Getting gas out of district heating in the Baltics

Photo: CEE Bankwatch Network

The Baltic countries of Estonia, Latvia and Lithuania have been some of the European Union (EU) Member States to make the most ambitious plans to phase out fossil fuels in their heating systems in the past decade. District heating has a long legacy in the region as the systems were built during the Soviet era. Their extensive systems have the potential to be a major asset to lowering their respective emissions if they are made more efficient and incorporate more renewable sources. The war in Ukraine and subsequent EU strategy to phase out Russian gas, paired with the resulting cutting off of gas flows to the EU from Russia,

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has made this goal to phase out gas-based district heating even more urgent. If taken seriously, it could make the region real front runners in renewable district heat in the EU.

In June 2022, the staff of Bankwatch and the Estonian Green Movement took a study visit to Latvia and Estonia to learn more about the heating situation in both countries. This follows a September 2021 study visit to Lithuania with a similar mission. The following report is a summary of the learnings from both trips based on interviews with relevant stakeholders, including public authorities, researchers, industry players and non-governmental organisations, as well as desktop research.

District heating in the Baltics

District heating technology has progressed over the decades, mostly driven by Nordic countries such as Denmark, Sweden and Finland. First-generation district heating refers to the first systems created that utilised steam and high temperatures but were generally inefficient and unreliable. Second-generation district heating moved to a system that heated water by burning oil, gas or coal and sent that heated, pressurised water through pipes, also at high temperatures, around 100 °C. Third-generation district heating is a more efficient system that uses primarily gas, coal or oil but has prefabricated, pre-insulated pipes and can operate at lower temperatures which allows for more renewable sources such as biomass and solar thermal to be incorporated. Fourth-generation district heating continues in reducing the necessary temperature to lower than 60 °C and incorporates a wide range of renewable heat sources including heat pumps, waste heat recovery, heat storage and renewable-based electricity. To employ fourth-generation district heating, the connected buildings need to be energy efficient, either newly constructed or deeply reconstructed.

Most district heating systems in the Baltics are either second or third generation district heating based on their fuel sources and supply temperatures. In order for the systems in this region to reach the fourth generation, a higher mix of renewables would need to be incorporated and the temperatures in the system would need to be lowered. Currently, countries in the region are heavily reliant on biomass, with it covering about half of all heat consumption, and there are little to no low temperature control systems. Doing this would help avoid over reliance on one fuel source, make their systems more energy efficient, and potentially make them leaders in district heating innovation in central and eastern Europe, which could create new business opportunities and accelerate the development of higher generations of district heating throughout the region

Impacts of the European Green Deal and the REPowerEU plan on district heating in the Baltics

As a means of addressing the war of Russian aggression in Ukraine and the urgent need to phase out Russian fossil fuels, the EU decided to raise its climate ambitions via the REPowerEU plan. The goal of REPowerEU is to phase out Russian fossil fuels before 2030 by diversifying fuel sources, promoting energy savings, and accelerating the uptake of clean energy. This comes on top of the Fit for 55 package, a part of the European Green Deal, which is a set of proposals to revise and update EU legislation to achieve a 55 per cent reduction of greenhouse gas emissions with the long-term goal of climate neutrality by 2050. The phase-out of fossil gas as prescribed in the REPowerEU package therefore also has to adhere to the Fit for 55 regulation.

In the Baltics, fossil gas is mostly used for individual and district heating, electricity production and industry (see below). The Estonian, Latvian and Lithuanian governments are currently looking into the possibility of a direct replacement of Russian fossil gas with fossil gas imported from other regions via new liquified natural gas (LNG) terminals. However, this does not alleviate the economic risks of being dependent on imported fuels, which can also potentially come from authoritarian regimes who respect neither climate nor environmental concerns. In addition, the industry is considering the alternative option of replacing fossil gas with either shale oil, which would considerably increase greenhouse gas emissions and deteriorate air quality in cities, or biomass, which could have harmful effects on biodiversity and natural carbon sinks (see below). In the mid- to long-term, governments and industries in the Baltics should prioritise the uptake of clean energy through either the electrification of heating or a shift to biogas instead of replacing fossil gas with other non-sustainable fuels.

Heating sources in the Baltics

Compared to the rest of the EU, district heating systems in the Baltics are widespread and most of the residents rely on district heating for the heat supply: 62 per cent of citizens in Estonia, 65 per cent in Latvia and 58 per cent in Lithuania.[1] As most of the systems were built during Soviet times, some of them are technologically outdated and cause unnecessary heat losses. Developing the district heating sector plays an integral part in meeting the regional climate and energy goals, and heating networks should continue to be improved to decrease heat losses, increase the share of renewable energy, better utilise excess heat and develop smart operating solutions.

