Institute (EUI), and it works closely with the European Commission. The Florence School of Regulation, dealing with the main network industries, has developed a strong core of general regulatory topics and concepts as well as inter-sectoral discussion of regulatory practices and policies.

Complete information on our activities can be found online at: fsr.eui.eu

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