ANALYSIS OF TARIFF SETTING IN THE DISTRICT HEATING SECTOR OF EU COUNTRIES

UABio Position Paper N 14

Georgii Geletukha, Tetiana Zheliezna, Anatolii Bashtovyi

February 09, 2016

Publication at www.uabio.org: 09.02.2016
The publication is available at: www.uabio.org/activity/uabio-analytics
Responses and comments: geletukha@uabio.org

Content

Introduction 3
State of the art and prospects for the development of district heating sector in Europe 3
Analysis of district heating sector in the selected countries of the EU and Europe 8
Germany 8
Denmark 10
Great Britain 13
Finland 14
Austria 17
Sweden 20
Norway 21
Italy 23
Netherlands 24
Poland 26
Lithuania 27
Latvia 30
Estonia 31
Croatia 31
Situation in Ukraine. Recommendations for the improvement of heat market operation 32
Conclusions 34
Annex 1. Summarized information on the DH market structure and ownership in the selected EU countries 35
Annex 2. Summarized information on the heat market features in the selected EU countries 37
Abbreviations 41
Previous publications by UABio 41

Introduction

Position Paper N 14 prepared by the Bioenergy Association of Ukraine analyses the district heating sector of the EU countries. Especial attention is paid to such issues as regulation of the market and existing heat tariff setting schemes. Basic models of the heat market are studied. The Paper suggests recommendations on how to reform the district heating market of Ukraine based on the identified best EU's practices.

State of the art and prospects for the development of district heating sector in Europe

In the European Union, the biggest part of the final energy supply (45%) is heat that considerably exceeds other sectors of consumption: electricity 20%, transport 26%, non-energy use 9%. Residential sector consumes 40% of the final energy of which 68% is heating and 14% hot water supply.

At present, there are over 6000 DH systems in Europe, which provide 12% of the total heat demand. About 60 million people use DH; over140 million people live in cities where at least one DH system exists. In 2013, the share of citizens using DH exceeded 50% in eight European countries: Iceland – 92%, Latvia – 65%, Denmark – 63%, Lithuania – 57%, Estonia – 62%, Poland – 53%, Sweden – 52%, Finland – 50%.

CHP plants and co-generation installations running on all fuel types along with industrial waste heat make up the lion share of heat in European DH systems (72.8%). Fossil fuel boiler plans produce 19.5% and the rest (7.7%) is generated by biomass boiler plants and other renewable energy installations (**Fig. 1**). One can observe quite stable trend of increasing use of RES in DH (**Fig. 2**). Now, the average share of RES in the EU-28 DH systems is over **23%**. However, in some countries, the share varies a lot from the average value.

A very important issue is ***regulation of heat market and setting of heat tariffs***. At present, there are the following regime categories in European countries[1]:

- DH companies set competitive prices while *competition authorities* monitor *excessive* profits based on competition law (Sweden, Finland, Denmark, Germany, Austria, Belgium, France, and United Kingdom). According to expert opinion, under such tariff regime effective competition between DH and other heating solutions does not allow the prevailing heat suppliers to set heat prices that are too high (monopolistic heat prices).
- Alternative-based heat pricing as main pricing principle to promote DH against other heating solutions (like electrical heating in Norway and NG-based individual heating in the Netherlands).

[1] Harri-Pekka Korhonen. Overview of DH pricing and regulation in Europe. Fortum, 2012 http://www.lsta.lt/files/events/121204_FORTUM/10_Overview%20of%20DH%20pricing%20and%20regulation%20in%20Europe_H-P%20Korhonen.pdf

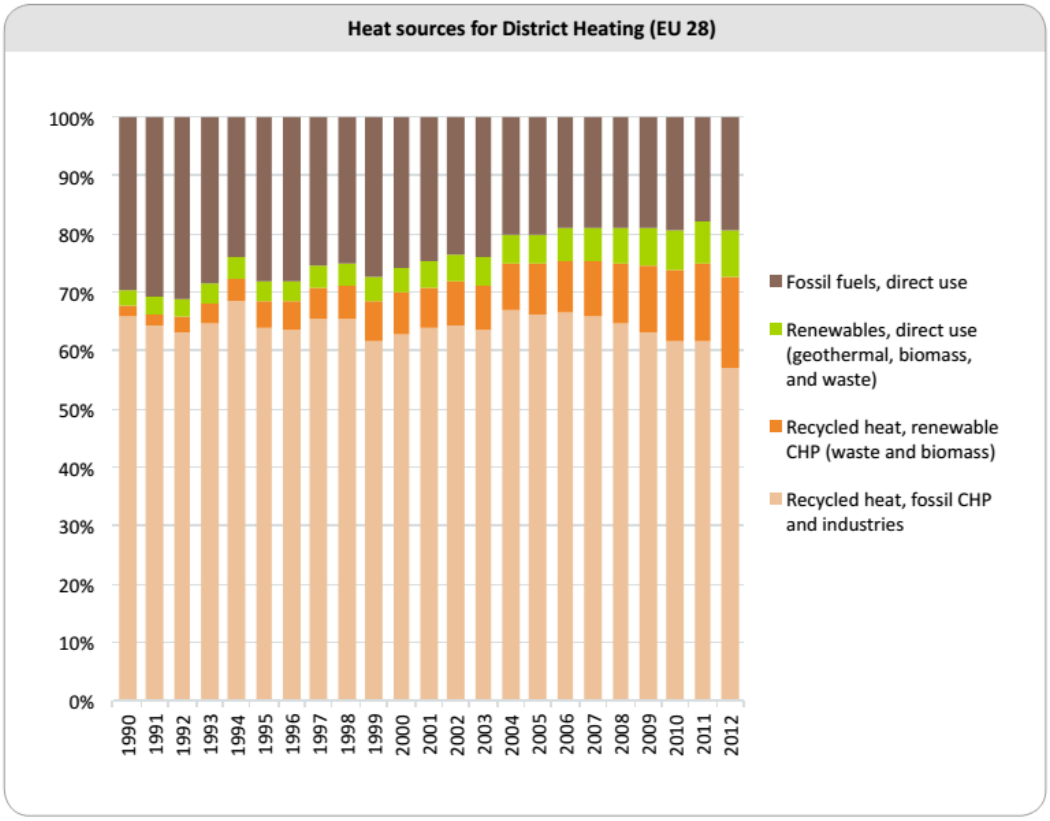
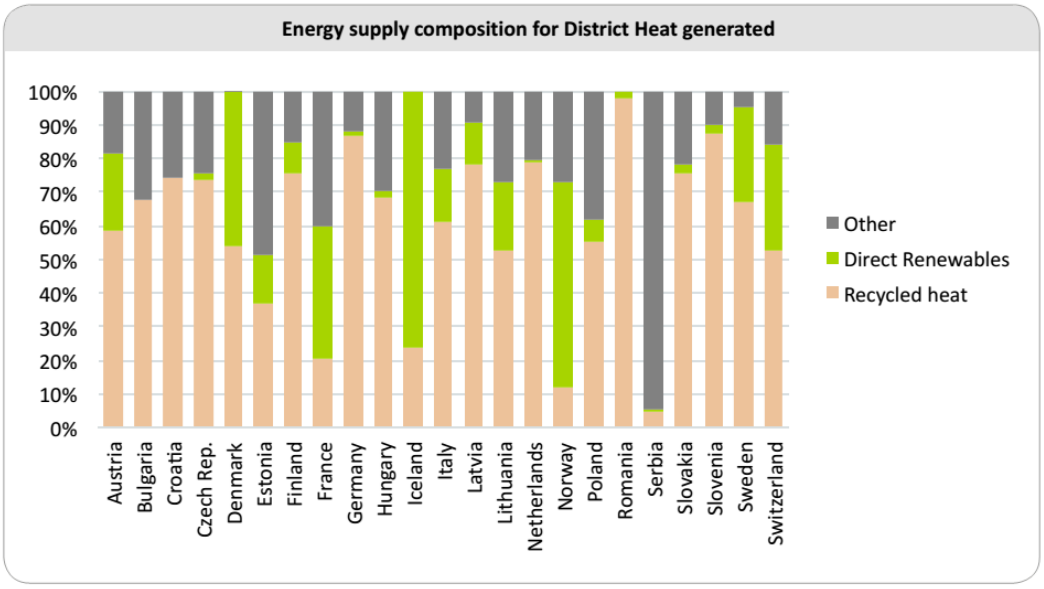


Fig. 1. Heat sources for DH in EU-28[2]



'Recycled heat' includes surplus heat from electricity production (CHP), Waste-to-Energy cogeneration plants and industrial processes independently of the fuel used (renewables or fossil) for the primary process. Two-thirds of the energy delivered by heat pumps is also considered as recycled heat. 'Direct renewables' cover the use of renewable energy in heat-only boilers and installations other than CHP. 'Other' covers heat-only boilers, electricity and one-third of the heat originating from heat pumps

Fig. 2. Energy supply composition for district heat generated (2012)[2]

[2] District Heating and Cooling Country by Country 2015 Survey. Euroheat&Power (paid access) http://www.euroheat.org/DHC---Statistics-4.aspx?PID=417&M=NewsV2&Action=1&NewsId=557

- Heavy-touch ex-ante price control based on established methodology and approval of *maximal* prices by autonomous national *regulator*. At that, a DH company can deviate from the tariff fixed for it towards lower values (Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary, Bulgaria, and Macedonia).
- Heavy-touch ex-ante price control based on established methodology and approval of heat prices by autonomous national *regulator*. At that, a DH company cannot deviate from the tariff fixed for it (Russia, Belarus, Romania, and Ukraine).

The Position Paper covers the tariff regime categories in more detail by the example of some selected countries.

Other key issues connected with each other are *unbundling* in DH and *heat network access by third-party producers*. The Paper covers these questions briefly, as another position paper will be dedicated to them later.

Unbundling means a legal division of existing heat supply companies into at least two independent companies. The first company would be engaged in the production of heat while the second company would deal with heat transmission and supply. The main purpose of the unbundling is separation of heat production and heat transmission, since it is expected that such separation will facilitate heat network access by third-party producers (including producers of heat from RES).

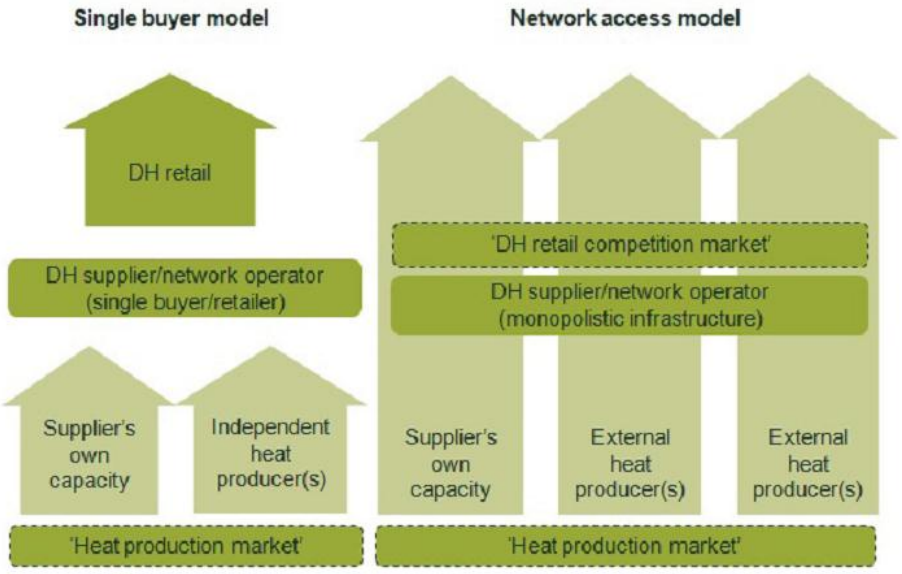
Heat network ***third-party access***[3] and its influence upon the development of competitive heat market is now under study and discussion in the EU. Unbundling of heat production and transmission and also TPA principle are already implemented in the EU's electricity and gas markets. Since the heat market is much more complicated by its structure, ownership and operation peculiarities, the issue of wide application of TPA still is under examination and analysis by experts.

At present, there are two models of DH market in Europe[4]:

- In the ***single-buyer model***, the heat supplier/network operator offers heat to similar end-customers on equal terms and prices, although the ownership of different parts of heat networks varies. This can be achieved if the overall responsibility for heat retail to end customers is directed into one body – e.g. the main heat network. Under this model, the vertically integrated network operator needs to provide access to third-party producers and its own production source on equivalent terms (**Fig. 3a**). This model is the most common design of DH systems across Europe, and is usually stipulated in the respective country legislation.
- In the ***network access model***, producers have access to heat networks provided that the producers are supplying heat to their own end-customers via ***open heat networks*** (**Fig. 3b**). This model is possible under current energy law in Poland, but it is otherwise practically

[3] Third Party Access (TPA) http://fsr-encyclopedia.eui.eu/third-party-access-tpa/
[4] Regulated third-party access in heat markets: how to organize access conditions. Oxera Agenda June 2014 http://www.oxera.com/getmedia/195b43b0-6bd3-4fc4-8b13-df95f80acf2e/Regulated-third-party.pdf.aspx?ext=.pdf

never implemented (except for some large cities in Poland and a pilot project in Espoo, Finland[5]) due to its complexity. Open district heating may call for a higher degree of unbundling inside the DH system than there is today in EU countries.



a) *б)*

Fig. 3. Basic variants of DH system designs[4]

The types of TPA under the single-buyer model are detailed below[4]:

- *Type 1:* Negotiated (voluntary) network access.
- *Type 2:* Negotiated (mandatory) network access.
- *Type 3:* Fully regulated network access.

Under *the negotiated (voluntary) network access,* the DH network operator and supplier determine, on a voluntary basis, how to set up the heat dispatch order to the DH network. They then choose, based on short- or long-term contracts, between available heat sources from ***their own and external*** sources. The model works because the DH network operator has an economic incentive to look for lowest-cost heat sources, since the economic benefit from lower heat production costs can be shared between the end-customers and the DH network operator/supplier. This model is currently applied in *Germany*, *Sweden* and *Finland*, for example.