Historically, fossil fuels such as heavy oil and shale oil have been the main fuel sources in district heating, but the political drive, environmental regulations and market signals have initiated a shift towards local biofuel in the past decades. In all three Baltic states, the share of fossil gas in district heating has been decreasing due to renovation projects and new biomass boiler instalments in small district heating networks with the help of EU funding in the previous financing periods. Today, biomass, mainly wood chips and wood waste, has become a primary source of heating in the whole region, accounting for 80 per cent in Lithuania, 70 per cent in Latvia and 46.8 per cent in Estonia (as of 2018).[2] However, fossil gas is still a significant district heating fuel source in all three Baltic states, accounting for 29.6 per cent in Latvia, 17 per cent in Lithuania and 25.6 per cent in Estonia in 2018. In Estonia, the additional district heating fuel sources include oil shale (9.2 per cent), shale oil gas (6 per cent), municipal waste (6 per cent), shale oil (3 per cent) and peat (2.8 per cent). All three Baltic states have very little experience with centralised heat pump instalments, but the region has been assessed to have remarkable potential for using seawater, rivers, lakes and sewage water treatment plants as promising heat sources for large heat pumps.[3]

[1] Anna Volkova, Henrik Pieper, Hardi Koduvere, Kertu Lepiksaar and Andres Siirde, *Heat pump potential in the Baltic states*, *Nordic Energy Research*, 2021.

[2] Ibid.

[3] Ibid.

Fuel types

Gas

In the Baltic states, fossil gas as a fuel source in heating is the most prominent in Latvia, with a share of over 30 per cent.[4] In Estonia and Lithuania, it is a bit lower, with around 25 per cent and 17 per cent respectively.[5] Governments in the region have consciously strived to reduce their gas use in heating in the recent decade due to energy security concerns, as Russia is the main gas supplier via pipelines to the region. Thus, a considerable percentage of gas in district heating systems has been replaced with biomass in all countries. In all three countries, gas is used to cover peak demand in district heating systems.

Although fossil gas is framed in Europe as a 'bridge fuel' in the transition to renewable energy due to its lower CO_2 emissions at the point of combustion, the climate impact of methane emissions resulting from the full life cycle of gas is comparable to coal.[6] Curbing methane emissions is very important for combatting global warming, as the climate warming potential per unit of methane is 84 times more intense compared to that of a unit of CO_2 over a 20-year time period.[7]

The recent REPowerEU strategy created due to the global energy crisis and war in Ukraine sets out a more accelerated timeline for reducing gas demand in Europe, reducing energy poverty related to high energy prices and boosting energy security.

Biomass

Biomass is the primary fuel source for district and residential heat in the Baltics, with 50 to 65 per cent of heat being generated from it depending on the country.[8] As biomass is considered renewable and climate neutral according to the EU, it is also counted as the main contributor to renewable energy and climate policy targets in the Baltics, regardless of concerns about its sustainability. However, a large portion of the biomass that is currently produced in the Baltics is not used for domestic energy consumption but is exported as pellets to Denmark, the Netherlands and the UK.

According to the industry, mostly low-quality wood, such as logging and production residues, are used as biomass for heating. However, environmental organisations in the Baltics have claimed for years that the overall logging rate in Estonian, Latvian and Lithuanian forests is unsustainable. The current logging rate

[4] Volkova, Pieper, Koduvere, Lepiksaar and Siirde, *Heat pump potential in the Baltic states*.

[5] Ibid.

[6] Methane has a 3 per cent leakage rate. Ramon A. Alvarez, Stephen W. Pacala, James J. Winebrake, William L. Chameides and Steven P. Hamburg, 'Greater focus needed on methane leakage from natural gas infrastructure'. *Proceedings of the National Academy of Sciences* 109, no. 17 (2012), 6435-6440.

[7] Gunnar Myhre et al., 'Anthropogenic and natural radiative forcing', in *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. Thomas F. Stocker et al. (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2013).

[8] International Energy Agency, Heat generation by source, Estonia 1990-2020, *Energy statistics data browser*, accessed 11 September 2022.

(largely driven by exports[9] – including biomass for heating and the wood industry has a significant negative effect on biodiversity and the capacity of the forests to sequester carbon.

