National action plan for retrofitting DH networks in Lithuania

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Abbreviations

VERT	National energy regulatory council (*LT – Valstybinė energetikos reguliavimo taryba*)
DH	District heating
WACC	Weighted average cost of capital

1. Introduction

The overall objective of the Upgrade DH project is to improve the performance of district heating (DH) networks in Europe by supporting selected demonstration cases for upgrading, which can be replicated in Europe.

The Upgrade DH project supports the upgrading and retrofitting of DH systems in different climate regions of Europe, covering various countries: Bosnia-Herzegovina, Denmark, Croatia, Germany, Italy, Lithuania, Poland, and The Netherlands. In each of the target countries, the upgrading process was initiated at concrete DH systems of the so-called Upgrade DH demonstration cases (demo cases). The gained knowledge and experiences is further replicated to other European countries and DH systems (replication cases) in order to leverage the impact.

Core activities of the Upgrade DH project include the collection of the best upgrading measures and tools, the support of the upgrading process for selected district heating networks, the organisation of capacity building measures about DH upgrading, financing and business models, as well as the development of national and regional action plans.

This document specifically focuses on the **development of a national action plan** for the retrofitting of inefficient district heating networks **in Lithuania** and includes the results of the retrofitting approaches (see also the *District Heating Handbook* developed within the project [1]).

In Lithuania, the district heating system is an integral part of the general energy sector, closely related to the electricity system, fuel supply and other systems through technological and energy flow connections. All Lithuanian cities have well-developed district heating systems. The share of district heating contributes to 76% of the cities' and 53% of the country's total heating share. The main users of district heating services are residents living in apartment buildings. The total installed capacity of heat production facilities in district heating systems is 9582 MW. In 2017, almost 70% of heat was produced from RES (mainly biomass) and municipal waste in the Lithuanian DH sector. The share of heat from natural gas was less than 30% in the fuel balance. By 2030 Lithuania will strive to achieve that the heat produced from renewable and local energy sources in district heating systems would account for 90%.[2]

The analysis showed that at the moment in Lithuania there is no long-term national or regional action plans for sustainable DH systems. Lithuanian district heating market is under very deep regulation and there is a lack of investments into new efficient DH systems. International collaboration of experts as well as identification of sustainable options for DH systems is essential in this process. Therefore, a **list of existing regulation - problems - proposed solutions** that could support the development or retrofitting of DH networks was elaborated and can serve for inspiration to other countries with a similar DH market situation and legislative framework.

More specifically, in Lithuania, the DH sector is significantly supported and influenced by the state. Lithuanian DH Association provided an overview of legal acts and specific support and promotion measures that apply to the DH sector (Chapter 2). Challenges have been identified, as well as priority directions of improving the regulatory market conditions in the heat sector (see 2.5 SWOT analysis). Recommendations for the modernization of inefficient district heating systems were developed (Chapter 3) and presented at the RHC ETIP National Roundtable held on 15 October 2020 and during the KeepWarm final event on 12 November 2020 (Chapter 4). Any legislative changes which took place after that date are out of the scope of this report.

2. Current policy framework and country's DH overview

2.1 District Heating and CHP

District heating and Combined Heat and Power (CHP)

2.1.1 District Heating – Industry Structure

Lithuania has a well-developed district heating system. The share of DH in the overall heating sector remained constant over the last years: in average, around 57% throughout the country and around 76% in cities.

In 2019, 49 licensed heat supply companies with annual sales of more than 10 GWh were operating in the DH sector. These companies operate in all 60 cities and districts of Lithuania. The activity of these entities is regulated by National Energy Regulation Council (VERT). The pricing principle of basic price is applied. The essence of which is that long-term (3-5 years) heat prices are set for each DH companies. These prices are recalculated annually if the amount of heat sold, inflation, fuel structure and other factors, change.

The smaller heat supply undertakings (less than 10 GWH of annual production) are regulated and the prices are set by municipalities.

Private capital entered Lithuanian DH market in 2000. Up to 2016 around 40% of DH market were leased. During 2017-2019, the long-term contracts for the lease of DH companies in Vilnius, Palanga, Alytus, Vilkaviškis, Kazlų Rūda cities expired and the management was transferred to local municipalities. In 2019, municipalities owned about 93% of DH companies, while 7% were leased to foreign and domestic investors.

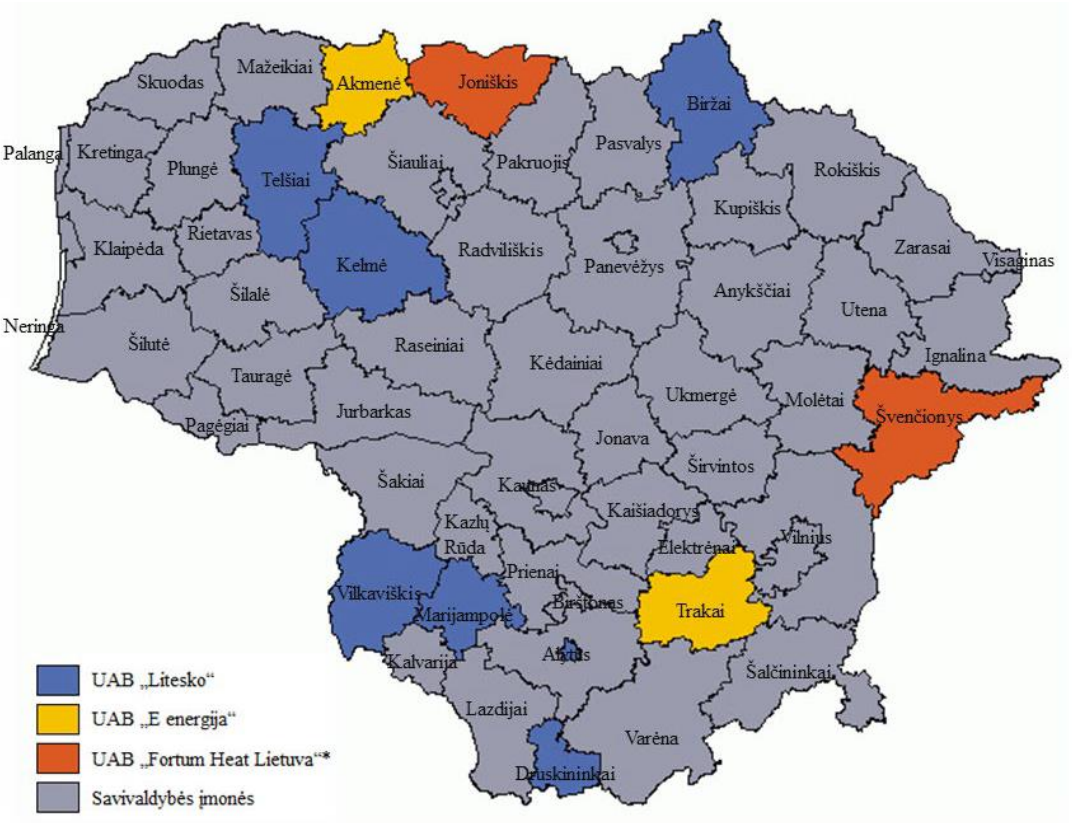

Fig. 1. Ownership management of DH suppliers at the end of 2019

In 2019, there were 12 DH companies which purchased heat from Independent Heat Producers (IHP). Currently, the market share of IHP makes around 34% (2869 GWh) of total

heat delivered to the DH networks. There are 44 independent heat producers: the mandatory pricing of DH production is applied to 27 companies, while 17 are unregulated. The major part (52%) of all IHP sales was generated by unregulated independent heat producers.