In the model of *negotiated (mandatory) network access*, although the conditions for access to the network may be stipulated in the legislation, they are ultimately negotiated between the network owner and the company requesting access. The following are examples of mandatory negotiated access:

- Mandatory rules for establishing regular competition (tendering) between all or selected alternative and new heat sources such as the monthly auctioning between independent heat producers in *Lithuania*. In this case, non-regulated competition is maintained by stipulating

[5] http://annualreport2013.fortum.com/en/sustainability/our-business/heat-distribution/open-district-heat-network/

that an independent heat producer is not allowed to produce more than one-third of total heating capacity, and that the impact on end-customer prices may not be significant.

- Specific mandatory rules for network access for preferred heat sources such as the mandatory heat off-take rules for renewable sources in *Poland*[6].
- Mandatory tendering for new capacity in *Estonia*.

Under the fully regulated network access, the legislator or regulator has determined the ex ante access provisions. If these preconditions are met by the acquiring heat source, the network owner is obliged to provide access to the network. In this model, it is usually important, or necessary, to unbundle the DH networks and production. A fully regulated network access model would raise a number of critical issues, as follows[4]:

- The general requirement for relatively unlimited access to DH networks would raise the question about how to offer equal location terms for all producers, and whether such access should still be provided if total demand is not expected to increase.
- Another question would be whether it is optimal to have multiple small-scale heat producers that want to access the heat networks when one bigger plant can produce the larger amount of required heat more economically.
- The principle of equal treatment for end-customers could be difficult to fulfil.

As far as we know, there is no larger-scale practical precedence for this kind of model in the DH sector. However, in Poland there are specific mandatory rules (open network access) for those heat producers that sell heat directly to end-customers according to the amount the end-customer is using. This model has been applied in only a few cases.

Stable expert opinion is that the costs of introducing access regulation under a regulated or mandatory negotiated access model should be lower than the expected benefits. Legislators and regulators should ensure transparent and non-discriminatory tendering processes and access provision. This becomes critical when companies are involved in both networks and production.

It can be concluded that heat market has essential peculiarities as compared with electricity and gas markets. The issues of promising areas of DH development, reasonable mechanisms and models for enhancing its competitiveness efficiency requires further research.

Efficiency of heat market operation also depends on the existing ownership models. With the recent changes in the DH industry, four major alternatives of ownership models for DH utilities have been identified[7]:

- Full public control by the state or municipality (*Helsinki, Munich, Göteborg, Vienna, and Budapest*).
- Full private control (*Uppsala, Malmö, Norrköping, Berlin, and Hamburg*).
- Mixed ownership and management – public and private.

[6] http://www.paiz.gov.pl/polish_law/renewable_energy
[7] District Heating System Ownership Guide http://projects.bre.co.uk/DHCAN/pdf/OwnershipManagement.pdf

- Not-for-profit community-owned cooperatives (*Denmark, Austria*).

The first two alternatives contain 100% ownership, public or private, with absolutely no commitment from the other side. Within the mixed and community ownership categories, various models have been developed:

1. Operation or management contract (*Borås*, Sweden).
2. Leasing (*Tallinn, Vilnius*).
3. Concession (*Paris* since 1927!)
4. Privatization only of heat generation (*Copenhagen, Warsaw, Brno, Riga, Bucharest*).
5. Selected private minority equity partnership (*Plzen, Düsseldorf*).
6. Minority private equity invited through the stock market (*Mannheim, Wroclaw*)
7. Majority private equity ownership (*Prague, Bratislava*).
8. Full private ownership with municipal support (*Southampton*).

These eight variants contain examples with full public ownership with private involvement in management, mixed ownership, and full private ownership with some public commitment. Therefore, this classification does not only reflect the ownership, but also management of DH systems. Other public private partnerships also can be found for financing, modernization, and customer support[8].

Available data show the growing tendency towards privatization of DH systems in Western European countries as well as in countries of Central and Eastern Europe. Now, the share of private ownership models in different EU countries comes to ***40%.*** Generalized information on the issue for some selected EU countries is presented in **Annex 1**.

Analysis of the district heating sector in some selected countries of the EU and Europe

Germany

In terms of quantitative indicators, the DH sector in Germany is one of the largest in Europe – the total installed capacity of heat generation in the sector is about 50 GW_{th} (2013). More than 13% of the housing facilities of the country are connected to DH. The main fuels used in the DH system are coal and natural gas. The share of renewables is only about **9% (Fig. 4)**.

The Act on the Promotion of Renewable Energies in the Heat Sector (EEWärmeG 2009[9]) makes mandatory the use of a certain share of heat from RES in new buildings. The law also encourages the use of heat from CHP in the DH system. Overall, heat from DH systems is not considered as renewable, but under certain conditions can be considered as an alternative to heat from fossil fuels and can be included to the implementation of fixed by the law requirements on RES. These conditions are (a) the production of a significant share of total heat energy from RES and (b) production of at least 50% of the total heat energy by CHP or receive it in the form of waste heat.

[8] Structure of the market and ownership of DH companies in European countries. Analytical report by SAEE. 2015.
[9] http://www.solarordinances.eu/Portals/0/STO%20BRD_EN4.pdf

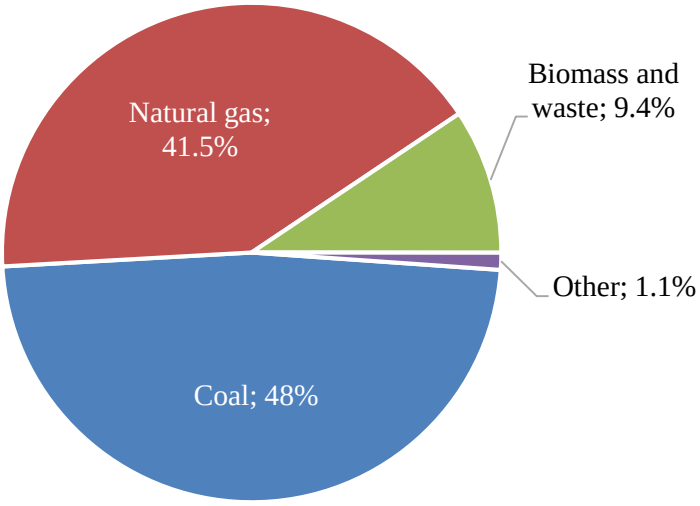


Fig. 4. Fuel use for DH in Germany (2013)[2]

Resolution "On the general conditions of heat supply in DH systems" (AVBFernwärmeV) regulates relations between suppliers and consumers (except industrial).

Heat tariffs are not regulated by the state and are formed at a competitive market. There is no standard method for setting of tariffs.

An independent body – *Department of Competition in Germany* (***German Competition Authority***)[10] – carries out general supervision of the heat market from the point of view of compliance with competition law fulfills. Federal Agency Bundesnetzagentur[11] performs the adjustment *only* in the sector of electricity and natural gas.

A comparison of biomass and fossil fuels prices shows that over the past decade the price of wood pellets is lower than the price of natural gas by 25-30% on average, and wood chips are cheaper in more than 2 times in comparison with natural gas. Also, wood fuel is almost always cheaper than oil **(Fig. 5)**.

[10] German Competition Authority (Bundeskartellamt)
http://www.concurrences.com/auteur/The-German-Competition-Authority?lang=fr
[11] http://www.bundesnetzagentur.de/cln_1421/EN/Areas/Energy/Companies/Companies-node.html

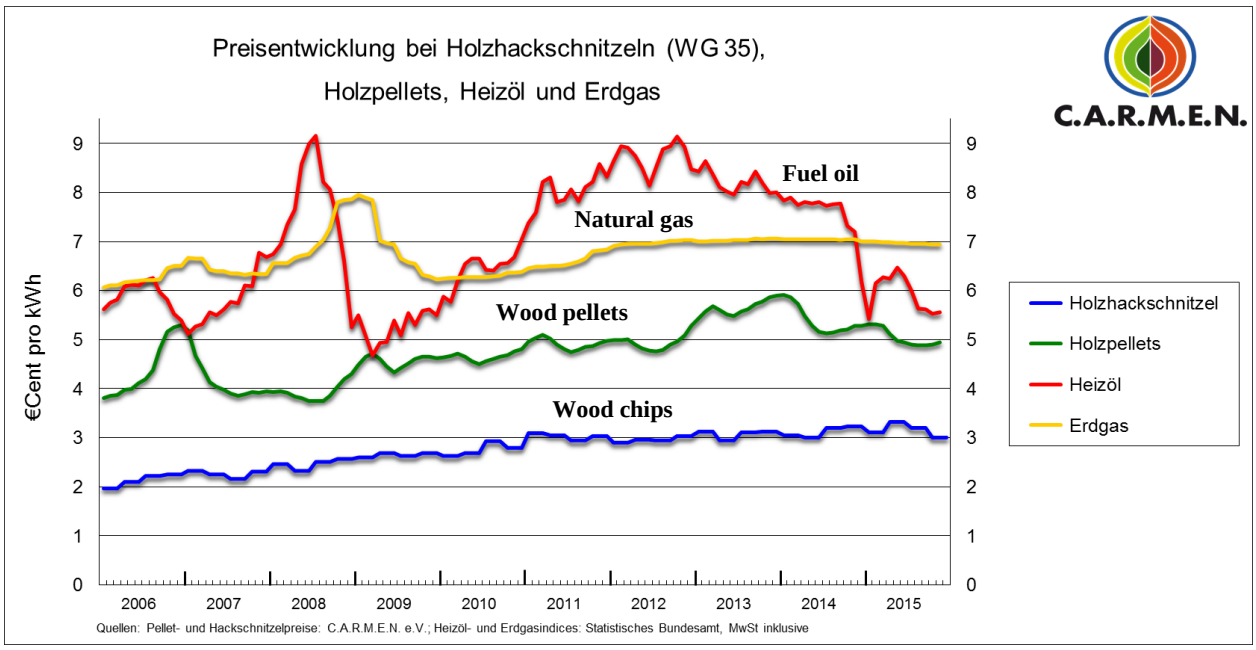


Fig. 5. Price development of biofuels and conventional fuels, €/MWh (incl. VAT)[12]

Average price of heat energy in DH system in Germany is 95 €/MWh incl. VAT (2013) (**Table 1**).

Table 1. Average price of heat energy in DH system in Germany (incl. VAT)[2]

Year	€/MWh*	€/GJ	UAH/Gcal*
2009	80.4	22.5	2506
2011	90.7	25.4	2826
2013	95.0	26.6	2960

** Hereinafter, conversions were done by the authors using ratios:*
1 GJ = 0.28 MWh, 1 Gcal = 4.19 GJ, 1 MWh = 0.86 Gcal
and the exchange rate of the National Bank of Ukraine on 25.01.2016 – 26.8 UAH/EUR. This exchange rate is used for the purpose of comparing the tariffs under the current economic conditions in Ukraine.

Denmark

In 2014, more than 63% of dwellings were connected to the DH system in Denmark. During the past 10 years the share of RES in heat generation in DH system has steadily increased and reached **47%** in 2013 (**Fig. 6**).

District heating companies are mainly owned by municipalities (especially in cities) or community cooperatives[8].

[12] http://www.carmen-ev.de/infothek/preisindizes/hackschnitzel/graphiken

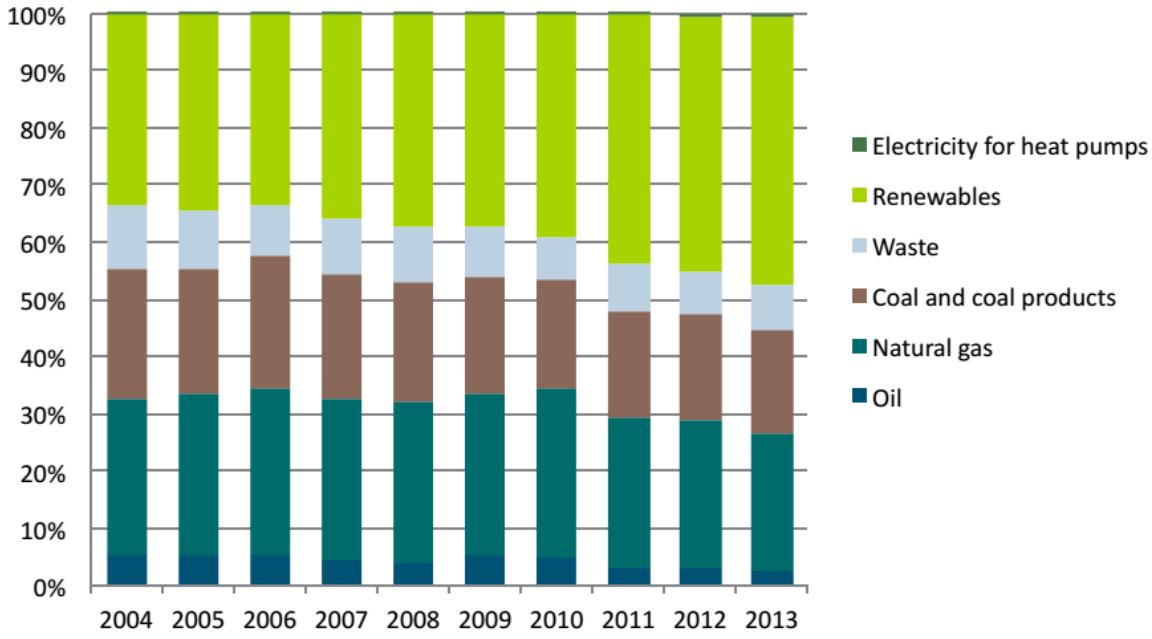


Fig. 6. Fuel use for DH in Denmark[2]

Danish DH market is regulated by the Heat Supply Act[13] (1979, as amended). According to this law, *regardless of the type of fuel used*, heat energy can be supplied according to tariff that necessarily includes the cost of the following components:

- Fuel;
- Salaries and other operating costs;
- Research activity;
- Administrative expenses;
- Supply;
- Costs related to the obligation to provide public services;
- Financial expenses for the previous period related to investments in the development of heating networks.

Tariffs are set by each heating supply company based on its specific cost and must be provided to the national regulator in the energy sector (***Danish Energy Regulatory Authority – DERA***[14]) only for information but not for approval. The tariffs must not be divided by type of consumers (population, industry, public sector, etc.).

The tariffs do not reflect a specific type of fuel, but only factual expenditures. Many companies use a few types of fuels or technologies, and such a thing as heat tariff from a particular type of fuel does not exist. Yet, there are statistic data on heat energy prices by companies with *the main use of a particular type of fuel or technology* (only heat production or co-generation of heat and electricity). These data are presented in **Table 2**, in which also a comparison of heat energy costs for individual heating systems, which use natural gas and oil, are given. The table shows that the

[13] http://www.iea.org/policiesandmeasures/pams/denmark/name-21778-en.php
[14] DERA http://energitilsynet.dk/tool-menu/english/

average cost of heat from biomass (preferred use) is generally equal to a cost of heat from natural gas and significantly lower than a cost of heat produced from oil.