There is potential for reducing the share of forest biomass in the energy mix by increasing the utilisation of residual straw and grass biomass from the maintenance of grasslands as well as manure and other by-products of the agricultural industry for biogas production. This would also have a much lower negative impact on biodiversity than forest biomass. Biogas could be used for electricity and heat production in existing fossil gas turbines and also as a transport fuel.

Oil shale

Oil shale is a sedimentary rock that is mainly used in Estonia for electricity, heat, and oil production. Due to heavily emission-intense oil shale mining, Estonia has long been among the countries with the highest CO_2 footprint per capita – in 2018, Estonia ranked number two in Europe and number 16 in the world.[10] Considering the increased CO_2 prices, tightening environmental regulations, and the political ambition to phase out oil shale by 2040, however, the oil shale industry is being forced to decline.

In addition to the heavy CO_2 footprint, oil shale mining poses several environmental concerns. Alarmingly, the oil shale industry generates massive waste: heaps of waste rock are a source of residual pollution, and the vast majority of the new oil shale mining residue and ash is piled up in ash hills. Oil shale mining negatively impacts the groundwater and the water regime, deteriorates the drinking water quality, and decreases the quality of the soil, thereby negatively affecting locals' health.[11] [12] These concerns have been increasingly addressed in the public debate.

The war in Ukraine has clearly demonstrated the importance of phasing out fossil fuels more rapidly than previously anticipated, but concerns about energy security have created favourable conditions for switching to domestic shale oil in district heating to overcome the state of emergency. To avoid long-term lock-in to unsustainable shale oil, however, the political actions need to support the decarbonisation of district heating.

Heat pumps

Heat pumps, if powered by renewable electricity, are an important part of decarbonising the district heating sector and meeting the net zero goal by 2050. Large-scale, centralised heat pumps are considered among the best power-to-heat options for coupling electrical and thermal grids, thereby helping to provide flexible electricity demand and increasing the share of renewables in power production. The centralised heat pump potential has largely been unused in the Baltic States so far and the region has overall little experience with centralised heat pump projects. When it comes to individual heat pumps, however, Estonia has the second

[9] Euractiv.com with AFP, 'Estonia's wood pellet industry stokes controversy', *Euractiv*, 16 December 2021.

[10] The World Bank, CO2 emissions (metric tons per capita), 2020.

[11] Ministry of the Environment of Estonia, *Eesti põlevkivi energeetilise kasutamise parima võimaliku tehnika uuring*, 2016.

[12] Anto Raukas and Jaan-Mati Punning, 'Environmental problems in the Estonian oil shale industry', *Energy & Environmental Science* 2, no, 7 (2009), 723-728.

largest share in Europe with 29.3 heat pumps per 1,000 households; the share in Lithuania is nine heat pumps per 1,000 households.[13]

However, heat pump instalments are not a silver bullet solution if the electricity is not based on renewable sources. This is particularly a problem in Estonia, where oil-shale-based electricity production (which accounted for 62 per cent of electricity production in 2021)[14] is very CO_2 intense. However, with the phase-out of oil shale in electricity production and a shift towards renewables production in the Baltics, this will gradually change. Additionally, accelerating heat pump instalments can pose remarkable challenges to the grid if this issue is not addressed through adequate planning and investment. According to Estonia's Heat Pump Association, the lack of electricity network capacity has not been a significant problem for private houses so far, but it may become a challenge in the near future if residential districts start switching from gas heating to heat-pump-based heating. It can also become a problem for apartment buildings since the capacities of the devices are larger than the grid can handle. The situation is similar in all three Baltic states.

Good examples in the region

Tallinn, Estonia

Utilitas is a private utility and energy company located in Tallinn, Estonia. It provides district heating to 5,100 buildings in eight cities across Estonia (Tallinn, Maardu, Haapsalu, Jõgeva, Keila, Kärdla, Rapla and Valga) – more than 177,000 households. It also generates electricity in combined heat and power stations (CHPs), which covers the electricity demand of more than 170,000 apartments (all of the apartments in Tallinn's district heating network). Utilitas owns three CHPs, 26 boiler houses, nine solar power plants and a waste incinerator, and also operates a district cooling system in Tallinn.

The company prioritises the use of local renewable energy; in all district heating networks outside of Tallinn, local wood chips are used as primary fuel. The average heat supply temperature is 75 °C and the return temperature of the water after its heat has been released is 45 °C. In case of cold weather (-30 °C), the supply temperature can reach 100 °C, but the company is trying to reduce the temperature to 80 °C through a redesign of the system. Utilitas has also been working on increasing the efficiency of the district heating grid by insulating the pipes. The average heat loss in old pipes is 12 to 13 per cent, but in pre insulated pipes it is 5 to 8 per cent.