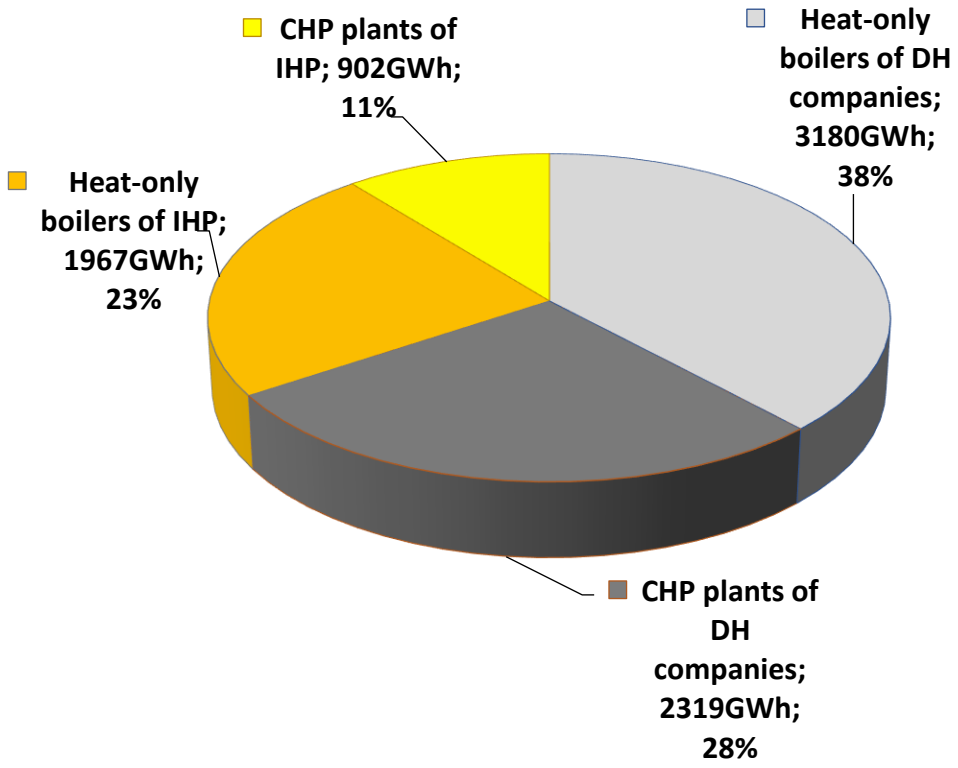

Fig. 2 The market share of DH production in 2019

The amount of heat purchased from IHP and/or produced by DH companies is determined by means of a heat auction organized by the operator of the Energy Exchange (Baltpool).

Significant changes in regulation and pricing in the DH market and their potential impact on technological-financial viability of DH supply companies were made in 2018 by the new Procedure of Heat Purchase from Independent Heat Producers adopted by VERT.

According to the legal regulation that has been used for almost 15 years, regulated DH companies have received fixed income to maintain heat production sources and purchased heat from IHP only if it was cheaper than produced in own boiler houses (variable costs). This has ensured the reliability of the heat supply and the principle of the lowest cost.

The new Regulation legalises competition at "full cost" - which means that all the revenue will be generated by the boiler-houses that will operate in that month and the ones who do not operate will receive no income (previously those who do not operate received fixed cost part). However, only planned heat supplier sources can guarantee the required parameters for each user and overall reliability of the process. IHPs do not have this capability because their production capacities are usually not geographically matching the demand.

The new Procedure for unregulated and freely operating IHP guarantees provides a better business environment and poses a significant risk of losing a significant part of the operating income for district heater production units. DH companies are not able to regain all investments made to already implemented heat production projects. Accordingly, there are no funds for fulfilling their financial obligations. There is a risk that the economic and technological bases of district heaters will be jeopardised.

In Lithuania, the total length of DH pipelines is approx. 2885 km. Annually about 50 km of pipes were replaced and about 10 km of new pipes were installed mainly to connect new consumers or optimise the configuration of the networks.

The total installed capacity of heat generation facilities in the DH sector is nearly 7800 MW, however the maximum demand for the power of district heating supply was 2900 MW in 2019. The total thermal input of biomass facilities was nearly 1 650 MW and was higher the current average base load of 1400 MW during winter.

Since 2007 the support form EU Structural fund made a significant impact in development of heat market: over 100 million eur support was allocated for fuel conversion from natural gas to local biomass. In addition, around 150 million eur subsidies were received for renovation and expansion of the DH networks. The following benefits of projects implemented by DH companies where achieved:

- Heat loses in the District Heating network decreased from 16,6% (2012) to 14,8 % (2019)
- Fuel input for District Heating production decreased from 93,6 kg.o.e/MWh (2012) to 90,1 kg.o.e./MWh (2019);
- The share of RES and municipal waste in the overall fuel structure of District Heating increased from 27% (2012) to 74,6 % (2019);
- Installed automatic heat substations in dwellings let save about 10-15% of energy consumption.

The DH sector is heavily regulated in Lithuania. The regulatory and pricing methods applied by VERT during the last years in the DH sector are completely inadequate to the actual situation. The provisions, requirements, and procedures of heat pricing methodology (as amended) and other legislation approved by the VERT are complex and difficult to understand for DH companies, municipalities as well as for consumers.

VERT pays great attention to the detailed specification and regulation of costs accounting, but there is little progress made in boosting activity of DH suppliers and their economic motivation to implement new technologies, improve reliability, develop the market and offer new services. The current regulation creates delays in setting basic prices, increases administrative burdens both for VERT itself and for the regulated companies.

2.1.2 District Heating – Supply and Demand

In 2019 the average outdoor air temperature during heating season was warmer than in 2018, and the volumes of district heating production and supply decreased by 6 %.

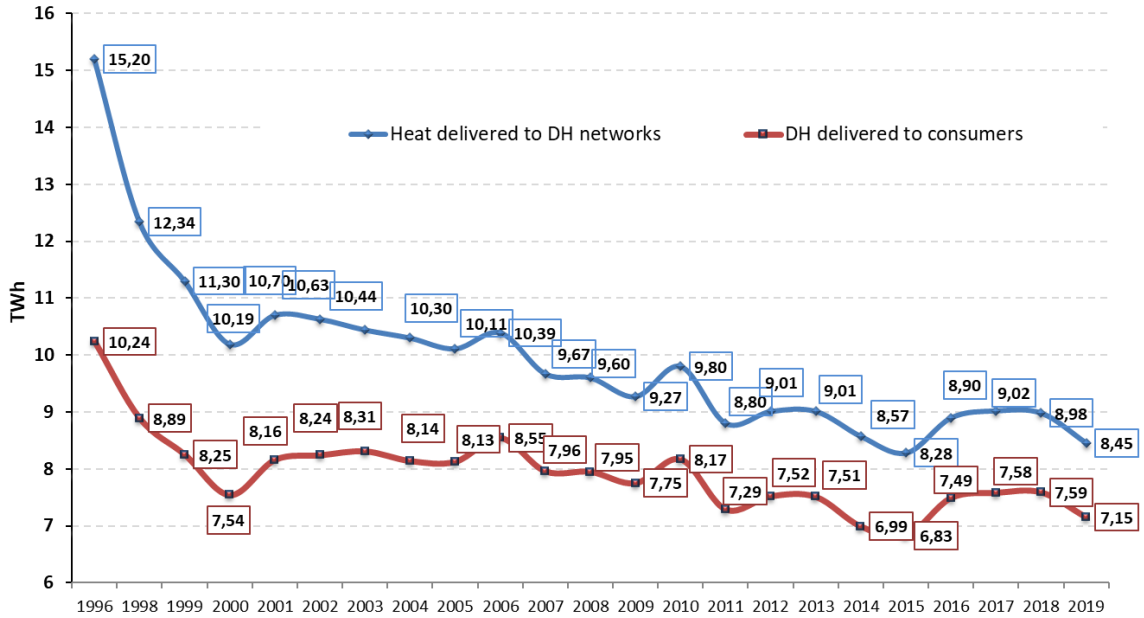

Fig. 3 Yearly statistics on heat produced and heat delivered

The main consumers of district heating are residential buildings, accounting for 73 % of the total consumption. The remaining users are the State, municipalities (14%) and business organisations (13.9%).

There is no comprehensive annual data on space and warm water heating volumes of decentralised users (especially about industry and commercial buildings).