Table 2. Heat energy cost in Denmark, 2015[15]

Type of fuel/technology	Heat energy cost, €/MWh incl. VAT				
	Min	Average	Max	Oil, individual heating	Natural gas, individual heating
Biogas*	77	121	161	170	106
Wood chips*	89	123	187	170	106
Straw*	77	116	162	170	106
CHP*	59	121	210	170	106
Large CHP	74	97	142	170	106
Decentralized CHP	52	102	166	170	106
Wood chips	56	100	106	170	106
Straw	68	104	137	170	106
Waste	38	95	170	170	106
Straw CHP	73	100	129	170	106
Wood chips CHP	59	84	106	170	106
Pellets from biomass	81	103	129	170	106
Other	67	109	186	170	106

** green field*

The average price of heat energy in district heating system in Denmark is around 125 €/MWh incl. VAT (2013) **(Table 3)**.

Table 3. Average price of heat energy in district heating system in Denmark (incl. VAT)[2]

Year	€/MWh	€/GJ	UAH/Gcal
2009	111.8	31.3	3484
2011	119.3	33.4	3718
2013	124.6	34.9	3883

An independent body – ***Danish Competition and Consumer Authority***[16] – carries out general supervision of the heat market from the point of view of compliance with competition law fulfills.

[15] Source – Danish DH Association (private contacts).
[16] Danish Competition and Consumer Authority http://en.kfst.dk/

Great Britain

In the UK, DH sector currently provides only 2% needed heat, but according to government's estimates this figure could rise to 14% by 2030.

The main fuel used in the UK DH system is natural gas (80%). It is followed by waste, oil and biomass. Most DH systems use one kind of fuel and have reserve gas boilers.

Tariffs for heat energy of different manufacturers are set at the competitive market of heat energy. At that, *heat providers are not required to publish the prices or disclose this information to any third party*[17].

An independent body – ***Competition and Markets Authority (CMA)***[18] – carries out general supervision of the heat market from the point of view of compliance with competition law fulfills.

According to a study conducted by experts on Consumer Protection[17], the price of heat energy for DH residential buildings with heat meters in 2013-2014 was 5.51-14.94 pence/kWh (68.9-186.8 €/MWh[19]). For comparison, the price of heat energy with individual gas heating was 9.55-11.60 pence/kWh (119.4-145 €/MWh), electric heating – 21.91-22.99 pence/kWh (273.9-287.4 €/MWh).

Incentives for heat production from RES (including biomass and biogas) in the domestic sector[20] (individual households) and non-domestic sector[21] (industrial, commercial, public sectors and non-profit organizations) are a new financial mechanism of the government to increase the heat production from RES. The *Office of Gas and Electricity Markets* ***(Ofgem)***[22] – non-governmental department and independent regulatory body that is recognized by European directives – is responsible for the realization and implementation of the incentive schemes on behalf of the Department of Energy and Climate Change[23]. In both cases (the use of RES in domestic and non-domestic sectors), the applicant (heat producer) must meet the necessary criteria and obtain certification of a heat generating installation according to appropriate procedures.

District heat supply of renewable heat is included in the stimulating scheme of the domestic sector (from 01.11.2012). Financial support is provided for the entire lifetime of the installation (20 years). Department of Energy and Climate Change regularly reviews the incentive scheme and expenditures for it, and adjusts the value of quarterly bonus to the basic tariffs[24]. After obtaining

[17] Turning up the heat: Getting a fair deal for District Heating users, 2015 http://www.staticwhich.co.uk/documents/pdf/turning-up-the-heat-getting-a-fair-deal-for-district-heating-users---which-report-399546.pdf
[18] CMA https://www.gov.uk/government/organisations/competition-and-markets-authority
[19] Hereafter, the average currency exchange is 1.25 €/£ (2013-2014)
[20] Domestic Renewable Heat Incentive https://www.ofgem.gov.uk/environmental-programmes/domestic-renewable-heat-incentive
[21] Non-Domestic Renewable Heat Incentive https://www.ofgem.gov.uk/environmental-programmes/non-domestic-renewable-heat-incentive-rhi
[22] Ofgem – Office of Gas and Electricity Markets https://www.ofgem.gov.uk/
[23] Department of Energy and Climate Change https://www.gov.uk/government/organisations/department-of-energy-climate-change
[24] https://www.ofgem.gov.uk/environmental-programmes/non-domestic-renewable-heat-incentive-rhi/tariffs-apply-non-domestic-rhi-great-britain

accreditation, the bonus, which depends on technology and capacity, is set to an installation **(Table 4)**.

Table 4. Bonus to tariffs on heat energy that is applied to heat generating installations which were accredited during the period 01.07-01.10.2015[24]

№	Eligible technology	Eligible sizes	Bonus to tariffs, pence/kWh (€/MWh)
1	Small commercial biomass (including solid biomass contained in waste)	<200 kW_{th} (Tier 1*) <200 kW_{th} (Tier 2**)	4.18 (52.3) 1.11 (13.9)
2	Medium commercial biomass (including solid biomass contained in waste)	200 kW_{th} ≤ and <1 MW_{th} (Tier 1*) 200 kW_{th} ≤ and <1 MW_{th} (Tier 2**)	5.18 (64.8) 2.24 (28)
3	Large commercial biomass (including solid biomass contained in waste)	≥1 MW_{th}	2.03 (25.4)
4	Solid biomass CHP systems (commissioned on or after 4 December 2013)	All capacities	4.17 (52.1)
5	Small biogas combustion	<200 kW_{th}	7.62 (92.3)
6	Medium biogas combustion (commissioned on or after 4 December 2013)	200 kW_{th} ≤ and <600 kW_{th}	5.99 (74.9)
7	Large biogas combustion (commissioned on or after 4 December 2013)	≥600 kW_{th}	2.24 (28)

** Tier 1 applies annually up to the Tier Break.*

*** Tier 2 above the Tier Break. The Tier Break is: installed capacity x 1314 peak load hours*

In 2013, the Department of Energy and Climate Change initiated a program Heat Networks Delivery Unit[25]). The program, which is valid until March 2016, provides financial support to local authorities for works of zoning, energy planning and feasibility studies.

Finland

District heating began to develop in Finland in the early 1950s. Currently, it is the most common form of heating available in almost all cities and towns in the country. District heating companies usually are in municipal ownership, although there are examples of working of international companies.

DH is considered as an effective and reliable system for densely built-up areas. The higher density, the more efficient DH is. DH system covers about 50% of the heating market **(Fig. 7)** and even

[25] HNDU https://www.gov.uk/government/publications/heat-networks-funding-stream-application-and-guidance-pack

>90% the largest towns. Most public and commercial buildings are also connected to the DH system.

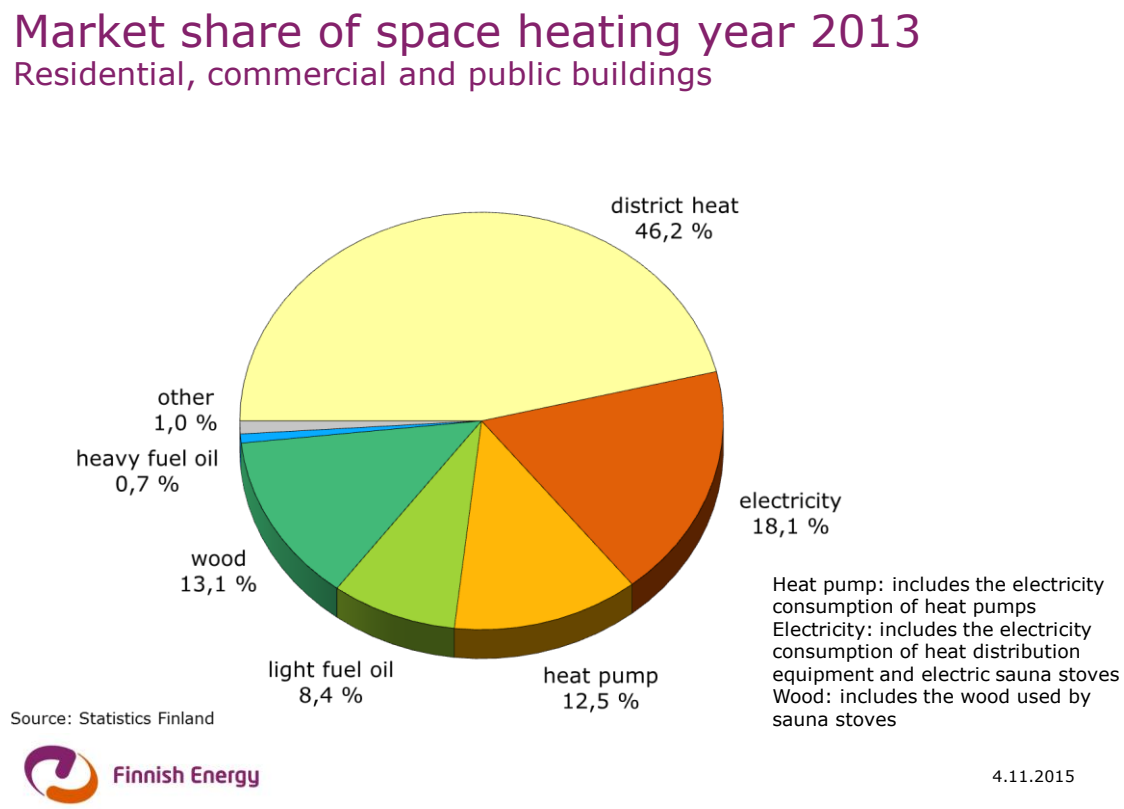


Fig. 7. Market share of space heating in Finland (2013)[26]

In the DH system, it is used natural gas (25%), coal (2.5%), peat (11%) and a growing volume of wood **(29%)** and other biofuels **(7.4%)**, for example, biogas **(Fig. 8)**. Almost 80% of district heating is obtained from heating plants producing heat and electricity (CHP, cogeneration), as surplus heat from industry, or from biogas combustion in landfills.

Housing cooperatives or other homeowners are customers of the DH system in Finland. Consumption of heat energy is measured for each customer. Heating expenses are divided between residents, usually according to a residential area. Pricing system is widely used, and includes[27]:

- Charges for connections, which amount depends on a location and size of a house.
- Rate for heat energy consumed. The tariff depends on the fuel type, from which heat energy was produced, as well as the fixed and variable components of the heating supply costs.

Market heat tariffs are set by local district heating companies, they are different for different regions. Pricing is regulated by energy taxes that apply to electricity, coal, natural gas, fuel peat, liquid fuels (including bioethanol and biodiesel) [28].

[26] Finnish Energy, District Heating http://energia.fi/en/home-and-heating/district-heating
[27] Finnish Energy, Price of District Heating
http://energia.fi/en/home-and-heating/district-heating/price-district-heating
[28] Excise Taxation Customer Bulletin 21, May 2015
http://www.tulli.fi/en/finnish_customs/publications/excise_tax/excise_taxation/021.pdf

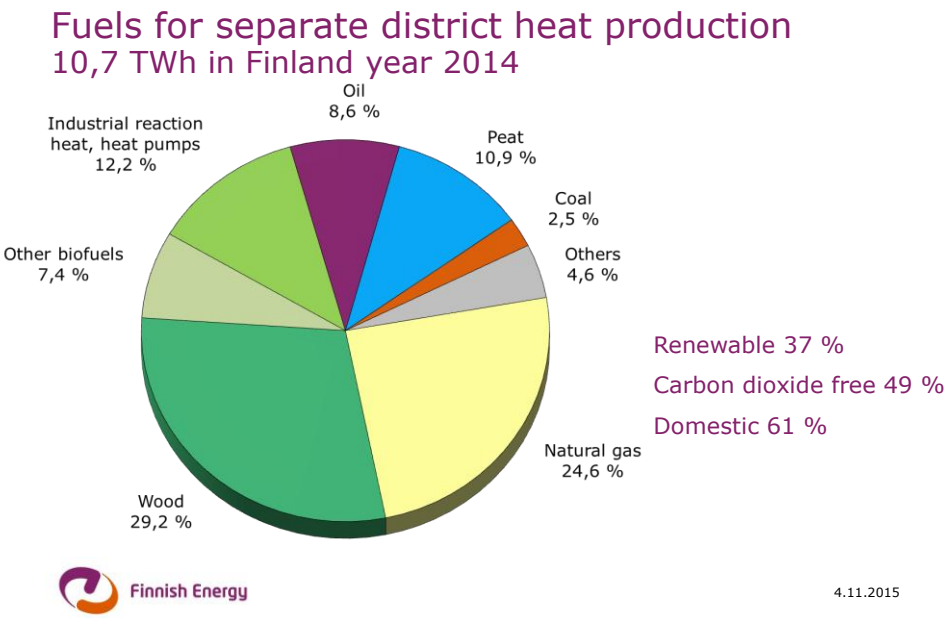


Fig. 8. DH fuels structure in Finland (2014)[29]

Heat energy market in Finland has always been liberalized, and there is no specific legislation on DH, although some legislative acts (for example, the law "On energy efficiency") directly or indirectly affect it. Activities in the field of DH are regulated by competition law and consumer protection. Under the current standards of the competition law, a DH heat supplier has a dominant position at the market relative to consumers. Rights of the customers are protected by the Consumer Protection Act.

General supervision of the heat market from the point of view of compliance with competition law fulfills is carried out by ***the Finnish Competition and Consumer Authority***[30]. The Energy Authority regulates *only* electricity and gas markets[31].

Finnish Energy[32] is an association of producers and suppliers of electricity, heat energy in DH system and related services. Twice a year (1 January and 1 July), it collects heat prices from proper companies for three new residential buildings of different sizes. Finnish Energy activities aim to improve competitive conditions at the energy market, including in the DH sector.

The average price for heat energy in the DH system in Finland at the beginning of 2014 was about 73 €/MWh including VAT (**Fig. 9**). Approximately 29% of the price is taxes. The price varies depending on the location of the DH system and its size (the last factor has the greatest impact).