Utilitas has a climate neutrality strategy, the aim of which is to achieve a 95 per cent share of renewable energy in the system by 2030 through CHPs, large-scale heat pumps and modernisation of the system. The most difficult decarbonisation challenge is meeting demand at peak load, which will likely be covered by a combination of new solutions, including heat accumulation tanks and demand side regulation through smart metering. The short-term challenge is providing heat for Tallinn's district heating network in the 2022-2023 winter in the absence of Russian fossil gas, which will most likely be replaced by shale oil. The gas crisis has also significantly increased the interest of households with individual gas boilers in connecting to the heating grid.

[13] Volkova, Pieper, Koduvere, Lepiksaar and Siirde, *Heat pump potential in the Baltic states*.

[14] Data explorer, *Ember*, accessed 11 September 2022.

Salaspils, Latvia

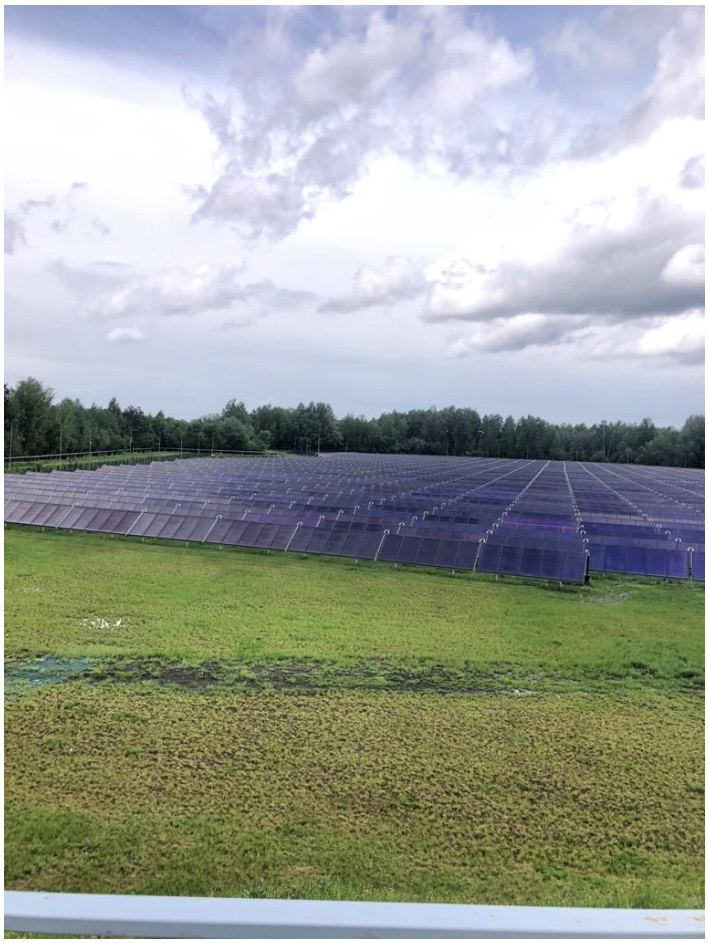

Photo: CEE Bankwatch Network

Salaspils Siltums is a municipality-owned district heating company near Riga, which supplies 65 gigawatt hours (GWh) of heat to around 17,000 customers, 85 per cent of the town of Salaspils. The energy mix of Salaspils Siltums is comprised of 70 per cent wood chips, 20 per cent solar energy and 10 per cent gas (which is used to cover peak load). They use local wood chips and waste wood from local business when possible. The company reinvests 50 per cent of its profit in the development of the district heating systems and 50 per cent in the municipality of Salaspils, where it is used for energy efficiency improvement programmes. These investments in modernising the system have been supported by EU funds, which are aimed at switching smaller district heating systems from gas to biomass in Latvia. The maximum supply temperature at the coldest times (-25 °C) is 90 °C; the average is 60-70 °C. The return temperature is 40 °C: the company ensures it receives low temperatures upon return with the help of a remote data control system, which improves the overall efficiency of the system. They have also invested in renovating the pipes of the district heating system, due to which the heat loss percentage is very low (8 per cent).

The heat from solar panels is stored in an accumulation tank, which makes the heat stored during the day available to be used in the evening.