In 2017, private households not connected to district heating systems used up to 790 thous. t.o.e (tons of oil equivalent). It is almost the same amount of fuel (795 thous. t. ones of fuel) that was used by DH companies for the production of district heat. Heat production in decentralised households in 2017:

firewood 72.4%, natural gas, 14.8%, liquefied petroleum gas and gas oil – 1.67%, solid fuels (coal, peat, briquettes) – 7.48%.

There are 38 000 multi-family apartment houses in Lithuania. Almost 18 000 (700 000 flats) are connected to DH networks out of which:

- 3 200 are old, uninsulated buildings;
- 10 600 buildings are of extremely poor quality;
- 1 200 buildings are partially renovated;
- And 3 000 are newly built and renovated buildings.

The major problem of the Lithuanian DH sector is inefficient heat consumption in buildings. The average annual heat consumption is 160 kWh/m2, whereas in newly built and renovated multi-apartment buildings 80–90 kWh/m²

EU Structural Funds are supporting the complex modernisation process of multi-family apartment buildings. However, between 2005 and 2019 only 2200 apartment houses were renovated.

Many problems still exist in demand-side management: for instance in the area of legal adjustment of relations with district Heating consumers, particularly with residential consumers in multi-family apartment houses

During winters, the average heating payment makes approximately 30-40% of total monthly family income. There is no entity/body that would be responsible and accountable for heat consumption in apartment buildings; national control system does not exist either.

Inhabitants of apartment buildings usually lack the technical possibilities to regulate heat consumption. Therefore, state authorities applied a reduced VAT rate of 9 % for District Heating since 2004. Also, low-income families can receive monthly compensations for heating and hot water bills but inhabitants must apply for compensation themselves to local municipal authorities which are responsible for the allocation of such funds.

It seems that DH suppliers and consumers, as well as state authorities are interested in the promotion of more rational heat consumption, implementing a range of energy efficiency measures in buildings. Unfortunately, from the beginning of the Lithuanian independence, separate apartments were privatised, but not the multi-family apartment building. This resulted in a situation in where there is no single owner of a building. As a result, a number of important decisions related to maintenance of common property are not made. A part of the residents treats their apartment as absolute private property and behave regardless of the other co-owners' interest. Many inner heating systems were reconstructed illegally (radiators, heating surfaces, etc.),, therefore the inner heat and hot water systems became hydraulically unbalanced.

Currently, the annual growth of heat consumers makes around 0.3 % (mostly in large cities: Vilnius Kaunas, Klaipėda), while the quantity of disconnected users was only 0.05%.

The heat supply in each municipality is organised according to the general planning documents or specialised local heat plan. District heat supply and competition zones are drawn up in the territory of the municipality. Only licensed company in the District Heating zone are allowed to connect all new heat consumers. The connection cost is included in the general heat price or paid by special fee. Heat consumers in the competition zone could be connected and heat supplied on the basis of individual cost and prices.

Apartment owners have the right to disconnect their apartment's heating and hot water systems but in exercising this right, they must follow the statutory disconnection procedure and not harm other flat owners.

In 2019, the DH sector recorded one more impressive achievement – local biomass (mostly wood chips) and municipal waste accounted 74,6 % of the fuel used for producing heat. The structure of primary fuel has dramatically changed over the past few years.

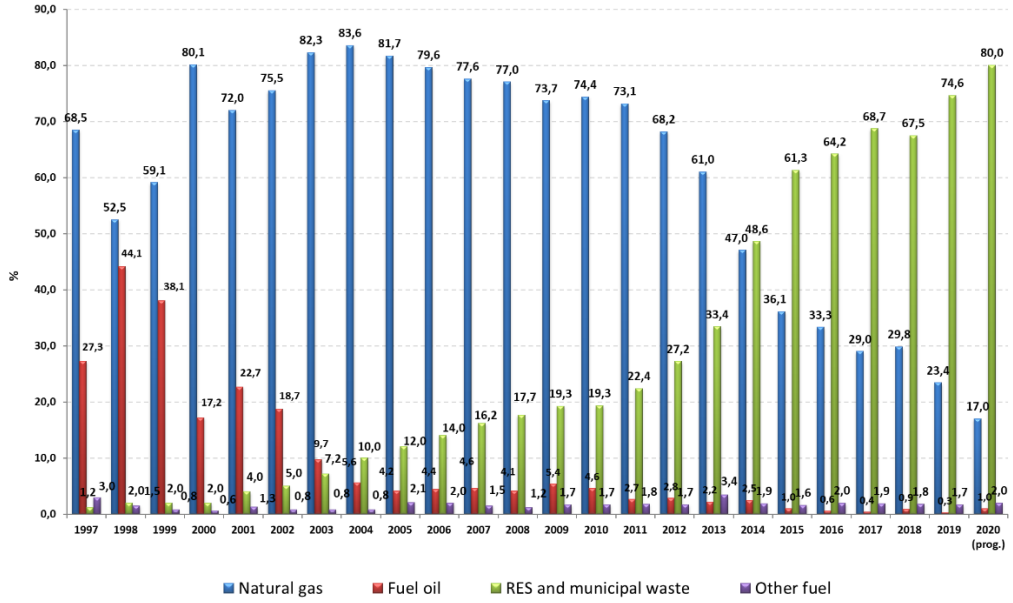

Fig. 4 The structure of primary fuel in DH production 1997 – 2019

The average price of local biomass used for DH is 3 times less than the price of natural gas.

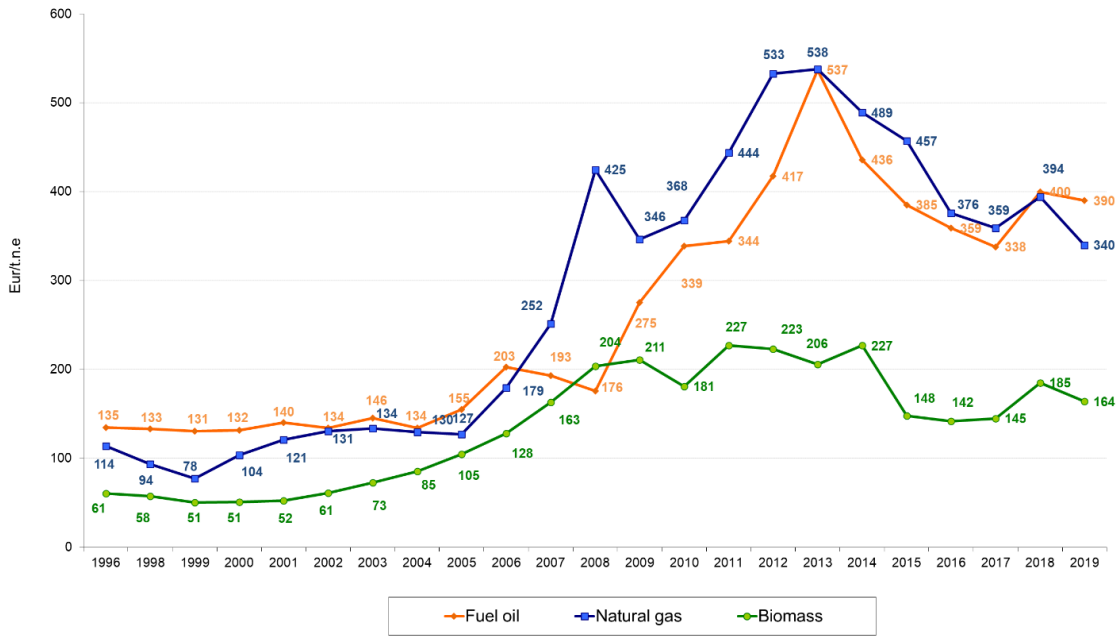

Fig. 5 The average price of natural gas and biofuel for DH production in Lithuania

The peak in prices for natural gas in 2007-2012 and the EU's policy of greater use of renewables have led to the rapid construction of biomass-fired boilers and cogeneration plants in Lithuania. A considerable contribution here was made not only by heat suppliers, but also by independent heat producers who built about one third of the plants using biomass.

There is a national fuel and energy exchange in Lithuania, BALTPOOL, where all heat producers are required to buy fuel and sell heat.