[29] Finnish Energy, District Heating in graphs, year 2014
http://energia.fi/en/statistics-and-publications/district-heating-statistics/district-heating
[30] Finnish Competition and Consumer Authority http://www.kkv.fi/en/
[31] Energy Authority https://www.energiavirasto.fi/web/energy-authority/energy-authority
[32] Finnish Energy http://energia.fi/en/finnish-energy

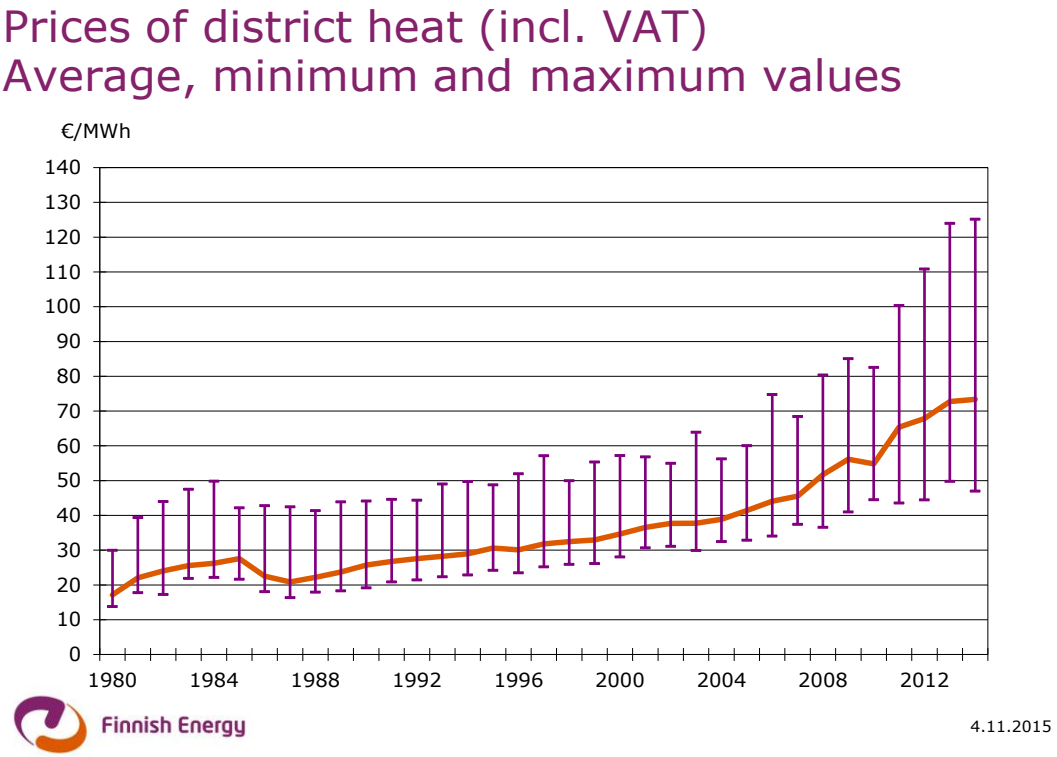


Fig. 9. Development of minimum, average and maximum values of DH prices (incl. VAT) in Finland[33]

Austria

In Austria, district heating occupy a central position in the total energy supply. Approximately one third of the final energy consumption is used for heating and hot water supply. At that, DH (including hot water supply) provides about 21% of the total heat demand. The total installed capacity of DH equipment in Austria amounted to 10300 MW_{th} in 2013 (8200 MW_{th} in 2009).

The main fuels for heat generation in the DH system are natural gas and biomass. The share of biomass is steadily growing. At present, DH boiler houses produce about **54%** of heat energy from biomass and 38% from natural gas (**Fig. 10**). In addition to heat boilers, heat for the DH system is also produced from CHPs – **32%** from biomass, 44% from natural gas (**Fig. 11**).

According to available data, all enterprises that produce heat directly for DH and CHPs that produce heat indirectly are owned by municipalities[8].

Unlike gas and electricity markets, which are regulated by the state authority Energie-Control Austria (E-Control[34]), *Austrian heat market is not regulated*, and heat prices are set by DH

[33] Finnish Energy, District Heating in graphs, year 2014
http://energia.fi/en/statistics-and-publications/district-heating-statistics/district-heating
[34] http://www.e-control.at/econtrol

companies. *Heat producers are not obliged to reveal their tariffs*[35]. There is no legislation directly dedicated to DH. Indirect influence is through legislation on CHP[36].

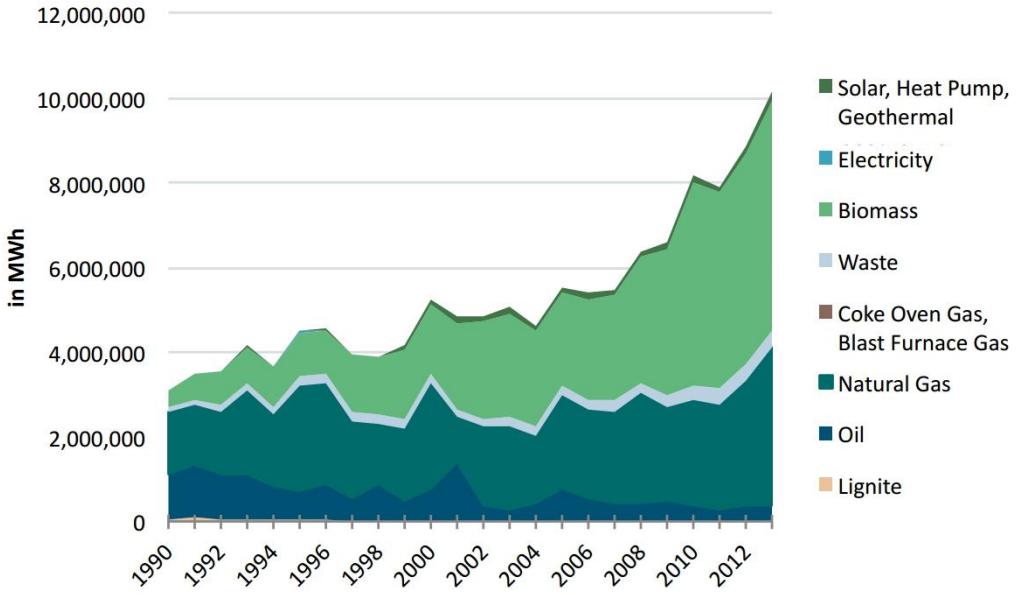


Fig. 10. Heat from heating plants by fuels in Austria[2]

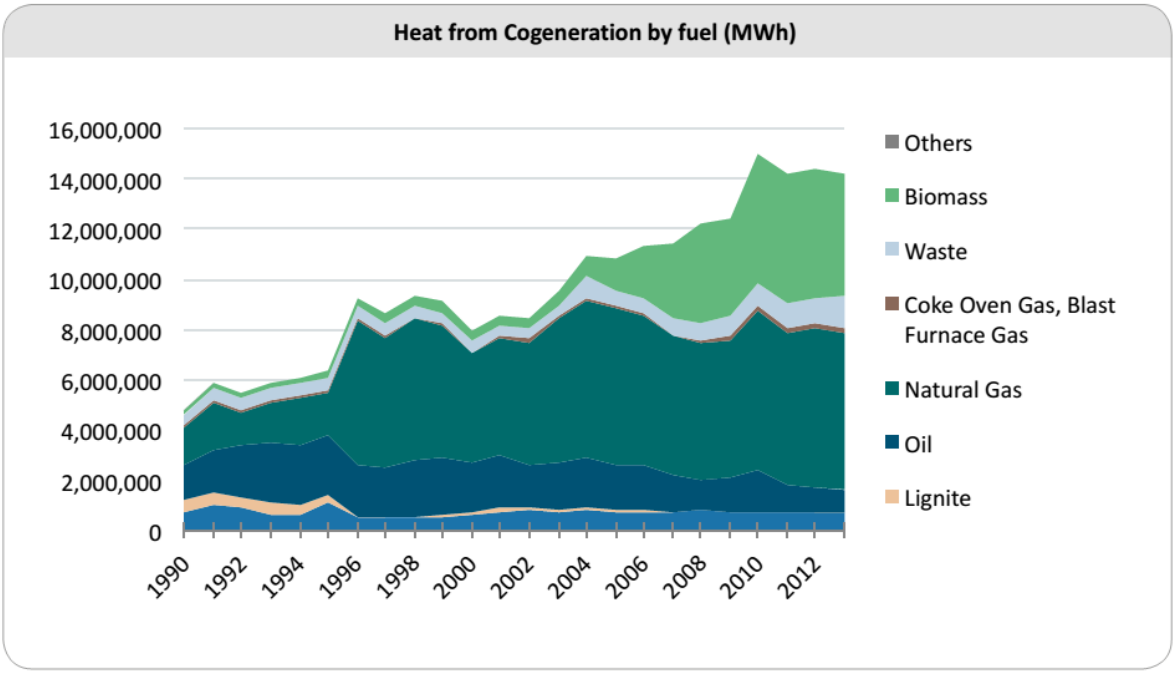


Fig. 11. Heat from cogeneration by fuels in Austria[2]

[35] Josef Kaufmann, Johann Pressl, Philipp Guler. Fernwärmeversorgung, 2014, 80 p. http://media.arbeiterkammer.at/stmk/Fernwaerme_2014.pdf

[36] Britt Aronson, Stefan Hellmer. An International Comparison of District Heating Markets, 2009. http://www.svenskfjarrvarme.se/Global/FJ%C3%84RRSYN/Rapporter%20och%20resultatblad/Rapport%20marknad/2009/An%20International%20Comparison%20of%20District%20Hetaing%20Markets.pdf

An independent body – ***Austrian Competition Authority***[37] – carries out general supervision of the heat market from the point of view of compliance with competition law fulfills.

Development of prices for heating fuels in Austria during 2003-2014 is given in **Fig. 12.** It can be seen that the price of wood pellets is 30-40% lower than prices of natural gas and substantially lower than the price of heating oil (except 2003).

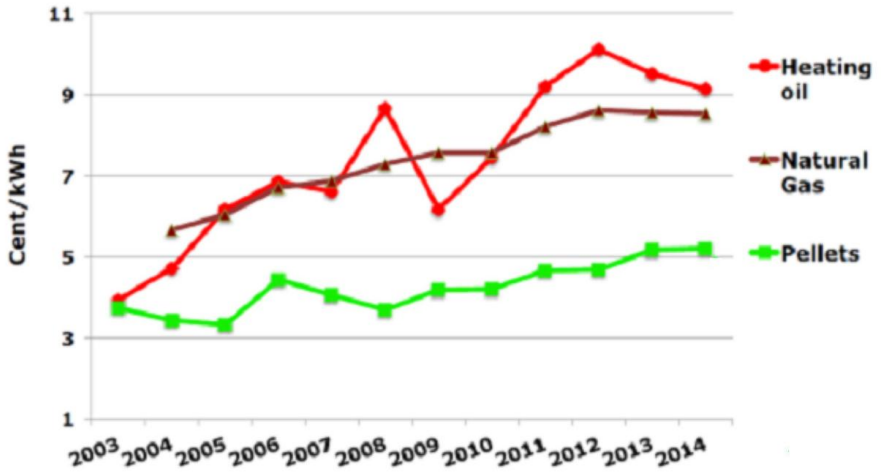


Fig. 12. The average prices for heating fuels in Austria[38]

Average district heating price in Austria is about 78 €/MWh incl. VAT (2013) (**Table 5**), and the existing price range is 60-110 €/MWh[39].

Table 5. Average district heating price in Austria (incl. VAT)[2]

Year	€/MWh	€/GJ	UAH/Gcal
2009	72.5	20.3	2259
2011	76.1	21.3	2371
2013	77.6	21.8	2418

Some laws that begin or continue to subsidize heating and cogeneration were included in the national legal package on energy efficiency that came into force in 2015. One of them is the law Heating and Cooling Network Expansion (WKLG). The law provides pre-conditions for expansion of DH (and cooling) and the appropriate infrastructure in the country. According to this law, the investment motivation of the use of RES to support the small regional heat suppliers in rural areas and DH expansion in towns/cities is realized.

[37] Austrian Competition Authority http://www.en.bwb.gv.at/Seiten/default.aspx
[38] Rimantas Germanas. "District heating became "greener". The advantages of the use of biofuels". Presentation at the Conference "Financial instruments for stimulating energy efficiency. State initiatives in the housing sector and international projects", 11 November 2015, Kyiv, Ukraine.
[39] Source: private contacts.

Sweden

In 2013, there were 450 DH systems in Sweden with the total installed capacity of the equipment of 23.7 GW_{th}. 52% of the population use DH services.

The feature of Sweden is the relative stability of the DH generation sector and the absence of state plans to expand the market. It is expected that in the future it may even slightly decrease, mainly due to active efforts aimed to improve the energy efficiency of buildings.

As it is shown in **Fig. 13**, the structure of fuel consumption for heat production for DH during 2003-2013 did not change significantly. One can see the use of relatively small amounts of oil, natural gas, and coal and fairly large share of biomass (about **35%**) in the fuel structure.

Heat energy prices in the Swedish DH system are not regulated. District heating companies set them at the competitive heat market. Yet the market is under the supervision of the ***Swedish Energy Market Inspectorate***[40] and the ***Swedish Competition Authority***[41]. In addition, there is the Swedish District Heating Board[42], which is an independent unit of the Swedish Energy Agency[43], and solves problems between district heating companies and consumers in accordance with the Law on District Heating.

