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Overview of Lithuanian DH sector: past, current situation and future challenges

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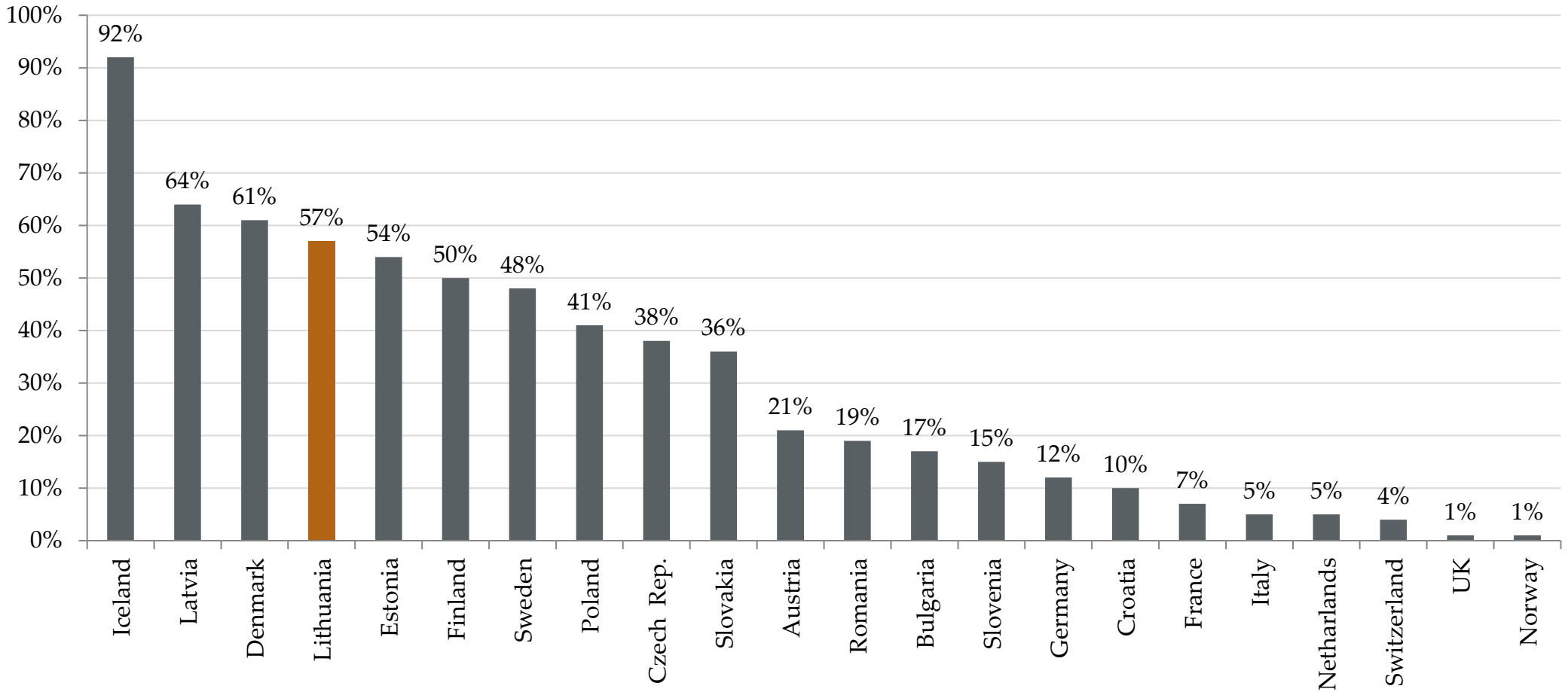
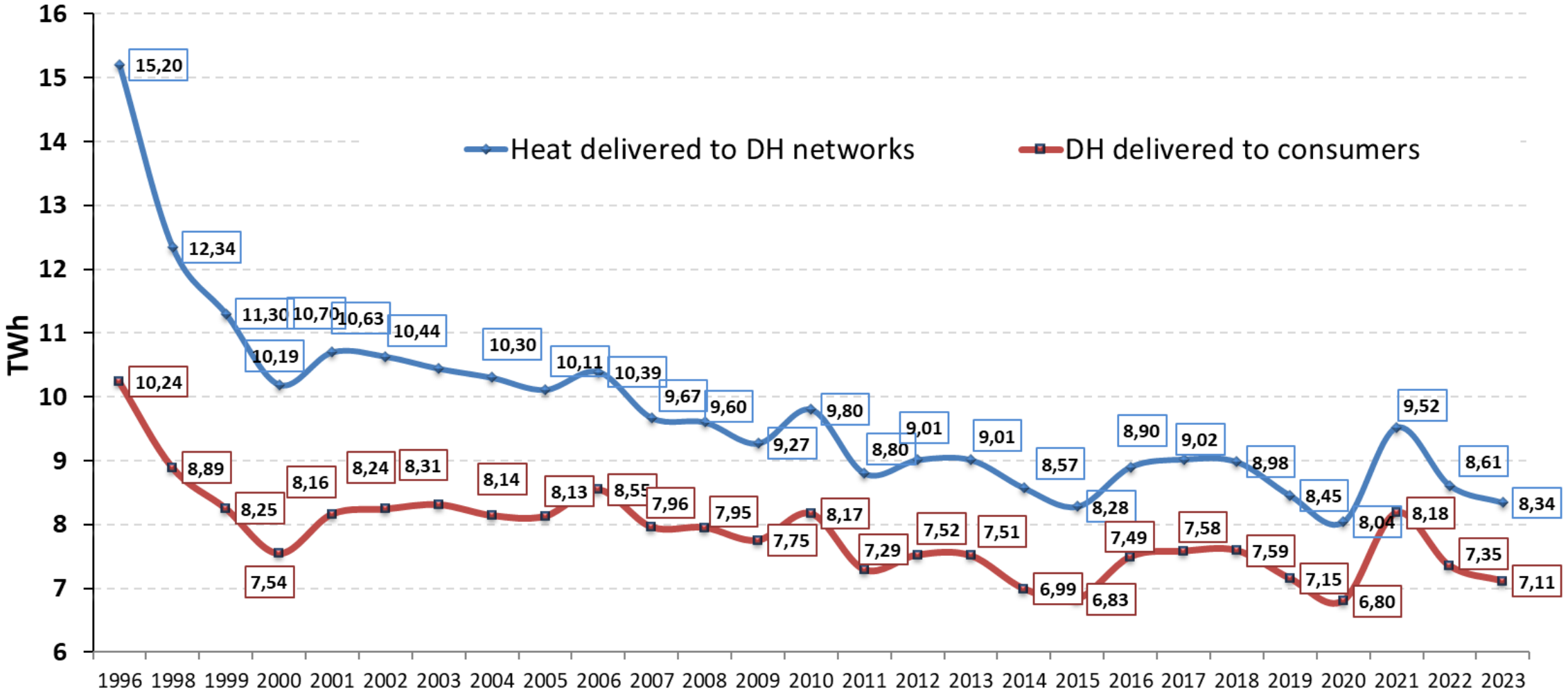
District heating share in European countries