The replacement of fossil fuels – in particular natural gas - with renewable biomass has significantly reduced CO_2 emissions.

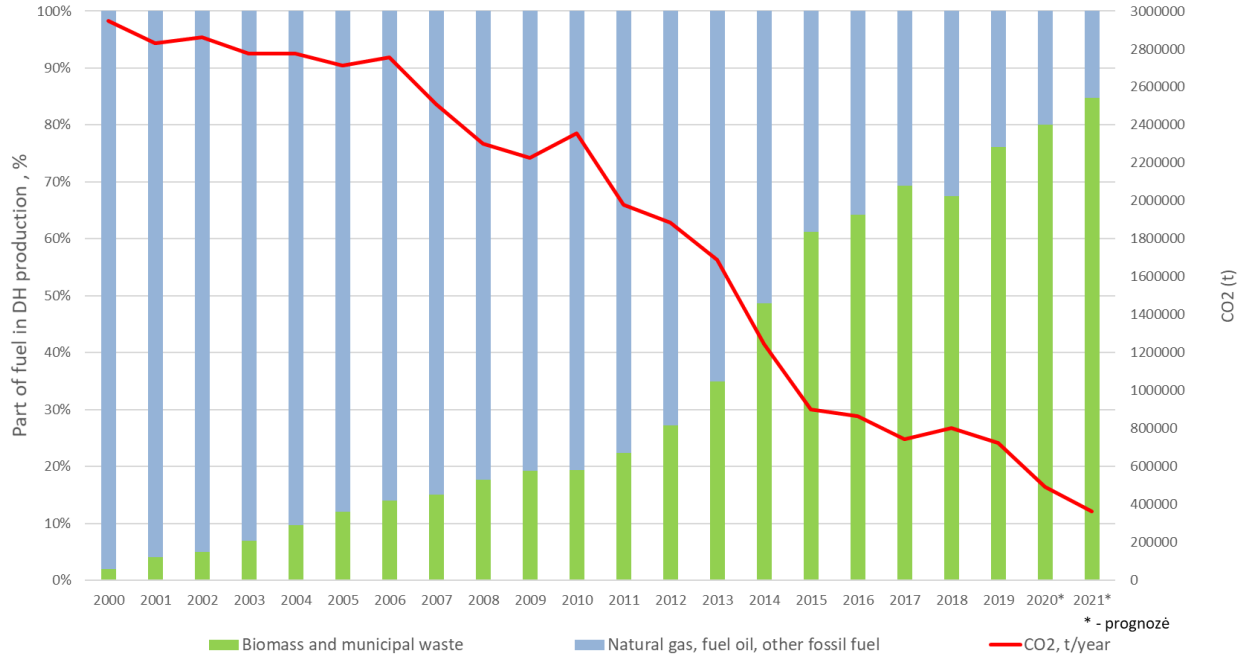

Fig. 6 Greenhouse gas (CO2) emissions in Lithuanian DH Sector

It was mainly on account of decarbonisation of the DH sector that Lithuania has long achieved the EU's target of reducing carbon emissions by 20% by 2020. Additionally, the saved quantities of CO_2 emissions are sold to other countries. The large share of renewable energy in the production of district heating means that this energy is suitable even for class A++ buildings. As biofuels are two to three times cheaper than natural gas and EU subsidies are used for equipment, heating prices have fallen significantly in recent years and district heating is increasingly appealing to heat consumers.

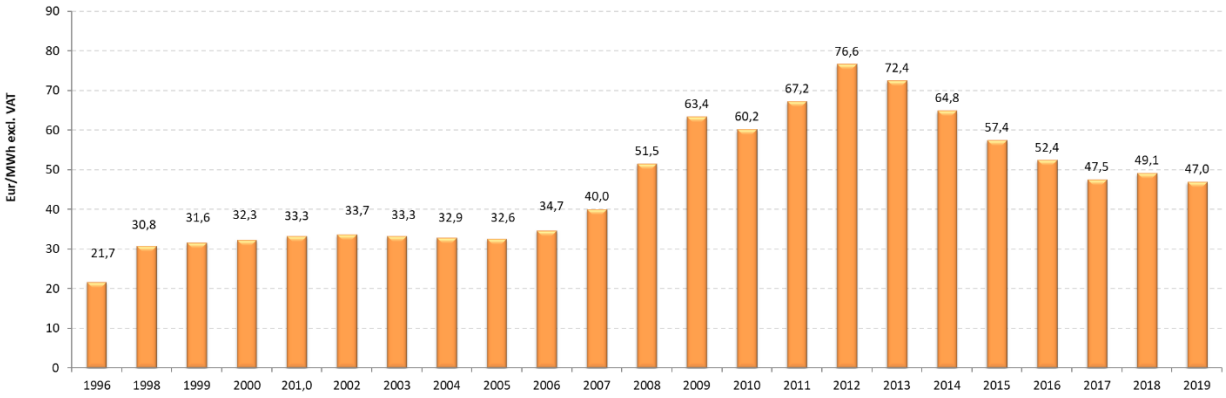

Fig 6. Average DH price in 1996-2019

Rapid replacement of imported natural gas with local renewable biomass is also of great benefit to the Lithuanian economy: new jobs are created, more funds and taxes remain in the country, regions are developing and new industries are growing. Today, Lithuanian manufacturers of boilers and other equipment sell their products and services not only in Eastern Europe, but also in Western European countries. Support for biomass penetration in the Lithuanian DH sector is considered one of the best examples of the use of EU support.

2.1.3 CHP development

In 2019, 3.2 TWh of heat energy was generated in CHP plants. It accounted for about 38% of the total heat energy produced in the DH system. The total installed CHP capacity both in DH companies and independent heat producers was 670 MWe and 1,413 MWth, including 88 MWe and 333 MWth of biomass and municipal waste CHP capacities.
CHP plants are built and operating in all large Lithuanian cities. Unfortunately, with the natural gas and fuel oil price growing, the electricity produced in natural gas CHP plant can hardly compete with cheap imported electricity. In 2015, the Government of the Republic of Lithuania adopted a resolution to abolish the electricity buy-back quota and no longer set the volume of eligible electricity produced from fossil fuel CHP plants. The consequence of such a decision made negative impact. The amount of electricity delivered to the national network over the period 2015-2019, produced from DH CHP plants decreased by 60%. At the end of the 2015, Vilnius CHP-3 was shut down; other large natural gas CHP plants in Kaunas and Panevėžys continue operating on a fragmentary basis only.