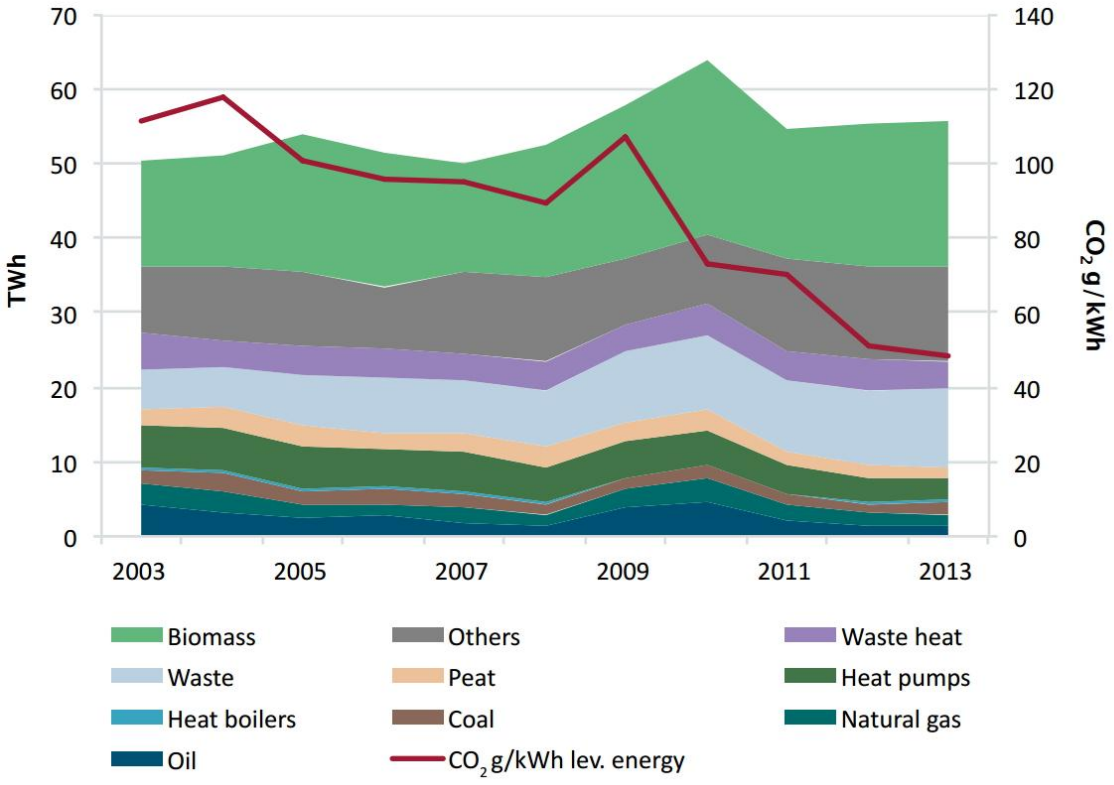


Fig. 13. Production of district heating and specific emissions of CO_2 in Sweden, 2003-2013[2]

[40] Energimarknadsinspektionen http://ei.se/en/
[41] Konkurrensverket http://www.konkurrensverket.se/en
[42] http://www.energimyndigheten.se/en/about-us/our-organisation/
[43] Swedish Energy Agency http://www.energimyndigheten.se/en/

The District Heating Act 2008:263[44] is aimed to protect consumer rights and enhance transparency of price setting in the sector. According to the law, heat producers have to negotiate with their clients before making any changes in the conditions of heat supply. The government or the authority appointed by the government can issue resolutions concerning the obligation to provide DH price information to the public. Some amendments on registration and billing customers for actual DH heat consumption were introduced to the act from 1 January 2015.

An average district heating price in Sweden is about 71 €/MWh incl. VAT (2013) (**Table 6**).

Table 6. Average district heating price in Sweden (incl. VAT)[2]

Year	€/MWh	€/GJ	UAH/Gcal
2009	63.2	17.7	1969
2011	67.5	18.9	2103
2013	71.1	19.9	2216

After liberalization of the energy market in 1996, many DH boiler houses and heating systems, which had been in municipal property, were sold to private companies and to the state Swedish company Vattenfall[36]. At present, the share of municipal companies prevail, they own 74% of heating systems and provide 66% of the total heat supply. Yet the general trend is a gradual increase in the proportion of privately owned enterprises.

Norway

In Norway, DH sector provides about 10% of the heat demand. A key role at the market of heat energy currently plays its production from cheap (excessive) electricity from hydropower plants (>60%).

There are several requirements for the use of renewable and CO_2-neutral energy sources in the DH system in Norway, so now their share is 70%. Fossil fuels are used only at peak loads, and every year the amount of their use id reduced **(Fig. 14)**. The government aims to cease using fossil fuels in the DH system by 2020.

DH market is regulated by the Energy Act (1986) and the Planning and Building Act (1985, as amended) [45], which contribute to the development of the DH competitive market. The Energy Act regulates pricing to protect consumer rights and the Planning and Building Act includes an obligation to connect to the DH system as from 1986. Heat energy prices from different producers are set at the competitive market of heat energy. Yet, there is one limitation fixed in the Energy Act: *the price of heat from the DH system must not exceed the cost of electric heating in a region*[46]. This "stimulates" the non-use of electric heating.

[44] http://ei.se/Documents/Publikationer/lagar_pa_engelska/District_Heating_Act.pdf
[45] Planning and Building Act
https://www.iea.org/beep/norway/codes/the-planning-and-building-act-2010.html
[46] https://www.hafslund.no/english/districtheating/home/8151

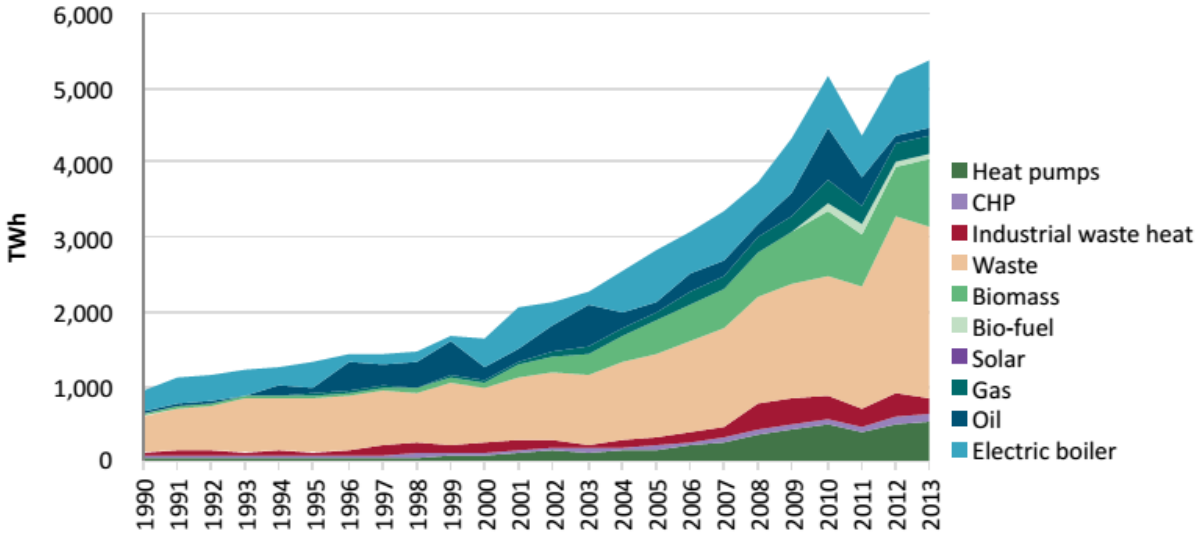


Fig. 14. Fuel use for district heating in Norway[2]

The National regulator in the energy sector (the ***Norwegian Water Resources and Energy Directorate – NVE***[47]) is responsible for the electricity and DH markets. Yet in practice, it pays attention mainly at the electricity market because DH has relatively small share in the country in comparison with hydropower. The regulator issues licenses for production of heat energy (license is needed only for a capacity of >10 MW_{th}) and consider complaints about pricing.

Heat energy cost includes the connection fee to the network, the annual fixed fee and fees for the amount of heat consumed. An average district heating price in Norway is about 81 €/MWh incl. VAT (2013) (**Table 7**).

Table 7. Average district heating price in Norway (incl. VAT)[2]

Year	€/MWh	€/GJ	UAH/Gcal
2009	92.9	26.0	2895
2011	71.4	20.0	2225
2013	80.7	22.6	2515

There are tools to stimulate the development of the DH infrastructure and the use of RES in DH. According to the newest version of the Planning and Building Act (2010), all buildings with the area over 500 m^2 have to be provided at least 60% of renewable heat. The use of fossil fuels and direct electric heating is prohibited in all new and renovated buildings.

[47] NVE – Norwegian Water Resources and Energy Directorate https://www.nve.no/english/

Italy

In Italy, the situation at the energy market is quite difficult because it has recently been partially liberalized. As a result, it is possible that in the near future in the country regulated and market prices will coexist, and consumers will be able to choose suppliers[48].

The same applies to the DH sector, although its share in the country is very limited compared to individual heating systems. Some companies are trying to develop this sector, but to build new infrastructure requires a lot of money and it should be noted that most Italians prefer their own private heating. The installation of individual heating boilers in each apartment, even in large buildings is quite common.

Minimum service standards and tariffs are set and monitored by the ***Regulatory Authority for Electricity and Gas***[49], which is an independent body. By the special legislative act (04.07.2014), it was assigned to be in charge of following issues in the DH sector:

- continuity, quality and safety of heat supply and metering systems;
- criteria for tariff determination for connection of customers to a heating network;
- procedures for realizing rights on disconnection;
- procedure for providing tariffs for heat supply, connection, disconnection and the use of auxiliary equipment by heating network operators;
- connection of new heat producers to the DH network system under normal operating conditions;
- heat supply amount, only if there are commitments to connect to the heating network which are introduced by a regional authority or municipality;
- criteria and conditions for granting end users devices for measuring individual consumption of heat energy/cold water/hot water for domestic use, and how a customer can take advantages of thermoregulation and heat metering in other companies, but not the existing supplier;
- rules of bills treatment, access to information on consumption and payment.

The main fuel used for DH systems in Italy has been natural gas. It accounts for about 77% of the total fuel used for DH (**Fig. 15**). At present, the share of biomass and other RES accounts for about **8%**.

[48] Source: private contacts.
[49] http://www.autorita.energia.it/it/inglese/about/presentazione.htm

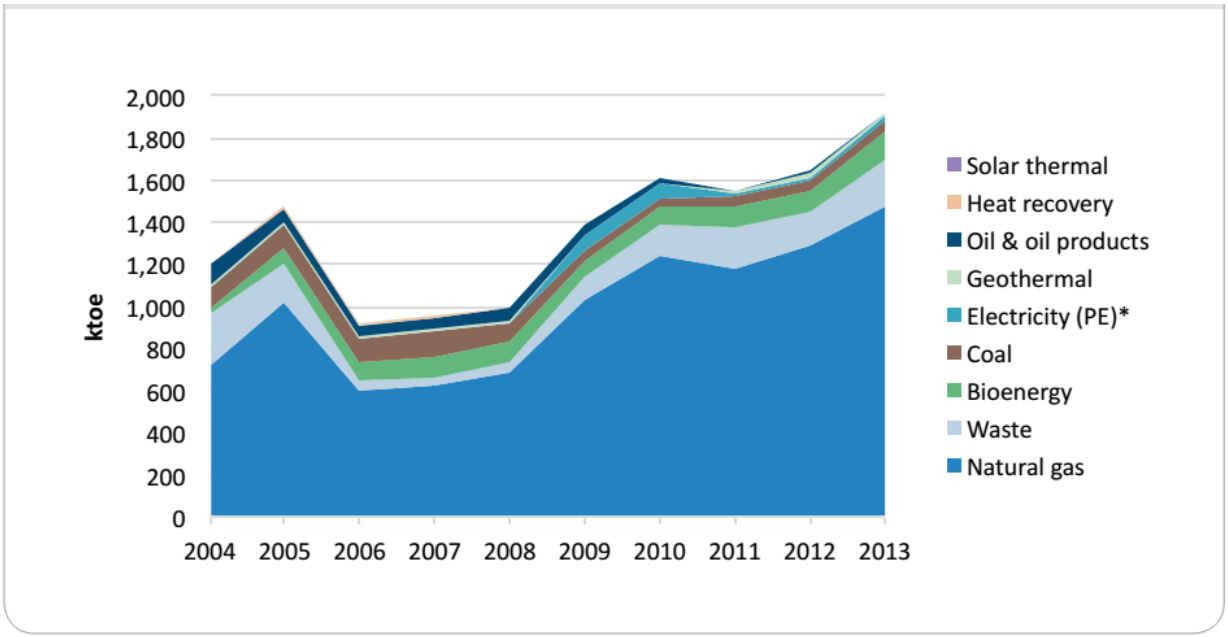


Fig. 15. Energy sources of district heating systems in Italy[2]

Netherlands

At present DH is not a big segment of the Netherlands' heat market. There are 13 large-scale heat distribution networks and 6900 small-scale ones in the country, of which 300 are owned by energy suppliers. The rest is owned either by small firms, associations of homeowners, housing corporations and other parties. On the whole, only about 5% of dwellings are connected to the DH system. The total share of district heating is slowly increasing. Main amount of heat is produced by 4 companies, 2 of which also deal with transmission and supply of heat.

According to data of 2013, the share of RES used for DH is **14%** (**Fig. 16**); ECN forecasts that by 2030 the share may rise to > 44% (including waste 30%, biomass/biogas 14%).

Heat market is regulated in the Heat Law (Warmtewet, 2014). The ***ACM***[50] ***(Authority for Consumer and Market***) sets each year the tariffs based on the price of natural gas and based on the Heat Law. The main principle of the Heat Law is that consumers should be protected from paying too much for heating their homes/SMEs. Therefore, the price of heating is based on certain parameters that are determined by the Minister of Economic Affairs in the Heat Regulation ("Warmteregeling"). The maximum price for the supply of heat consists of a fixed sum (281.78 EUR incl. VAT, 2015) with an additional 22.64 EUR/GJ consumed (incl. VAT, 2015, for previous years see **Table 8**). The principle is that consumers of DH *pay not more than if they had natural gas*. Because the supply price of gas has dropped, the maximum price of heat also decreases.