Vilnius, Lithuania

District heating covers 33 per cent of the annual heat supply for Vilnius. From its Soviet legacy, it has a rather old but extensive district heating network which until 2013 was fuelled by fossil gas or heavy oil imported from Russia. In an effort to be more energy-efficient, the city began to diversify its energy supply rapidly and now uses primarily locally-sourced biomass.

Through a EUR 90 million investment from the EU's Cohesion Fund, Vilnius built a new biomass CHP finalised in 2021 to replace existing fossil gas boilers. But what is more promising is that the Vilnius District Heating company plans to further diversify its heat sources beyond biomass and to incorporate solar thermal energy, heat pumps and waste heat from retail centres or wastewater treatment plants.

In order to do this, the network needs to be modernised to be able to incorporate lower temperature renewables, as most of the current network still requires high temperatures and there are significant heat losses. With a EUR 43 million investment from the European Investment Bank (EIB), the company has been investing in the Vilnius Heating Capex Programme for upgrading, renewing and refurbishing the district heating network through smart meters, new connections and the construction of new biomass and gas district heating boilers. According to the EIB, the majority of the investment will focus on network modernisation and the installation of biomass boilers, and the rest will go for gas boilers, which should only be used during peak loads. This should improve the efficiency of the network, thus reducing demand. Additionally, in 2021, Lithuania obtained EUR 20 million from the Modernisation Fund for investments in building insulation in the 2022 to 2027 period. The objectives of the scheme are to improve energy efficiency and reduce greenhouse gas emissions through the renovation of public buildings owned by municipalities.

The role of EU funds

Considering the pressing need to decarbonise the energy system and save energy, public finance is key to supporting the Baltic states in meeting the required emissions reduction targets and staying below 1.5 °C of warming as outlined in the Paris Agreement. As highlighted above, EU funds have already been used to some extent to modernise district heating networks in the Baltic states and reduce the dependence on fossil gas for heating. However, to keep pace with increasingly tightening environmental regulations and ambitious policies, considerably more financial resources must be invested in the uptake of positive measures that accelerate decarbonisation. Large-scale investments are needed to improve energy efficiency (renovation of buildings), upgrade the heating systems, minimise the heat transmission losses, expand renewable energy production, experiment with diverse pilot projects (e.g. electricity and heat storage), and alleviate the negative social impacts of energy transition. This entails fostering community energy schemes, re-skilling people who are currently working in the fossil fuel industry, and providing compensation for job losses to protect the households that are heavily reliant on the fossil industry and thus the most vulnerable.

At the time of publishing this briefing, EU Member States are finalising their investments plans for European structural and investment funds for the period from 2021 to 2027. The total EU funds allocated to Member States in this period amount to EUR 392 billion, and with national co-financing about EUR 500 billion will be raised as public investments. There are three main Cohesion Policy funds from which investments in climate change mitigation and energy transformation are being made:

- the European Regional Development Fund
- the Cohesion Fund
- the Just Transition Fund

Additionally, there is the Recovery and Resilience Facility, which provides grants and loans to Member States to recover from the COVID-19 pandemic and invest in priorities in line with the EU objectives. Thirty-seven per cent of these investments have to contribute to the green transition, and are therefore a source of funding for renovating district heating systems.

Since accelerating the green transition is an EU-wide priority in this planning period, Member States have the obligation to allocate at least 30 per cent of the European Regional Development Fund, 37 per cent of both the Cohesion Fund and Recovery and Resilience Facility, and 100 per cent of the Just Transition Fund to measures that support this cause.

Furthermore, the Modernisation Fund, financed from the EU Emissions Trading System, is available to help lower-income Member States modernise their energy systems through adding new renewables, improving energy efficiency, and facilitating the just transition of coal-dependent regions.

Recommendations

- Avoid long-term lock-in to unsustainable fuels such as fossil gas or oil when searching for a quick replacement for Russian gas.
- Diversify district heating beyond biomass by tapping into the potential of large heat pumps, short- and long-term heat storage, and biogas.
- Transition quickly to electricity generation from renewable sources so that the electrification of district heating leads to CO_2 reduction. For this, EU funds' investments should be linked to requirements to use renewable energy supply (e.g. the construction of heat pumps and electrification of public transport).
- Ensure political regulations and financial instruments accelerate large-scale deep renovation that drastically improves energy efficiency and provide support for heat pump instalments far beyond the current scope.
- Support the establishment of energy communities for decarbonising the heat sector in smaller towns where there is no interest from private suppliers.

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