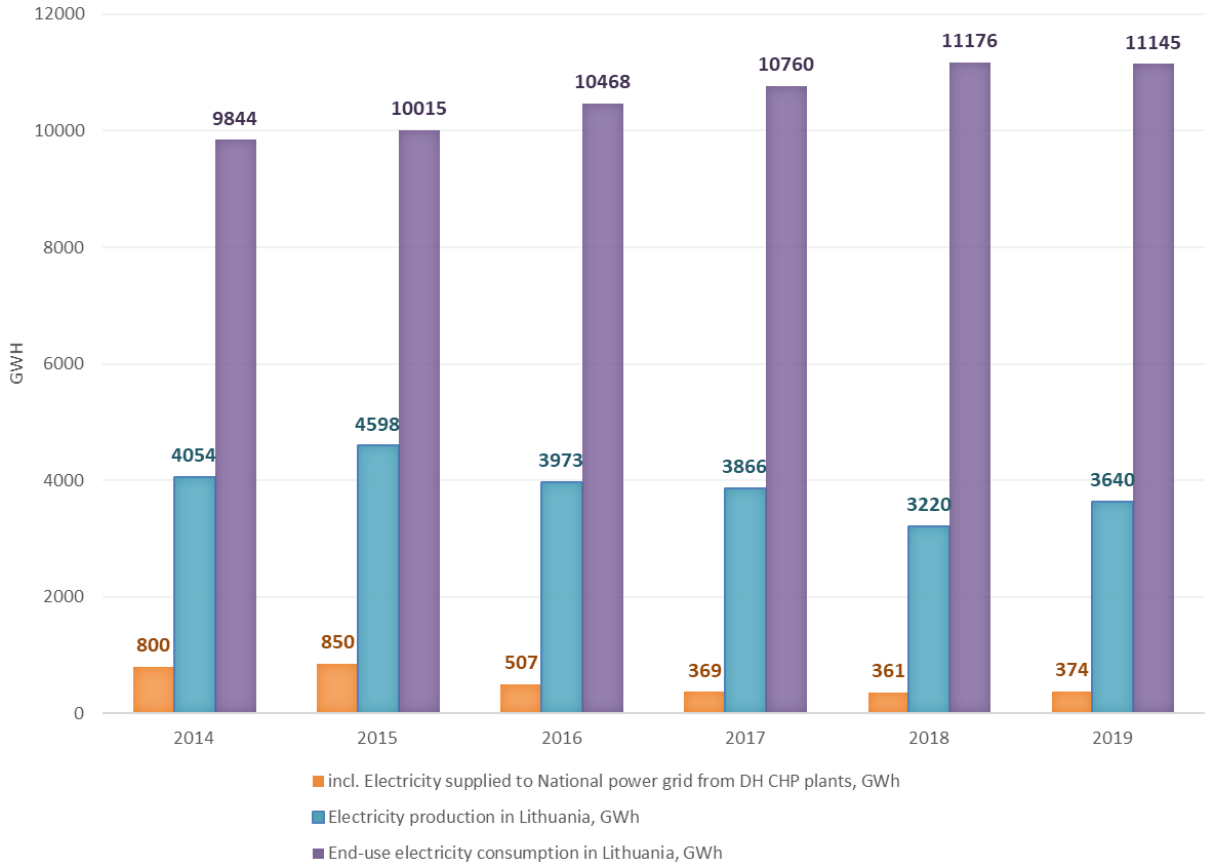

Fig. 7 The amount of electricity produced by DH CHP in the Lithuanian electricity generation and consumption balance

At the end of 2019 there were 17 biomass CHP plants operating in DH market. In 2019, about 370 GWh of green electricity was produced in biomass and waste to energy CHP plants, equivalent to approximately to 10% of the total volume of electricity (3640 GWh) produced in the country.

One of the goals set in National Energy Independence Strategy (2018) is to develop high-efficiency CHP plants that create possibilities for local electricity generation. It is planned that the construction of two modern biomass and waste-to-energy CHP plants in Vilnius (90 MW_e and 230 MW_{th}) and Kaunas (24 MW_e and 70 MW_{th}) will increase the Lithuania's renewable power generation capacity by around 20%. Kaunas waste-to-energy CHP plant started to

operate at the beginning of 2020, and modern Vilnius CHP plant will be in operation at the end of 2020.

These CHP plants are expected to satisfy around 40% of Vilnius and Kaunas district heat's needs. Currently, they are the largest energy project in Lithuania implemented over the past 20 years.

The financial support for small-scale CHP plant (up to 5 MWe) development is also provided via the EU structural funds 2014-2020. Howeverdue to unfavorable funding conditions (low funding intensity, limited maximum amount of support) no projects have been implemented so far.

2.2 National DH regulatory framework: a DH sector significantly supported and influenced by the State

The objective of the National Heat Sector Development Program 2015-2021 is to assess and to determine the opportunities and priorities, objectives, tasks and ways of their implementation in the context of national and international environmental, energy sector development trends and economic situation.

The area concerning modernization of inefficient district heating systems there are no regional or national action plans. The companies that are in bad financial – technological situation is often left on their own, with heavy regulatory burden which makes difficulties in making significant actions to implement changes.

2.2.1 Several legal acts design the significance of DH and development plans:

1. Law on the Heat Sector (EN) (establishes relations between participants);
2. National Energy Independence Strategy (EN) (emphasis on local biomass usage and cogeneration);
3. National Heat Economy Development Program (LT) (cogeneration penetration);
4. National Air Pollution Reduction Action Plan (LT);
5. Directions of EU support for the period 2021-2027;

2.2.2 Specific support and promotion measures apply in the LT DH sector:

1. Reduced VAT rate 9% instead of 21% applies to household consumers;
2. Individual support for heating and hot water consumers that requires support (assistance);
3. EU support for biomass boilers, cogeneration, pipelines ...
4. Climate change program support for renewable energy production sources, environmental measures, etc.;
5. Municipal support for specific projects;
6. Special heat management plans identify priority areas for DH (zoning);
7. Safe (regulated) investments in the heat transmission system;
8. Support for connection of new users;
9. Difficult disconnection of a separate apartment from the DH system;
10. Support for small (engineering) renovation - modernization of heat substations;
11. Future support for the development of district cooling systems.

2.3 EU level

However, there are no European regulation and/or strategies on the DH networks, and it is often left in the hands of countries government. The government in Lithuania does not show

enough interest in DH sector issues. The DH area is often in the shadow of more significant energy topics (gas or electricity).

2.3.1 National Energy and Climate Plan

The Government of Lithuania will soon introduce a new National Energy and Climate Action Plan for 2021-2030, in accordance with the requirements of the Energy Union Governance Regulation.

The National Energy and Climate Action Plan has been prepared on the basis of the integration of Lithuanian national legislation and international legislation, objectives, targets and achievements of commitments, strategies, and measures planned to be implemented.[3]

2.4 Regional level

On the municipality level there are some obligations. Each municipality must have Heat Sector Specific Plan heating zones are separated into:

- District heating zone
- Market zone
- Natural gas zone
- Unregulated

The issue regarding the municipalities' specific plans is that they are often outdated with only few updates time to time. In real life the Municipality Heat Sector Plan usually have negligible importance and stands more as recommendation rather than obligations.

Municipality Special Plans for Heating - Vilnius example (only LT).

2.5 SWOT analysis of DHC network in Lithuania

STRENGTHS (INTERNAL) • The district heating sector is already using more than 70% renewable energy sources.	**W**EAKNESSES (INTERNAL) • Risky investments in heat production, since (Independent heat producers can arise in any DH system which would usually mean in full or partial operation loss for existing few year-old infrastructure before its depreciation period finished); • Risky investments in the connection of new heat consumers (no long-term agreements);
OPPORTUNITIES (EXTERNAL) • Due to the fact that most of the legal acts and rules are outdated in many parts there is a significant potential for improvement of the DH sector	**T**HREATS (EXTERNAL) Generally: market conditions • Detailed and inflexible regulation hinders marketing of district heating; • Complicated and inadequate pricing - the heat price is recalculated every month – this imbalance financial flows and results in large payments in winter;

	• Ministry of Energy will not use EU structural funds in the new financial period will not support pipework installations which due to its long depreciation period is usually unattractive investments and increase burden for company's and its consumers. (The pipe network installations were funded in previous financial periods) • Authorities (energy regulator, municipalities, etc.) often fail to meet their obligations on time, which harms the DH operator in various fields. (Municipalities' heat sector plans are not renewed on time, regulator does not recalculate pricing on time, etc.) • Part of the objective costs are not recognized as justified by the regulator which result in financial losses for DH companies;

3. Proposed action plan

3.1 Heat management program and development planning

Existing regulation: Heat economy planning is performed at two levels - State (national heat economy development program) and municipal (special plans).

Problems: The Regulation of state-level planning does not allow to take into account the specificities of each municipalities and creates preconditions for the development of state projects, regardless of the needs of a particular municipality. Meanwhile, municipal special plans are in principle a map identifying heating zones. At the municipal level, there is no real planning of investments, capacities or modernizations.

Proposed solution: Better coordination between State and municipal levels for heat generation development and planning

The preparation of municipal plans is coordinated by the State, which, according to the plans prepared by municipalities, summarises the situation in the country and common priorities. The heat economy development program is prepared every 5 years. One State-level program is prepared, but according to the contribution of municipalities and taking into account the specificities of municipalities. The programs include the planned investment directions (including planned additional capacities for which heat capacity auctions will be announced (see below), heat demand and expected development, priorities, etc. Special plans (city layout issues and measures to achieve the goals) are prepared by municipalities.