[50] ACM https://www.acm.nl/en/

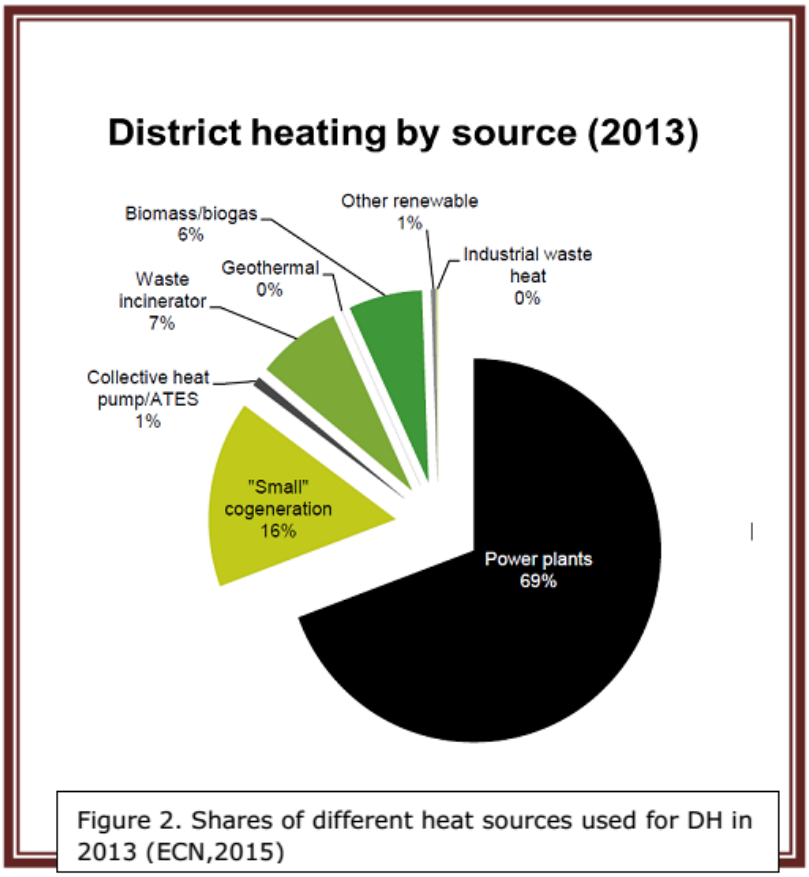


Fig. 16. Shares of different heat sources used for DH in 2013[51]

Table 9. Average DH price in the Netherlands incl. VAT (the variable part)[2]

Year	EUR/MWh	EUR/GJ	UAH/Gcal
2009	84.6	23.7	2636
2011	70.0	19.6	2181
2013	83.9	23.5	2615

In the past few years several large power utilities have sold some of their combined heat and power production assets to heat suppliers in an effort to enhance the economic efficiency and ensure the sustainability of the DH supply chain. This has resulted in an overall more integrated value chain for large scale district heating systems, where the heat suppliers also own and operate the main heat production units. In only a few large-scale DH systems, the heat supplier does not own and operate the main heat production units. This integration 'trend' could increase the already existing concerns of end-users regarding the monopoly position of heat suppliers[52].

With full liberalization of the Dutch energy market (for electricity and gas) in 2004, the Dutch energy consumers have become familiar with and are now used to being able to choose their own

[51] Kees Kwant, Maria Dragoman, Karin van Doorn. The heat market in the Netherlands. Renewable and fossil heating compared. RVO, 2015.
[52] Krisztina Szendrei & Eise Spijker. District heating systems: Breaking the monopoly? Policy brief, October 2015. http://www.warmtenetwerk.eu/assets/bioteam/JIN-Bioteam-policy-brief-2-on-District-Heating.pdf

energy supplier. The Dutch Ministry of Economic Affairs in its 2015 Heat Letter ('Warmtebrief') indicated to look closely into the option of creating "open networks" with an independent network operator that is subject to a TPA regime. It is expected that it may lead to a more competitive heat market with lower prices for end-users. The ultimate question is if and to what extent any forced unbundling of DH supply systems in combination with a TPA regime would guarantee a sufficient level of competition on the production side of the value chain[52].

Poland

Along with Germany, Poland has one of the biggest DH systems in the European Union by installed capacity. The DH system services 53% of the population. Now, there are 317 DH systems and 455 DH companies in the country. The installed capacity of DH has decreased a bit lately, from 59.8 GW_{th} in 2009 to 56.5 GW_{th} in 2013. General tendencies have been the development of the heat distribution networks and reduction of heat demand as a result of thermal insulation of buildings. In addition, according to the assumptions in the Polish Energy Policy by 2030, it is planned to replace heat-only generating plants supplying the district heating networks in Polish cities with cogeneration by 2030.

Structure of the fuel inputs in the DH system practically has not changed during past 10 years. Hard coal remains the main fuel (75.5%); biomass and organic waste contribute only with **6.5%** (**Fig. 17**).

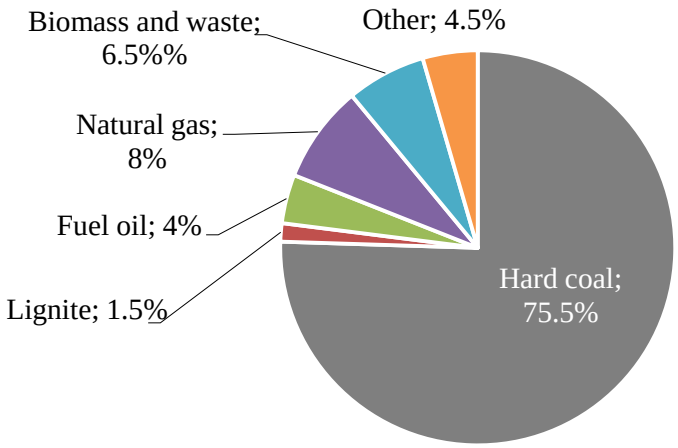


Fig. 17. Fuel structure in the DH system of Poland (2013)[2]

Energy Regulatory Office (ERO [53]***)*** is a central body of state control responsible for regulation in energy sector and development of competition. The President of ERO regulates operation of energy companies with the purpose to balance their interests and interests of clients. Among other activities, ERO checks calculations of companies submitted for the approval of tariffs for gaseous fuel, electricity and ***heat***; *approves the tariffs* and control their use. ERO has 8 regional offices.

[53] Energy Regulatory Office http://www.ure.gov.pl/en/about-us/presidents-duties/22,Presidents-duties.html

Average DH price in Poland is 54.5 EUR/MWh including VAT (2013) (**Table 9**).

Table 9. Average DH price in Poland (incl. VAT)[2]

Year	EUR/MWh	EUR/GJ	UAH/Gcal
2009	42.1	11.8	1312
2011	49.3	13.8	1536
2013	54.5	15.25	1698

Based on the Energy Law (1997), energy enterprises dealing with heat energy are obliged to purchase heat generated from RES interconnected to the grid located within the area of operations of such a seller, to the extent not exceeding the demand of the customers interconnected to that grid.[6]

Polish legislation *theoretically* gives opportunity to apply TPA in DH (*network access model*) provided that third-party producers meet certain economic and technical requirements. ***However, as mentioned earlier, the model is practically not implemented anywhere (except for several big cities) due to its complexity.*** One of the problems is that heat prices are regulated and not formed in competitive heat market[4].

Lithuania

According to data of 2013, there are 357 DH systems of 9920 MW_{th} installed capacity in Lithuania, which supply heat to 57% of the population. Almost 60% of all DH companies are municipally owned and the rest is leased.[8]

The share of natural gas in DH reduced from 83% in 2004 to 61% in 2013. During the same period, the contribution of biomass increased and reached **34%** of the total fuel consumption (**Fig. 18**). Biofuel includes wood residues (97.9%), straw, biogas (1.5%) and other (0.6%).

DH is regulated by the Law on Heat Sector[5454] (2003) and the Law on Energy from Renewable Sources[55] (2011). Heat supplier must be licensed; the rules for issuing the license are approved by the government. Heat supplier is obliged to connect to the heat network all producers of heat from RES. Priority of purchasing heat from third-party producers is the following: 1 CHP plants on RES, 2 – boiler plants and other RES installations, 3 – industrial waste heat, 4 – effective co-generation units, 5 – fossil fuel boiler plants.

According to the Standard Sale Agreement, heat price for a DH company is determined every month based on the price setting methodology. Base price for consumers is fixed taking into account costs of heat purchase and transmission, installation and maintenance of measuring devices, and accounting work.

[54] Law on Heat Sector http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=350871
[55] Law on Energy from Renewable Sources
http://www.iea.org/policiesandmeasures/pams/lithuania/name-38709-en.php

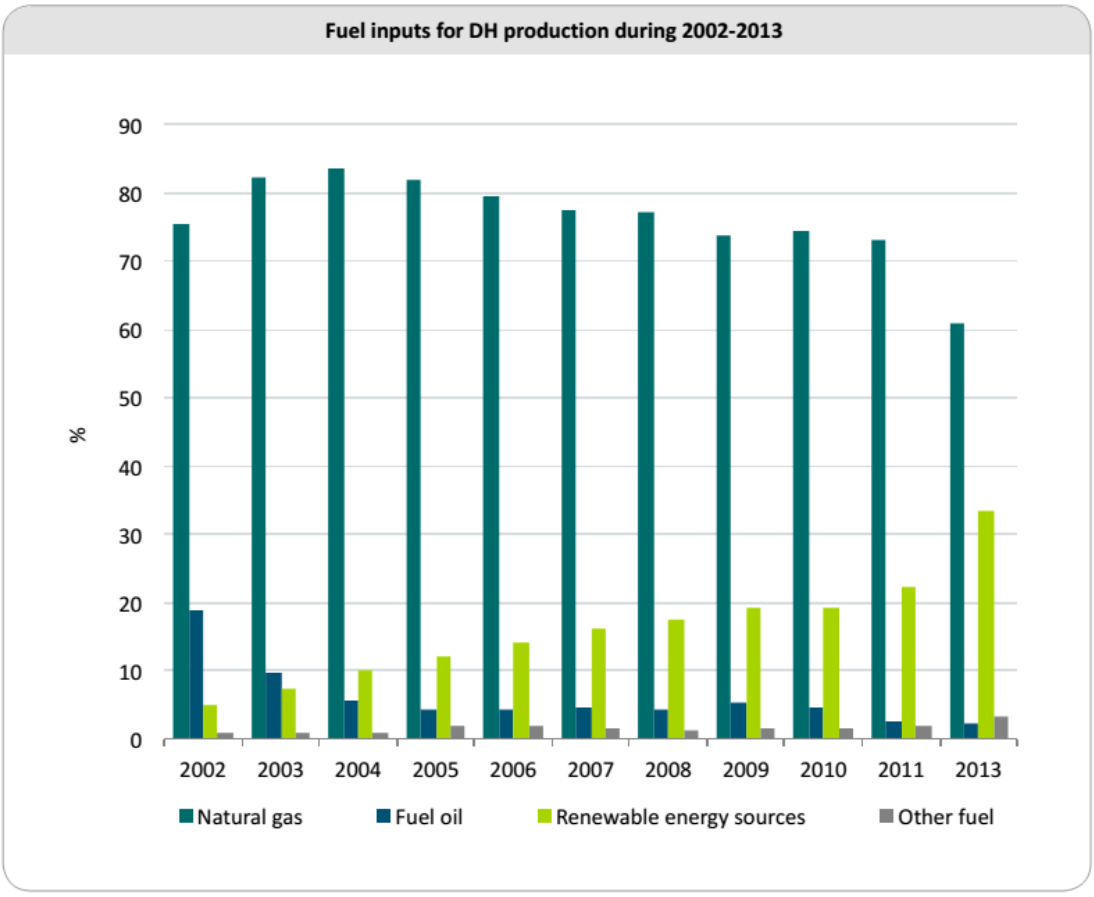


Fig. 18. Fuel inputs for Lithuania's DH[2]

DH sector is under control of the ***National Commission for Energy Control and Prices (NCC***[56]). At that, NCC *does regulate* the fuel cost as a part of heat tariff (now, on average, it is 54%[57]). *NCC regulation area* includes depreciation, staff costs, operation and maintenance, loan interest and other.[1]

Heat producers of > 10 GWh/yr (> 8600 Gcal/yr) are to prepare and submit their documents to NCC for the approval of basic prices. The approved basic prices are publicly announced and set for 3-5 years under condition of yearly reconsideration and correction in case of change in the market situation (for instance, change in fuel cost, inflation, trade volume). In accordance with the basic prices, Municipalities' Councils set heat sale prices for all licensed companies (supplying > 10 GWh/yr) and also set heat prices for producers selling < 10 GWh/yr (< 8600 Gcal/yr)[54].

During 2004-2013, Lithuanian DH companies spent about 2.3 billion EUR on the natural gas imported from Russia. At that, the price of local biofuels used in DH was much lower, for example since 2008 the price has been lower by 2-2.5 times that that of NG (**Fig. 19**). At present, the cost of wood biofuel as a part of heat tariff in Lithuanian DH is one of lowest in Europe, about 18 EUR/MWh (local wood chips and sawdust). For comparison, the cost of imported wood pellets in Austria is 52 EUR/MWh.

[56] NCC http://www.regula.lt/en/Pages/default.aspx
[57] http://www.regula.lt/en/Pages/prices.aspx

Difference in the fuel costs has an influence upon heat cost for final consumers. According to data of 2013, in cities with DH based mainly on gas heat price is about 84 EUR/MWh whereas in DH based on biomass heat price is only 58 EUR/MWh. Average DH price in Lithuania is about 78 EUR/MWh including VAT (2013) (**Table 10)**.