3.2 Heat supply, reservation and balancing (System services)

Existing regulation: The Law on Heat Economy does not regulate the provision of system services, such as reservation and balancing of heat generation. The provision and payment of these services is left to be regulated by by-laws. By-laws stipulate that heat production reservation services are provided by a heat supplier. The provision of the reservation service is paid for by heat consumers through the price of heat. Heat producers do not pay for the use of heat supply networks and other infrastructure. Balancing services are paid for by independent heat producers, taking into account the deviation from the planned and supplied amount of heat.

Problems: The balancing cost recovery formula does not reflect the full cost of providing the balancing service (for example, increased fuel prices due to urgent fuel purchases, etc.).

Independent heat producers do not contribute to the maintenance of heat supply infrastructure. For all heat producers, this infrastructure, its quality and development is a necessary precondition for running a business. The heat supply infrastructure is outdated and worn out. The current heat price model does not allow for the renewal of the heat supply infrastructure due to the particularly long period of pipe wear. There are no means to raise funds for infrastructure upgrades.

Proposed solution: Regulation of the basic principles of provision and payment of all system services by law.

The principles for the provision of balancing services would not change substantially, but the law would include a principle to ensure that all costs are covered.

The principles of reservation services are regulated by law, but in principle the model is not changed. The reservation service is provided by the heat supplier, the services are paid for by the consumers.

The law proposes to introduce a network efficiency tax, which would be paid by all heat producers (after excluding the heat supplier) in proportion to the share of heat produced and supplied to the network. The network efficiency charge would be calculated taking into account the additional costs incurred by the heat supplier in the network due to the heat producer (e.g. selected location, capacity, etc.). The network efficiency charge could be waived or reduced if the heat supplied by the producer to the network increases the efficiency of the network. The amount of the network efficiency fee is set by VERT. The fee is paid to the heat supplier on a monthly basis, depending on the amount of heat supplied to the network by the producers. The heat supplier does not pay the fee. The heat supplier's production facilities are considered to reflect the baseline scenario from which the increase or decrease in costs is assessed. The funds raised from this tax could only be used for the efficiency, renewal or development of heat supply infrastructure. Such heat supply infrastructure could not be included in the price of heat to consumers.

3.3 Heat pricing

3.3.1 Basic heat price and heat price regulation principles:

Existing regulation: The base price for heat is set for a period of 3 to 5 years. The base price captures the planned costs included in the price for the next 3-5 years. In this way, during the base price period, the heat supplier should be encouraged to increase efficiency in order to benefit from efficiency gains and savings. The price of heat is recalculated annually and monthly (in the latter case due to the price of fuel and purchased heat). The price includes the costs necessary for heat production, supply and customer service. VERT may or may not recognise specific costs as necessary.

The individual cost categories incurred by heat suppliers are compared with each other. If the individual cost category of the heat supplier exceeds the median of the heat suppliers of the respective group, such costs may not be included in the heat price.

Problems: (i) VERT allows the inclusion of "necessary costs" in heat prices, but the legislation does not define which costs are considered necessary or such definitions are very general. Accordingly, VERT has a wide discretion to prevent heat suppliers from incurring certain costs or to reduce the share allowed to be included. The part of the costs included does not create preconditions for efficiency gains. On the contrary, part of the necessary costs is covered by the profits of the heat supplier. (ii) The application of benchmarks to individual cost categories does not take into account the specificities and cost structure of different heat suppliers. (iii) The heat supply business unit (as opposed to production) does not generate timely revenue on its own, including due to depreciated infrastructure and limited efficiency.

Proposed solution: Heat pricing and incentive for suppliers through an updated benchmarking mechanism. The price of heat is binary. The price consists of a fixed cost component and a variable cost.

Fixed costs: In the groups of heat suppliers (it is proposed to provide two groups according to the amount of heat supplied - up to 10 GWh and above 10 GWh) the total fixed costs incurred by heat suppliers are compared (not according to separate cost categories as at present). Investment costs and depreciation are not included in the comparison. After the comparison, the median fixed cost of the group of heat suppliers is derived. If the costs provided by the heat supplier do not exceed the median, the heat costs provided by the heat supplier shall be included in the heat price. If the costs provided by the heat supplier exceed the median, the heat supplier must justify why such costs are necessary. If the heat supplier does not substantiate the necessity of the costs, the costs equal to the median of the group of heat suppliers are included in the heat price.

Further savings from heat suppliers to the heat supplier remain as a profit. The rules of profit sharing with customers are not applied, thus motivating heat suppliers to increase their efficiency during the validity period of the base price. Inefficiencies compared to the median cost of heat suppliers (also taking into account the additional allowable costs due to differences from the median) are covered by the profit of the heat supplier.

Mandatory taxes to be paid are included in the heat price in full.

The regulation would establish the possibility to take into account the specifics of a particular heat economy when setting the basic heat price and, in case of objective reasons, to justify and include additional costs exceeding the median cost of the group of heat suppliers. The Law on Heat Economy would define the criteria / cases in which VERT must take into account the differences between heat suppliers, which result in a heat price higher than the median of the group. The list provided would be non-exhaustive, providing preconditions for defence and other objective costs. These "other" costs and specificities should be defended by the heat supplier VERT, through objective differences from other heat suppliers. For example, higher labour costs per unit of energy produced, electricity consumption for heat pumps due to geographical reasons, and so on.

Under this model, the base heat price would be set for the respective group of heat suppliers simultaneously. The law would fix a specific period of validity of the base heat price, e.g. 3-5 years. During this period, the heat price is not recalculated due to the change in fixed costs, with the exceptions provided for, ie: (i) the amount of heat sold, (ii) reasonable new differences from the median cost increase, (iii) the risk of insolvency (should be accompanied by an audit / report), for reasons of insolvency and an action plan to restore solvency and increase efficiency), (iv) correction of identified actual or arithmetical / calculation / factual errors in the calculation of basic prices, (v) matched investments and (vi) inflation. All efficiency remains with the heat suppliers. At the end of the period, a new base price is set.

In the case of variable costs, the current requirements for the competitive purchase of fuel and heat are maintained, but the costs themselves are not regulated. Optimal fuel structure is not applied. VERT has the right to check whether the heat supplier rationally uses generation facilities when there is no competition in the heat generation market. Variable costs are covered in full on a monthly basis by including them in the heat price. Variable costs are included based on the fact for the previous month. The heat supplier publishes a variable price projection on a monthly basis (until 25 days). Consumers pay for the variable costs actually incurred.

The price of heat due to the payment of mandatory taxes (VAT, etc.) is recalculated from the date of the change in the taxes payable, regardless of the annual recalculations. The heat price due to this change is recalculated by the heat supplier without coordination with VERT. Following such recalculation, the heat supplier shall provide information on price adjustments made due to the tax change.

Investments and their payback are described below.

The mechanism would make it possible to dispense with VERT's verification of the reasonableness of individual costs and VERT's role as manager of the heat supply business. It would also reduce the administrative burden and the burden on VERT.

3.3.2 Investments and return on investments

Existing regulation: The heat supplier coordinates the investment with the relevant municipality and VERT. VERT approves an investment if (i) the investment is necessary for the heat industry or (ii) the investment reduces the price of heat. The heat supplier finances investments from its own and borrowed funds, as well as subsidies. The investment is included in the base price of heat after its completion, during the next annual heat price recalculation.

The Law on Energy stipulates that when setting State-regulated prices, the return on investment and / or return on equity (hereinafter collectively referred to as the return on investment) must be assessed. The current Law on Heat Economy does not, in principle, detail the principles for determining the return on investment, and the methodology for determining the rate of return on investment approved by VERT essentially refers only to the Law on Energy. According to this methodology, the rate of return on investment for an undertaking is determined for the regulatory period, without changing the established capital structure and the cost of equity, but is adjusted annually.

The rate of return on investment for an undertaking is determined for the regulatory period according to the theoretically determined optimal capital structure, which differs significantly from the real equity to debt ratio historically formed in heat supply companies. This ratio is the same for all regulated sectors: gas, electricity, water, heat supply, etc.