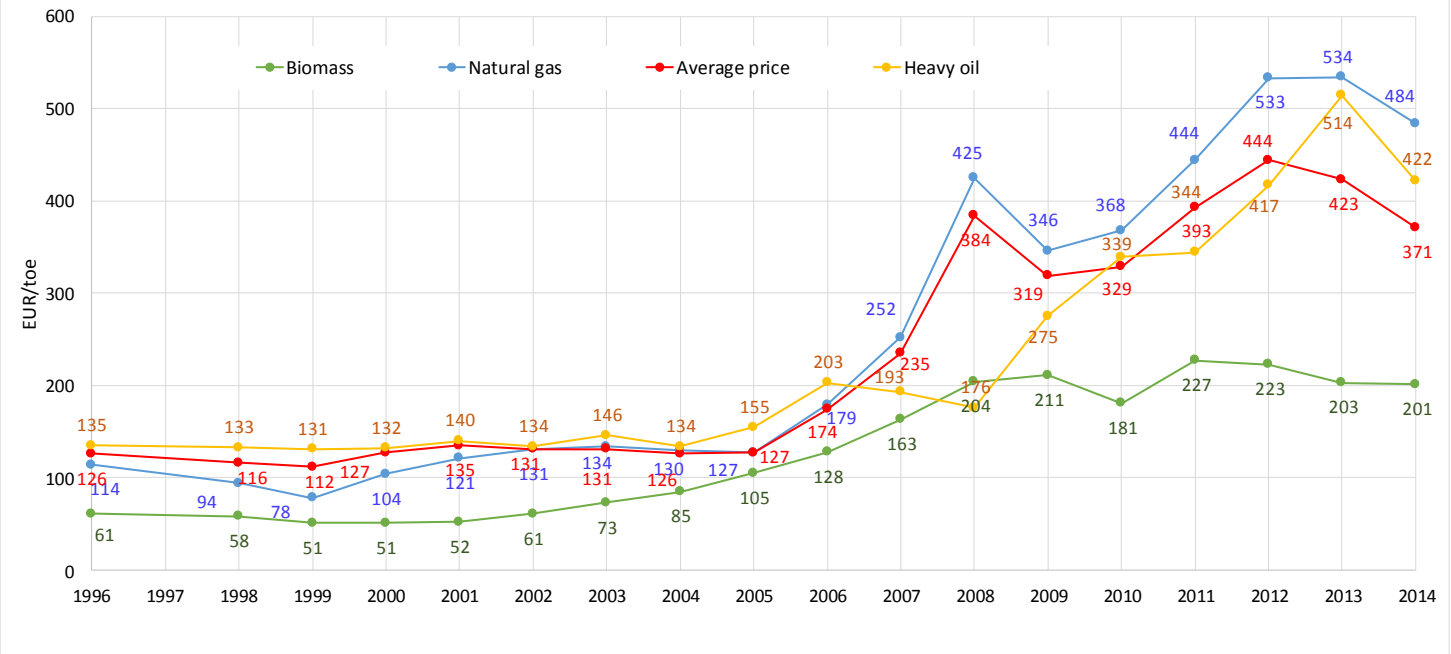


Fig. 19. Dynamics of fuel prices in heat production sector of Lithuania[38]

Table 10. Average DH price in Lithuania (incl. VAT)[2]

Year	EUR/MWh	EUR/GJ	UAH/Gcal
2009	68.6	19.2	2138
2011	72.1	20.2	2247
2013	78.2	21.9	2437

Since 2011, one can observe the rise in number of biomass boiler plants constructed by third-party producers: the total installed capacity was 126 MW in 2011, 323 MW in 2013, and 640 MW (forecast) in 2015. In spring of 2013, the first CHP plant on *biomass and MSW* of 50 MW_{th} + 20 MW_e) was put into operation in DH system as a *third-party producer* of heat by Fortum Klaipeda (all the previous CHP plants were introduced by DH companies). Now, each year Lithuanian DH companies buy about 22% of the total heat volume from third-party producers. Further rise in the share of third-party producers is expected.

It should be noted that biomass boilers are introduced not only by third-party heat producers but also by DH companies. Total installed capacity of these boilers came to 440 MW in 2011 and 716 MW in 2013.

Latvia

DH is an important part of Latvia's energy sector providing 65-70% of the total heat demand and serving 65% of the population. Latvia is one of the leaders in the EU for multi-storey residential buildings served by district heating. District heating systems in Latvia are mainly owned by local municipalities, in some cases by private owners.

During past 10 years, there have been a strong trend to replacing natural gas by RES, for the most part, wood chips. Now the share of RES in DH comes to about **28%** (including CHP plants) (**Fig. 20**).

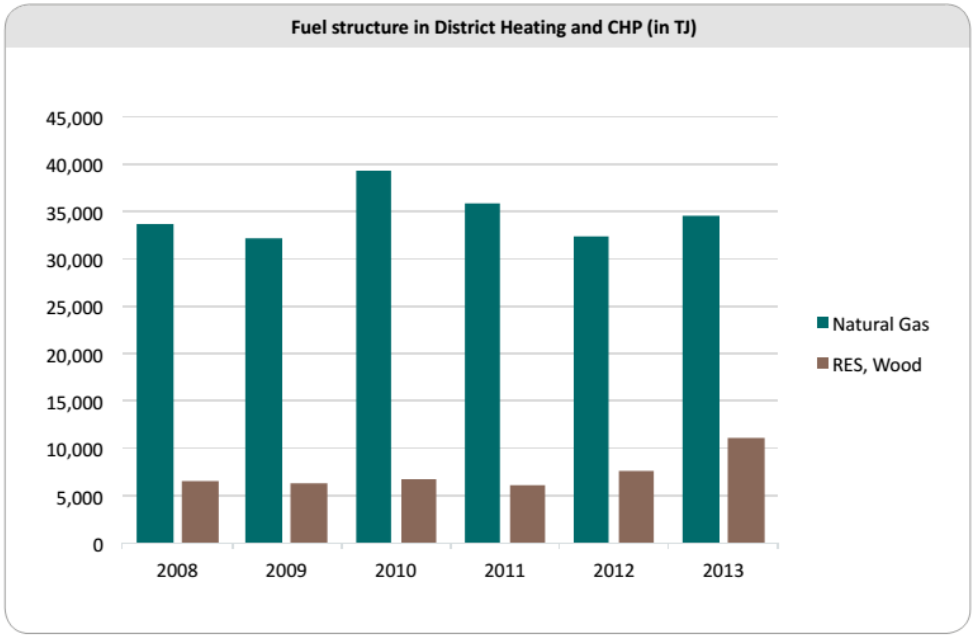


Fig. 20. Fuel structure in Latvia's DH system[2]

Heat supply in Latvia is considered a regulated public service. The regulation applies ***only*** for heat producers of > **5** GWh/yr (> 4300 Gcal/yr), for which ***Public Utilities Commission (PUC[58])*** approves heat tariffs. Small-scale production of heat is not regulated with the purpose to mitigate administrative burden upon the producers.

Heat tariff depends on a number of factors including the size and technical condition of a DH system, the type of fuel used and even some political issues. Average DH price in Latvia is about 69 EUR/MWh including VAT (2013) (**Table 11)**.

Table 11. Average DH price in Latvia (incl. VAT)[2]

Year	EUR/MWh	EUR/GJ	UAH/Gcal
2009	60.0	16.8	1870
2011	65.0	18.2	2026
2013	69.3	19.4	2160

[58] Public Utilities Commission http://www.sprk.gov.lv/lapas/thermal-energy91

Estonia

In Estonia, 62% of population is served by DH system. According to data of 2011, main fuels for heat production were natural gas (37%), wood (34%) and shale oil (15%). By 2013, the share of gas in DH system decreased to 32%.

Estonia's national strategy is to fully regulate the district heating sector and its prices. At the same time, a district heating customer has right to disconnect from the network without any penalties and use any local solutions for the production of heat.

According to the District Heating Act (2003), at the beginning, the regulation of heat prices was *selective* and applied for all CHP plants in the DH system and for DH companies supplying > 50 GWh/yr. Since 2010, *all heat prices* have been regulated by the state. The main reason for the decision was the fact that the issue of correlation between the heat prices and household incomes had caused a high level of political interest. The District Heating Act defines the parties in the DH market and their specific responsibilities and rights.

Estonian Competition Authority[59] (District Heating Department) approves the *maximal* price for heat production for each producer and *maximal* sale price for heat for each supplier and each region/city. Average DH price in Estonia is about 66 EUR/MWh including VAT (2013) (**Table 12)**.

Table 12. Average DH price in Estonia (incl. VAT)[2]

Year	EUR/MWh	EUR/GJ	UAH/Gcal
2009	53.2	14.9	1658
2011	66.1	18.5	2060
2013	66.1	18.5	2060

Croatia

DH sector practically has not been developing in Croatia during past 15 years, and existing networks require considerable renovation. The main fuel in the DH system is natural gas (nearly 89%); the share of biomass (wood pellets, wood chips, and firewood) is only 5% (**Fig. 21**). Now, development of DH and involving RES in heat production is included in priority energy policy of the country.

Legal regulation of the heat market is performed by the Thermal Energy Market Act[60] (2013). Production and supply of heat is realized under *free competition*. Transportation of heat is considered *communal service*. Production, transportation and supply of heat require licensing. The same company can perform all the three types of activity provided that it obtained a license for each of them.

[59] Estonian Competition Authority (Konkurentsiamet) http://www.konkurentsiamet.ee/index.php?id=14196
[60] Thermal Energy Market Act http://www.mingo.hr/en/page/kategorija/energy-market-in-the-republic-of-croatia

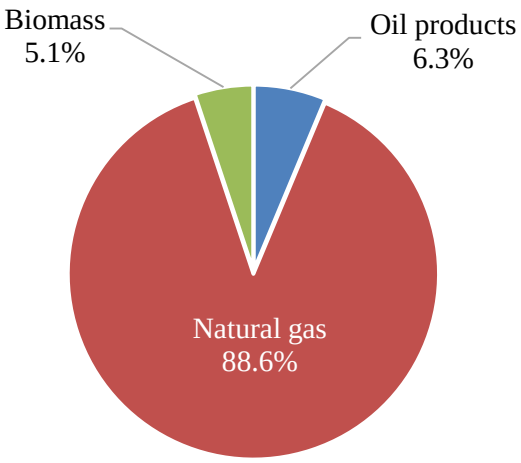


Fig. 21. Fuel structure in the DH system of Croatia (2013)[2]

Tariffs for heat transmission are calculated based on a methodology approved by the ***Croatian Energy Regulatory Agency (HERA[61])***. The tariffs are set taking into account the justified expenditures of a heat transmission company in respective territory.

Tariff for heat production for a company that provides > 60% of the DH system demand is calculated based on a methodology approved by the National Regulator. In case of smaller share, the tariff is fixed under market conditions. Price of heat produced for commercial use is set under market conditions in any case. Approximate heat tariff in DH system of Croatia is 26 EUR/MWh[62] (a variable part that depends on the amount of heat consumed) (2013).

Situation in Ukraine. Recommendations for the improvement of heat market operation

Ukraine is sorely in need of replacing fossil fuels by alternative energy sources for heat production. Especially urgent is the issue of replacing natural gas in housing-communal sector where the volume of gas consumption by DH companies was about 8.6 billion m^3 in 2014 and over 6.9 billion m^3 in 2015[63]. Bioenergy may play an important part in this; however, a serious barrier for introducing bioenergy technologies in housing-communal sector is *absence of the competitive* heat market.

At present, it is typically for almost all cities and towns when there exist the only *monopolist*, a local DH company. In most cases, it is a communal company, which uses natural gas for heat production. At that, the DH company is legally engaged in heat production as well as heat transmission.

The existing DH companies, due to their monopoly position and a conflict of commercial interests, are not interested in new third-party producers and often put obstacles in the way of their network connection. Each new «MW on biomass» leads to reduction of «MW on natural gas» and therefore

[61] HERA http://www.hera.hr/en/html/activities.html
[62] Unlocking the potential for private sector participation in District heating. IFC, 2014 http://www.ifc.org/wps/wcm/connect/8fb84a00496e1a08a2c9f2cda2aea2d1/WB+IFC+Private+Sector_web.pdf?MOD=AJPERES
[63] http://www.epravda.com.ua/news/2016/01/15/576715/

the decrease of income of the DH companies. In addition, heat consumption trends to decrease due to gradual implementation of thermal renovation measures by population and other heat consumers. Therefore, the competition of local DH companies with third-party biomass heat producers is even more undesirable.

We consider that availability of private heat producers contributes to creation of sound competitiveness with communal DH companies and makes them to set competitive tariffs and enhance operation efficiency.

At present, due to incomplete legal base of the state regulation of heat supply sector, there exist considerable obstacles to effective operation of heat market in Ukraine. It is also connected with an uncertain model and schemes of the market operation. Consequences of the situation are as follows:

- there are no preconditions for the creation and growth of competitiveness in the heat supply sector;
- there are no stimuli for improving production, transmission and supply of heat;
- there are some barriers for third-party heat producers network access (including biomass boiler plants, biomass CHP plants and co-generation installations);
- consumers are not protected from economic abuse of natural monopolists;
- tariff setting methods are imperfect;
- legal basis for implementing energy efficiency measures in DH is incomplete.

One can say that now Ukraine's DH sector is practically in stagnation, there are neither investments nor modern companies operating on the market. During a long period, there had been a wrong tariff policy in the country when NG price for population was lower than that for DH companies. That led to expanding disconnection of domestic consumers from DH systems and changeover to individual heating systems. Only in 2015, the tariff policy radically changed and as a result, one can expect the inverse process – gradual expansion of DH systems.

Creation of *a competitive heat market* in Ukraine and improvement of legislation seem to solve most problems of the sector. In our opinion, it is necessary to do the following:

- To implement legal unbundling of the existing DH companies into at least two independent enterprises. The first company would be engaged in heat production; the second one would deal with heat transmission and supply.
- To allow privatization of heat generation. Companies engaged in heat transmission remain communal and as before cannot be privatized.
- To legally ensure network access for the producers of heat from RES.
- To introduce tenders to be held at least once during a heating season. A company that won the tender supplies the heat produced to DH system.

Implementation of the above measures requires a number of *amendments* to the Law of Ukraine "*On heat supply"*. Experts of the Bioenergy Association of Ukraine are ready to actively participate in the development of the relevant legislation.

Taking into account available experience of European countries and some local peculiarities, we can suggest the ***single-buyer model*** with ***negotiated (mandatory) network access*** of third-party producers for a new structure of Ukraine's heat market[64].

We also suggest the following ***conditions*** for the third-party producer network access and sale of heat into DH system:

- compulsory tendering;
- ensured network access for the producers of heat from RES;
- a third-party producer cannot supply into DH system more than 1/3 of its total heat demand.

Probably, the National Regulator will continue its regulation of heat tariffs only during the transition period of the creation of a new model of the heat market. After creating competitive heat market in Ukraine, the Regulator will only *supervise the tariffs* (as it is in the developed EU countries).

Advantages of the competitive heat market include reduced tariffs for consumers, considerably increased share of heat produced from renewables and therefore decrease in use of natural gas in the housing-communal sector. Replacement of the imported NG by local energy sources leads to saving currency in the country, developing local economies, creating new jobs and filling the state budget by taxes paid.

The National Renewable Energy Action Plan until 2020[65] envisages replacement of 7.2 billion m^3 of gas by biomass in 2020. According to UABio's estimation, up to 40% of this replacement will be implemented in the housing-communal sector. To fulfil the substitution in the planned scope, it is necessary to create a competitive heat market in Ukraine.

Conclusions

Analysis of the state of the art of DH sector shows that the developed European countries have already created the competitive heat market, and the rest of EU countries are on the path to it. Almost all EU countries implemented unbundling in heat market to a greater or lesser extent, and provided network access for third-party heat producers.

Best practices of European countries with consideration of the local conditions can be implemented in Ukraine to improve efficiency of heat market operation. Implementation of measures needed for creating competitive heat market requires a number of amendments to the Law of Ukraine "On heat supply". Experts of the Bioenergy Association of Ukraine are ready to actively participate in the development of the relevant legislation.

[64] The models are described above in the chapter on State of the art and prospects for the development of district heating sector in Europe.
[65] Approved by the Resolution of the Cabinet of Ministers of Ukraine N 902-p of 01.10.2014 (in Ukrainian) http://zakon4.rada.gov.ua/laws/show/902-2014-%D1%80

Annex 1. Summarized information on the DH market structure and ownership in the selected EU countries

Country	*Production of heat*			*Transmission*[8]			*Distribution*[8]		*Supply*		
	Type of ownership	Number of companies or networks (%)	Production volume, GWh	Type of ownership	Number of companies	Volume	Type of ownership	Number of companies	Type of ownership	Number of companies	Key consumers
Sweden[36]	Municipally owned companies	253 networks (74%)	38 616 (66%)	-	-	-	-	-	-	-	Residential sector (59%) Industrial sector (12%) Services and other (29%)
	Private companies	66 networks (19%)	15 818 (27%)								
	State companies	25 networks (7%)	4 364 (7%)								
Denmark[66]	Municipally owned companies	55	~65%	Municipal	-	25%	Municipal	-	-	~600[36]	Residential sector (64%) Industrial sector (6%) Services and other (30%)[2]
	Community-owned cooperatives	~350	~35%								
Finland[36]	Municipally owned companies	17	11 750 (39%)	-	-	-	-	-	-	-	Residential sector (55%) Industrial sector (10%) Services and other (35%)
	Stock company, municipal ownership	78	14 067 (47%)								
	Private companies	4	4 197 (14%)								
Lithuania[36]	Municipally owned companies	a bit <60%	-	-	-	-	-	-	-	-	Residential sector (72%) Industrial sector (7%) Services and other (21%)
	Leased companies	~40%	-								
Austria[36]	State (municipal) companies	90%	-	-	-	-	-	-	-	-	Residential sector (37%) Industrial sector (14%) Services and other (49%)
	Private companies	10%	-	-	-	-	-	-	-	-	

[66] Danish District Heating Association (Dansk Fjernvarme) http://www.danskfjernvarme.dk/sitetools/english

Poland[67]		455 companies[2]:									Residential sector (70%) Industrial sector (8%) Services and other (22%)
	State companies	3%									
	Housing-building cooperatives	3%									
	Municipally owned companies	9%									
	Joint-stock companies (JSC)*	26%									
	LLC*	55%									
	Other	4%									
Latvia[2]	Almost all the companies are municipally owned; there are few examples of private ownership	68 DH systems	8% (private companies) [68]								Residential sector (72%) Industrial sector (2.2%) Services and other (25.8%)

** According to data of 2011, 23% of JSC and LLC are privatized.*

[67] District heating in Poland - the chosen basic information http://www.lsta.lt/files/seminarai/080911_Budapestas/Poland.pdf

[68] Central and Eastern European District Heating Outlook // KPMG Energy & Utilities Centre of Excellence Team, Budapest, Hungary. https://www.kpmg.com/SK/en/IssuesAndInsights/ArticlesPublications/Publicationseries/Documents/Central%20and%20Eastern%20European%20District%20Heating%20Outlook.pdf

Annex 2. Summarized information on the heat market features in the selected EU countries

Country	*Competitive heat market*		
	Market description	**Authority**	**Tariffs (prices) details**
Germany	Heat tariffs are not regulated but formed in the competitive market. Legislation in the heat sector: The Act on the promotion of renewable energies in the heat sector (EEWärmeG 2009 p.[9]); the Ordinance on general conditions for the supply of DH (AVBFernwärmeV).	General supervision is performed by ***the German Competition Authority***[10]. Federal agency Bundesnetzagentur[11] regulates *only* electricity and gas markets.	There is no standard method for setting heat tariffs. During past 10 years, wood pellets have been steadily cheaper than NG (on average by **25-30%**). Wood chips have been cheaper than NG by **40%**. *Average DH price*: **95** EUR/MWh (**2960** UAH/Gcal[69]) incl. VAT (2013).
Denmark	Heat tariffs are set by each DH company based on its actual expenditures. At that the tariffs must be the same for all types of consumers (population, industry, public sector etc.) DH sector is regulated by the Heat Supply Act[13] 1979.	General supervision is performed by ***the Danish Competition and Consumer Authority***[16]. Heat tariffs should be reported to ***the Danish Energy Regulatory Authority (DERA***[14]) for information (not for approval).	Heat tariffs, *regardless fuel type*, must include a number of components, in particular, fuel cost, operational cost, energy delivery cost, expenses and costs of the previous period, which accrued due to investing in the network development and other. Average DH price under (prevailing) use of *biomass* is comparable with heat from NG in the individual heating system and much lower than heat from heavy oil. *Average DH price*: **125** EUR/MWh (**3883** UAH/Gcal) incl. VAT (2013).

[69] In the table, calculation of heat prices into UAH/Gcal is done by the authors using the average currency exchange rate of the National Bank of Ukraine for the respective year: 2013 – 10.61 UAH/EUR, 2014 – 15.72 UAH/EUR, 2013-2014 (on average) – 13.64 UAH/EUR.

Great Britain	Heat tariffs are set by the producers in the competitive heat market. At that, the companies <u>are not obliged</u> to reveal the prices to a third party.	General supervision is performed by ***the Competition and Markets Authority (CMA)***[Ошибка! Закладка не определена.]. Office of Gas and Electricity Markets (**Ofgem**)[22] is a non-ministerial government department and an independent national Regulatory Authority responsible for managing state support for heat production from RES.	Government <u>*supports heat production from RES.*</u> Department of Energy and Climate Change updates the premiums to the basic heat tariffs every quarter (**14-92** EUR/MWh). <u>*DH price for residential sector*</u> in 2013-2014: **69-187** EUR/MWh (**2150-5827** UAH/Gcal). *For comparison*: heat price under individual gas heating is 119-145 EUR/MWh (**3708-4519** UAH/Gcal), and under electrical heating 274-287 EUR/MWh (**8539-8944** UAH/Gcal).
Finland	Market heat tariffs are set by local DH companies. The companies are usually municipally owned, though there are a few examples of the operation of international companies. Rights of the customers are protected by the Consumer Protection Act. *Single-buyer* model of DH market.	General supervision is performed by ***the Finnish Competition and Consumer Authority***[30]. The Energy Authority[31] regulates *only* electricity and gas markets.	Heat price includes: connection fee that varies according to location and the size of the house; energy charge that depends on the fuels used and the variable costs in heat procurement. Price setting is regulated by energy taxes (the taxes make up ~ 29% of the heat price). <u>*Average DH price*</u>: **72** EUR/MWh (**2244** UAH/Gcal) incl. VAT (2013).
Austria	Heat prices are set by DH companies. At that, heat producers *are not obliged* to reveal their tariffs. There is **no legislation** directly dedicated to DH. Indirect influence is through legislation on CHP.	General supervision is performed by ***the Austrian Competition Authority***[37].	<u>*Average DH price*</u>: **78** EUR/MWh (**2418** UAH/Gcal) incl. VAT (2013), and the existing range is 60-110 EUR/MWh (**1870-3428** UAH/Gcal).
Sweden	DH prices are not regulated. *The District Heating Act* 2008:263[44] is aimed to protect consumer right and enhance transparency of price setting in the sector. *Single-buyer* model of DH market.	***Swedish Energy Market Inspectorate***[40] and ***Swedish Competition Authority***[41] supervise the heat market.	To ensure competitiveness with other heat supply schemes (for example heat pumps) many DH companies form their prices openly, based not on the actual expenditures but taking into account prices of the nearest competitors. <u>*Average DH price*</u>: **71** EUR/MWh (**2216** UAH/Gcal) incl. VAT (2013).

	Heat market with regulated tariffs		
	Market description	**Regulator**	**Tariffs (prices) features**
Norway	DH market is regulated by the Energy Act (1986) (that includes a regulation of prices to protect customers) and the Planning and Building Act[45]. *Single-buyer* model of DH market.	***Norwegian Water Resources and Energy Directorate*** (***NVE***[47]) is responsible for electricity and DH markets. In action, NVE mainly takes care of electricity market as DH occupies a relatively small segment in the country. The Regulator issues licenses for heat production for the installations > 10 MW.	According to Energy Act, *DH price cannot exceed the local price of electrical heating*. Heat price includes the connection price, fixed early price and price for the heat consumed. *Average DH price*: **81** EUR/MWh (**2515** UAH/Gcal) incl. VAT (2013).
Netherlands	Heat market is regulated by the Heat Law (2014 p.). The main principle of the Law is that consumers should be protected from paying too much for heat.	***Authority for Consumer and Market***[50] annually ***sets prices*** for heat based on NG price and provisions of the Heat Law. In addition, they take into account certain parameters determined by the Ministry of Economic Affairs in the Heat Regulation.	Heat price consists of a fixed part (281.78 EUR incl. VAT in 2015) and a variable part that depends on the amount of consumed heat: **81** EUR/MWh incl. VAT in 2015. *Average DH price*: **84** EUR/MWh (**2615** UAH/Gcal) incl. VAT (2013). The main principle is that DH consumers *should not pay more* than in case of individual heating based on NG.
Poland	Theoretically, the legislation allows applying *network access model* under meeting some obligatory economic and technical conditions. ***But it is practically never implemented due to its complexity.*** DH market model is a combination of *single-buyer* and *network access* models.	***ERO – Energy Regulatory Office***[53] ***checks and approves tariffs*** for heat production and transmission and controls application of the tariffs.	*Average DH price*: **54,5** EUR/MWh (**1698** UAH/Gcal) incl. VAT (2013).

Lithuania	DH is regulated by the Law on Heat Sector[54] (2003) and the Law on Energy from Renewable Sources [55] (2011). Heat supplier must be licensed. Heat supplier is obliged to connect to the heat network all producers of heat from RES. *Single-buyer* model of DH market.	***National Commission for Energy Control and Prices(NCC***[Ошибка! Закладка не определена.]) ***approves base heat prices*** for the suppliers of > **10** GWh/yr (> 8600 Gcal/yr). Based on these prices, ***Municipalities' Councils set*** heat sale prices for the licensed companies and ***set heat prices*** for producers selling < **10** GWh/yr (< 8600 Gcal/yr).	In the heat price, NCC *does not regulate* fuels costs. *NCC regulates such components as* depreciation, staff costs, operation and maintenance, loan interest and other[1]. On average, fuel costs make up 54% of the heat price[Ошибка! Закладка не определена.]. *Average DH price*: **78** EUR/MWh (**2437** UAH/Gcal) incl. VAT.
Latvia	Heat supply is considered a regulated public service. But regulation applies ***only*** to heat producers of >5 GWh/yr (**>4300** Gcal/yr). DH systems are mainly owned by local municipalities, in some cases by private owners. *Single-buyer* model of DH market.	***Public Utilities Commission (PUC***[58]) approves heat tariffs ***only*** for the suppliers of > **5** GWh/yr (> 4300 Gcal/yr). Small-scale production of heat is not regulated with the purpose to mitigate administrative burden upon the producers.	*Average DH price*: **69** EUR/MWh (**2160** UAH/Gcal) incl. VAT (2013).
Estonia	According to the District Heating Act (2003), at the beginning, the regulation of heat prices was *selective*; since 2010, all heat prices have been regulated. The District Heating Act defines the parties in the DH market and their specific responsibilities and rights. *Single-buyer* model of DH market.	***Estonian Competition Authority***[59] approves *maximal* heat production price for each producer and *maximal* heat sale price for each supplier and each region/city.	*Average DH price*: **66** EUR/MWh (**2060** UAH/Gcal) incl. VAT (2013).
Croatia	Heat market is regulated by the Thermal Energy Market Act[60] (2013). Production and supply of heat is realized on the basis of *free competition*. Heat transmission is considered *communal service*. Production, transmission and supply of heat require a license.	Tariffs for heat *transportation* are calculated by the methodology approved by ***HERA (Croatian Energy Regulatory Agency)***[61]. Tariff for heat *production* is determined by the methodology approved by the Regulator for producers providing **> 60%** DH demand. Otherwise, the tariff is formed in the market.	Approximate DH tariff (variable part): **26** EUR/MWh (**810** UAH/Gcal) (2013).

Abbreviations

CHP – combined heat and power
DH – district heating
LLC – limited liability company
MSW – municipal solid waste
NG – natural gas
RES – renewable energy sources
TPA – third-party access

Previous publications by UABio

http://www.uabio.org/activity/uabio-analytics

1. *Position Paper N 1* (2012) "Position of bioenergy in the draft updated energy strategy of Ukraine till 2030".
2. *Position Paper N 2* (2013) "Analysis of the Law of Ukraine "On amending the Law of Ukraine «On Electricity" No5485-VI of 20.11.2012".
3. *Position Paper N 3* (2013) "Barriers to the development of bioenergy in Ukraine".
4. *Position Paper N 4* (2013) "Prospects of biogas production and use in Ukraine".
5. *Position Paper N 5* (2013) "Prospects for the electricity generation from biomass in Ukraine"
6. *Position Paper N 6* (2013) "Prospects for heat production from biomass in Ukraine"
7. *Position Paper N 7* (2014) "Prospects for the use of agricultural residues for energy production in Ukraine".
8. *Position Paper N 8* (2014) "Energy and environmental analysis of bioenergy technologies"
9. *Position paper N 9* (2014) "State of the art and prospects for bioenergy development in Ukraine"
10. *Position paper N 10* (2014) "Prospects for the growing and use of energy crops in Ukraine"
11. *Position paper N 11* (2014) "Prospects of biomethane production and use in Ukraine"
12. *Position paper N 12* (2015) "Prospects for the development of bioenergy as an instrument for natural gas replacement in Ukraine"
13. *Position paper N 13* (2015) "Analysis of energy strategies of the EU and world countries and the role of renewables in their energy systems".

Civic union "Bioenergy Association of Ukraine" (UABio) was established to create a common platform for cooperation on bioenergy market in Ukraine, as well as to provide the most favorable business environment, accelerated and sustainable development of bioenergy. General constituent assembly of UABio was held on September, 25, 2012 in Kyiv. The Association was officially registered on 8 April 2013. Among UABio members there are over 10 leading companies and over 20 recognized experts working in the field of bioenergy.

http://uabio.org