Problems: Coordinating investments in municipalities is often a political process and / or duplicates the decisions of the municipality as a shareholder in the heat supplier. Municipalities often do not have the technical competence to decide whether an investment is necessary or whether the investment costs are reasonable. The investment coordination performed by VERT focuses on localised formal criteria and does not assess the efficiency of the heat management system as a whole.

The inclusion of an investment in the price of heat after its completion results in a deferral of up to one year from the time the investment is put into operation until the heat supplier begins to recover depreciation and return on investment.

The current Law on Heat Economy does not sufficiently establish the principles of determining the return on investment and, unlike other sectors, VERT has more freedom to interpret what constitutes a reasonable return on investment in a heat industry. Also, the current return on investment approval is based on its determination for the regulatory period, which is adjusted

annually. This creates uncertainty and increases the cost and risk of investment projects (higher risk is assessed by financial institutions, greater uncertainty, etc.).

As optimizing the capital structure according to the established VERT optimal would cost significant additional costs, incur additional costs that would not be considered necessary, the capital structure differs significantly from the optimal, losing return on investment, risks securing, maintaining and expanding heat supply activities.

> Proposed solution: Coordination of investments with the municipality is refused. Investments are coordinated only with VERT. VERT combines investments when (i) the investment is necessary for the heat economy in accordance with the requirements of legal acts or (ii) the investment increases the efficiency of the heat economy. VERT does not assess the return on investment. VERT compares investment projects between heat suppliers, their impact on the heat economy, energy efficiency, cost-benefit analysis, compliance with the priorities of the heat economy program.

The investment may be included in the heat price through the determination of the base price or the annual recalculation of the heat price, provided that the investment is completed and put into operation during the next year of the price validity. The part of the investment that will be proportionate to the relevant period after the planned completion of the investment may be included.

The law proposes to detail the main principles of determining the rate of return on investment in the heat sector, emphasizing the incentive objectives of this mechanism, i.e. to ensure that the return on investment (i) encourages operators to upgrade obsolete infrastructure (system of bonuses, incentives and other additional financial benefits); (ii) help to ensure security and continuity of supply; and (iii) raise other specific KPIs assessing the efficiency and quality of service of the undertaking (increase in the number of users, reduction of heat transmission losses in the networks, number of accidents in the network, etc.). It is also proposed to establish the principle that the return on investment for economic operators can be set for the payback period of a specific investment and to provide for a minimum return on investment, which would remain constant even after the annual conversion (for a certain period, the return on investment could not fall below the minimum threshold). Such regulation could apply to a specific investment. In this way, economic operators would be guaranteed a certain amount of cash flow, which would significantly reduce investment financing costs and final heat prices for consumers. This would not only make it cheaper to finance, but could also lead to larger projects being implemented, which would benefit consumers. The minimum weighted average cost of capital (WACC) for an investment is fixed during the investment adjustment, which would significantly reduce investment financing costs and final heat prices for consumers. This would not only make it cheaper to finance, but could also lead to larger projects being implemented, which would benefit consumers. The minimum WACC for an investment is fixed during the investment adjustment. which would significantly reduce investment financing costs and final heat prices for consumers. This would not only make it cheaper to finance, but could also lead to larger projects being implemented, which would benefit consumers. The minimum WACC for an investment is fixed during the investment adjustment.

The capital structure is recalculated according to the capital structure of the existing heat supply companies. The typical capital structure is determined accordingly. After the first recalculation, VERT reviews the typical capital structure before setting the base price.

3.3.3 Heat price differentiation

Existing regulation: Article 32 (5) of the Law on Heat Economy provides for the possibility to differentiate the price of heat for consumer groups depending on the costs incurred.

Problems: The mechanism does not work in practice due to the fact that VERT would have to approve each differentiated price.

Proposed solution: Allow price differentiation for commercial consumers (consumption over # MWh per year). VERT would not regulate such prices. This would allow offering customized solutions to large commercial users. The investment required to connect such commercial customers could not be included in the heat price applicable to all customers.

3.3.4 Heat pricing procedure

Existing regulation: The draft basic price of heat and annual recalculations are prepared by the heat supplier. The basic heat price project is submitted 5 months in advance. until the base price expires. If the heat supplier supplies more than 10 GWh of energy per year, the municipality participates in the process and has 30 days to comment to the VERT on the heat price. VERT checks and approves the base heat price. The municipality sets the price of heat for the first year. The VERT checks that the heat price has been set correctly by the municipality. If the heat supplier supplies less than 10 GWh of energy, VERT does not participate in the pricing. The basic price of heat is approved by the municipality, and the final price is calculated and applied by the heat supplier.

The heat price is determined using the data of the last three full years prior to the submission of the draft basic price to VERT / Municipality.

The price of heat is recalculated annually due to changes in fixed costs and investments, as well as changes in some variable costs other than fuel and the price of purchased heat. The heat price is recalculated on a monthly basis due to changes in the prices of fuel and purchased heat.

Problems: It may take more than a year from the submission of the draft base price to VERT before the price takes effect. The pricing procedure is lengthened by (i) VERT workload and available resources, (ii) calculation complexity and individual calculation for each heat supplier, (iii) coordination processes with the municipality when the heat supplier supplies more than 10 GWh of heat.

Obsolete data from several years ago are used to determine the basic price of heat. The recalculation of the heat price is delayed by one year due to the change in the amount of variable costs other than fuel. The use of outdated data distorts the set price of heat. Delayed recalculation of variable costs has a negative effect on the cash flows of heat suppliers.

As a result of the annual conversion, heat suppliers lose efficiency gains and most of the profits earned in excess of the allowable return on investment. Such a system does not motivate heat suppliers to increase efficiency, which would reduce the price of heat in the long run.

Proposed solution: The basic heat price for heat suppliers supplying more than 10 GWh of heat per year is set by VERT. The municipality is not involved in this process. The heat supplier prepares a draft base price, which is approved by VERT. If the heat supplier's costs do not exceed the median of the heat supplier group, VERT does not review the heat supplier's base price. The heat supplier calculates and applies the heat price for the first year. VERT has the right to check whether the heat supplier has

correctly calculated and applied the heat price. The principle is similar to the one currently applied to suppliers supplying up to 10 GWh of energy, only VERT operates instead of the municipality. The procedural change will reduce the administrative burden on heat suppliers and speed up the process of setting the base price for heat. The process should also be more depoliticised.

For heat suppliers supplying less than 10 GWh per year, the price of heat is set by the relevant municipality in the same way as above. VERT provides municipalities with the necessary information on the median cost of heat suppliers in the heat supplier group.

The law could oblige VERT to prepare official base heat price calculators. Such calculators would standardize and speed up the calculation of the price of heat. VERT is already using them, but informally.

Audited data on regulated activities for the last two full years prior to the submission of the draft price are used to determine the base heat price. The same regulation period is used for all heat suppliers in the respective group. The price also uses cost projections for the next 3 years, which are determined by VERT on the basis of a limited number of components (e.g. inflation).

As the omission of data from one supplier may distort the price of heat for the whole group to the detriment of consumers, the omission of the data required to establish the price would be considered a serious infringement of energy activities with a penalty of 10% of turnover. VERT may reduce or waive the sanction depending on the reasons for not providing the data. Failure to provide data would not suspend pricing for the group as a whole, i.e. the price would be set without the data of the non-reporting heat supplier, including the non-reporting entity.

Annual heat price recalculations are made (i) for heat sold, (ii) for reasonable differences from the median cost of a group of heat suppliers, (iii) for insolvency risk (should be accompanied by an audit / conclusion, for insolvency reasons and an action plan to restore solvency and efficiency). (iv) the correction of identified errors in the calculation of basic prices, (v) the matching of investments and (vi) inflation. If the VERT has performed an inspection and found irregularities or errors, the heat price may be recalculated without waiting for the annual recalculation. The price of heat is not recalculated due to the implemented efficiencies. The annual heat price recalculation is performed and applied by the heat supplier, without the intervention of VERT. VERT has the right to check whether the price has been recalculated correctly. If the price is found to be incorrect,

The heat price is recalculated by the heat supplier on a monthly basis without the intervention of VERT due to the change in all variable costs. VERT shall have the right to verify the appropriateness of such conversion.

The law establishes a term for VERT / Municipality to determine the basic heat price. If VERT / Municipality delays in setting the price, the price calculated by the heat supplier shall take effect, which may be reviewed by VERT / Municipality. Following such a review, the adjustments made by VERT / Municipality have no consequences for the heat supplier for the past period. VERT / Municipal adjusted price applies forward.

3.4 Consumer relations

Existing regulation: The Heat Economy Act does not regulate prosumers.

Problems: With the proliferation of individual heating solutions, consumer-producer regulation will become relevant.

Proposed solution: Establish relationships with consumer-producers. A model similar to that used in the electricity sector is possible, with a savings tax. The storage fee would depend on

the additional costs incurred by the heat supplier (eg network balancing) and other relevant criteria.

3.5 Administration of internal maintenance of buildings

Existing regulation: Since 2011, large heat suppliers have been banned from also supervising the internal systems of buildings. The insurance also applies to companies related to the heat supplier. Accordingly, heat suppliers do not have the right to manage or regulate the parameters of heat points. The insurance does not apply to heat suppliers who have concluded agreements with the Ministry of Energy on energy saving in accordance with the Law on Energy Efficiency of the Republic of Lithuania and are installing new energy efficiency measures in the building during the term of the agreement.

Problems: Heating substation and the proper maintenance of consumers' internal systems are an important part of an integrated heat economy affecting the efficiency of the whole system. Removing this part binds your hands to streamline the system. At the same time, the issue of redemption of heating points after the 2011 amendments to the Law on Heat Economy remains unresolved.

Proposed solution: Removes the restriction on heat suppliers to maintain heating points and home interior systems. The comfort level (room temperature) is determined by the building owner or the owners' association / The building owner, the maintenance of the internal systems and the heating station determine the optimal temperature schedule to ensure the required comfort. The potential internal system supervisor may sign a heat saving agreement with the Building Owner specifying the amount of heat consumed per year (under defined conditions). The heat supplier has the right to determine the temperature of the water returning from the heating substation to the heating networks. Failure by consumers to comply with the return water temperature requirement may result in additional costs / charges for consumers exceeding the return water temperature. This would encourage consumers to keep the return water temperature as low as possible. This would ensure minimum electricity consumption for heat transportation. It would also ensure lower heat losses in heating networks. This measure would contribute to the reduction of heat transmission costs and, at the same time, to the reduction of heat prices.

The internal systems of the house would be subject to security and reliability requirements. The technical design of newly installed heating points (including retrofitting heating points) should be coordinated with the heat supplier. In the case of existing heating stations, the heat supplier has the right to give instructions regarding the modernisation of the heat substation if the existing equipment is unusable or causes significant losses (open system). Such instructions could be appealed to VERT.

The heat supplier has the right to enter the heating point free of charge during working hours, and in case of emergency and outside working hours. The home administrator has a duty to arrange for such access.

In case the manager does not follow the instructions of the heat supplier, the heat supplier includes additional costs for the residents of the respective house due to non-compliance with the instructions (e.g. cogeneration water price, leaks at the heating station.) If defects in the heating station endanger the whole system. mixing with the internal heating system of the house system), and the manager does not follow the instructions for more than 12 months. the heat supplier has the right to perform the necessary work to eliminate the defect and invoice the users for the work or disconnect the house.

Heat substation must be owned by the homeowners. If the house does not have a heating point by ownership (or other legal basis), within 12/24 months. from the entry into force of the

law, acquires it from a third party for the residual value or other agreed price (not exceeding the residual value) or installs its own heating point.

3.6 Unregulated activities

Existing regulation: The law does not regulate the activities of other heat suppliers. By-laws require the application of the principles of separation of costs and revenues.

Problems: There are disputes with VERT as to which costs and revenues should or should not be attributed to regulated activities. For example, when the infrastructure of a regulated activity is used for an unregulated activity but does not incur any additional costs for the regulated activity. The problem may become more acute for heat suppliers through the further development of unregulated activities, such as the refrigeration service provided using heat supply pipes.

Proposed solution: The law defines that a heat supplier has the right to engage in other unregulated activities. Such activities are subject to the prohibition of cross-subsidisation and accounting separation requirements. The law proposes to establish the principles of accounting separation in accordance with the principle of carrying out the activities of a separate business unit.

3.7 Taking over the management of the heat economy

Existing regulation: The law succinctly defines the rights and obligations of the entity that has taken over the heat economy.

Problems: Insufficient regulation, incomplete, leaves a wide margin of discretion to municipalities and entities that have taken over the management of the heat economy.

Proposed solution: It is proposed to abolish such regulation in the Law on Heat Economy. Municipalities that opt for the transfer of heat management are available with other mechanisms, such as a concession, regulated by separate laws.

3.8 Regulatory frameworks and legislation: improving the regulatory market conditions in the heat sector (2021-2030 period)

Overall, for the period 2021-2030, the following actions should be given priority:

1. Establishment of a legal regulatory environment that encourages investment attraction and creates a non-discriminatory environment for all participants of the district heating market;
2. Increasing transparency in the biomass market;
3. Promoting and prioritizing the district heating for consumers in urban areas in order to reduce air pollution;
4. Evaluation of the current situation and perspective development of decentralized sector heat supply, envisaging rational development directions, evaluating the change of heat production technologies, increasing the efficiency of heat production and consumption;
5. Assessment of the current situation in the cooling sector, performance of a prospective analysis for district cooling.

The most important goal for heating and cooling sector of Lithuania is consistent and balanced renewal (optimization) of district heating systems, ensuring efficient heat consumption, reliable,

economically attractive (competitive) supply and production, enabling the implementation of modern and environmentally friendly technologies using local and renewable energy sources, ensuring system flexibility and a favourable environment for investment. In accordance with the good practice of the other EU countries, the transition to the 4G district heating supply in Lithuania must be promoted by integrating solar plants, heat pumps, etc. into the district heating networks and promoting the use of surplus and waste heat.

4. Promotion of the action plan and recommendations

As the content of the present document is relevant for national stakeholders, all the information is available in Lithuanian language and Lithuanian District Heating Association is focusing on different aspects of this action plan in their advocacy work. For more information, please refer to the responsible contact person at Lithuanian District Heating Association.

At the European level, the Lithuanian perspective was in the spotlight of the RHC ETIP National Roundtable, which took place during the 100% RHC event 2020 on 15 October 2020. The overall objective of the roundtable was to discuss how the target of a 100% renewable heating and cooling future is being approached in Lithuania and what are the challenges and possible solutions, according to representatives from different sectors.

The event recording includes presentations and discussions with:

- Indre Buteniene – Head of Strategy; City of Klaipeda
- Liudas Getautas – President; Lithuanian Heat Pump Association
- Valdas Lukoševičius – President; Lithuanian District Heating Association
- Darius Biekša – Director; Lithuanian Energy Agency

It was moderated by Eglė Randytė – Managing Director at VšĮ Atnaujinkime miestą

Additionally, the Lithuanian approach to DH policies and planning was presented at the UpgradeDH workshop, which took place during the KeepWarm final event on 12 November 2020. The overall objective of the session was to discuss local aspects, challenges and policy solutions for energy efficiency in DH systems.

The event recording (https://keepwarmeurope.eu/finalconclusions/) includes presentations and discussions with:

- Ina Bērziņa-Veita – President; Latvian District Heating Association
- Valdas Lukoševičius – President; Lithuanian District Heating Association, Lithuania
- Ajla Merzić – Lead Expert Associate for Power Generation Unit Development; JP Elektroprivreda BiH d.d., Bosnia and Herzegovina
- Susana Paardekooper – PhD Fellow; Aalborg University, Denmark

It was moderated by Dominik Rutz – Head of Unit Bioenergy & Bioeconomy; WIP Renewable Energies

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