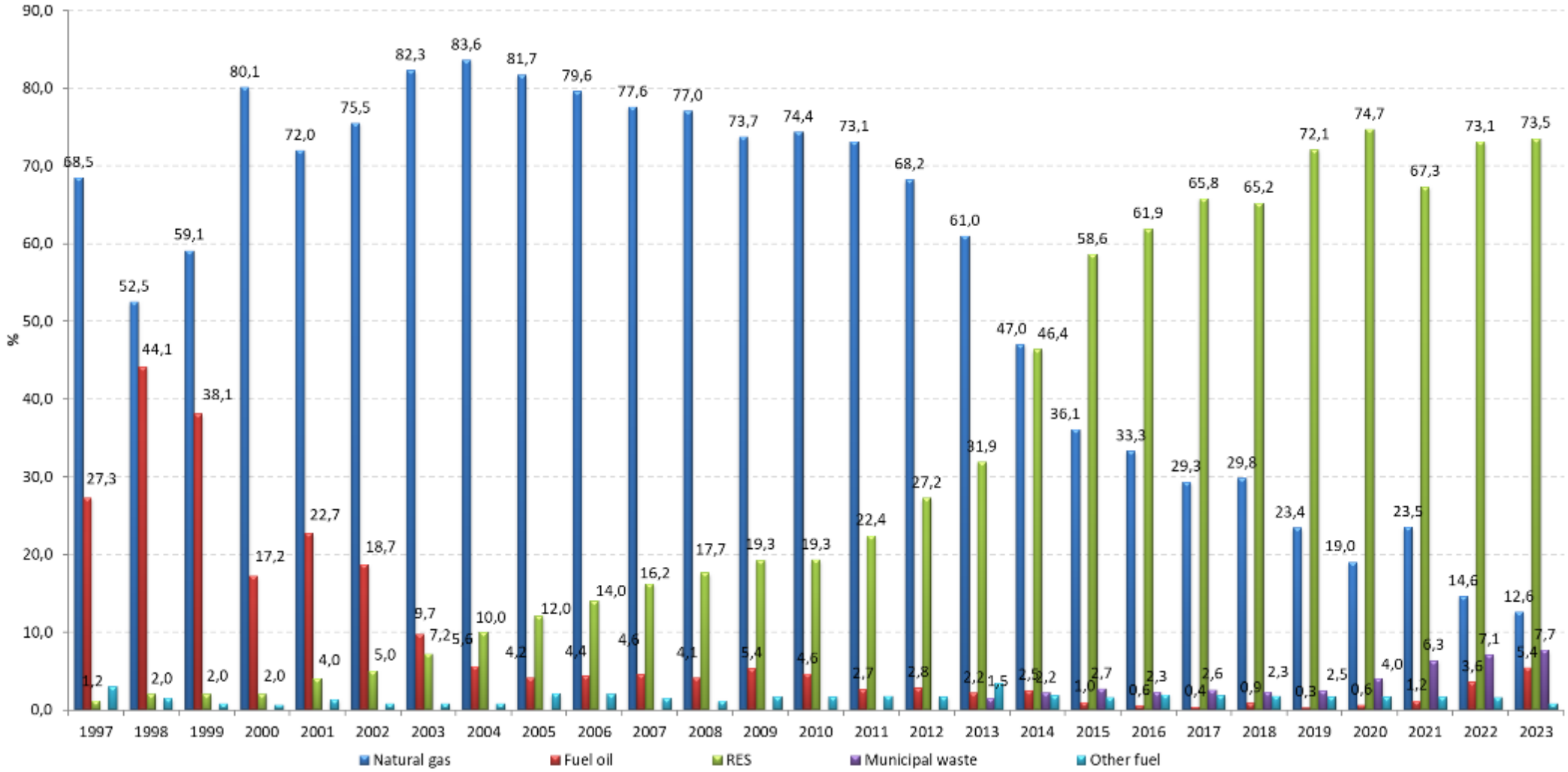


District Heat Production and Sale



Fuel mix in DH sector

Large share of biomass – less dependancy on natural gas



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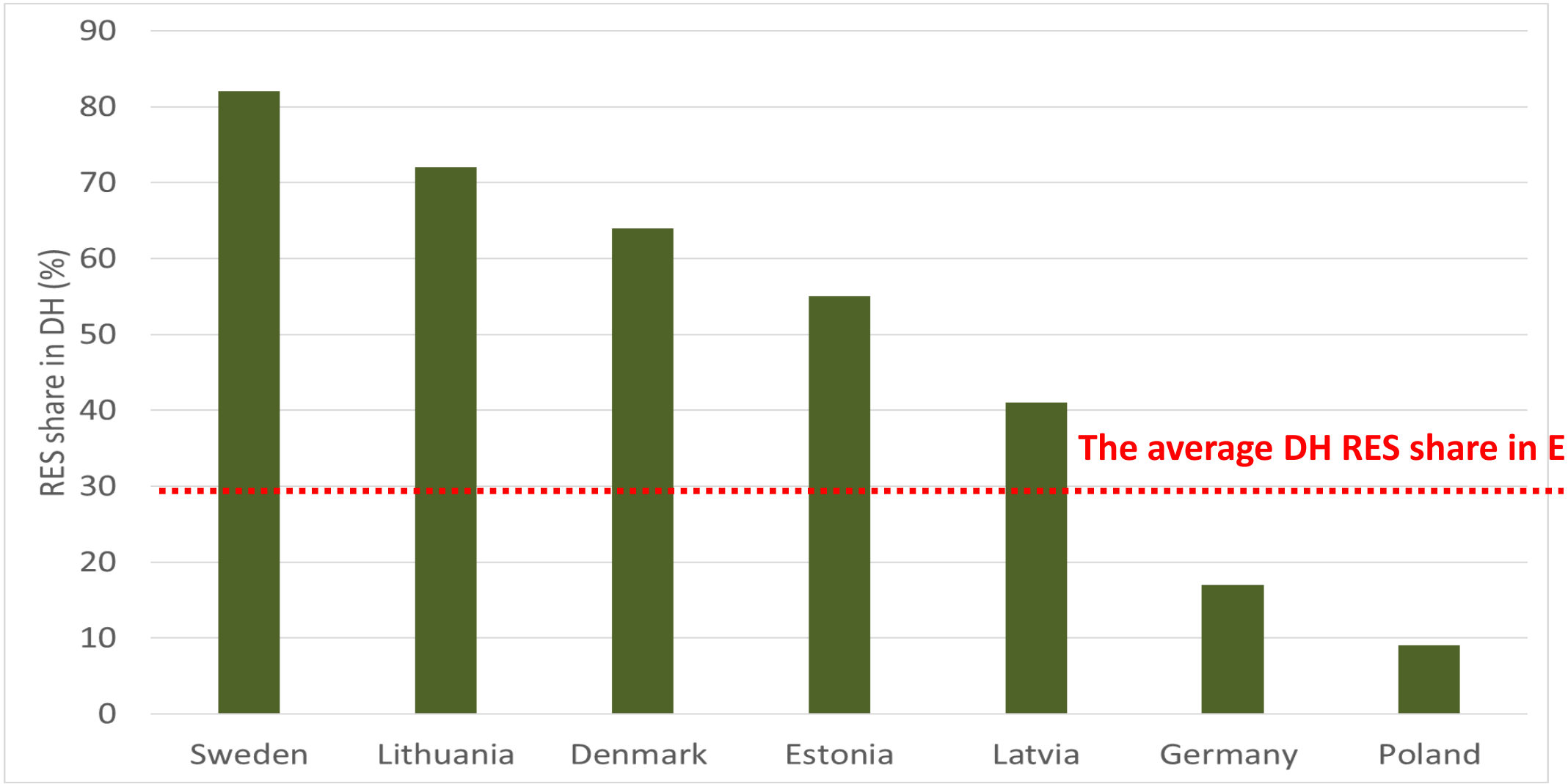
Renewables share in EU DH sectors



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Different forms of EU framework influence on transfomation of district heating (DH) in Lithuania

A. Direct regulation – mandatory implementation related to timeshedule etc. typically – safety, environmental and similar requirements

B. Indirect influence of EU policy via international obligations of the member state. For ex., energy independence, share of renewable resources, social security etc.

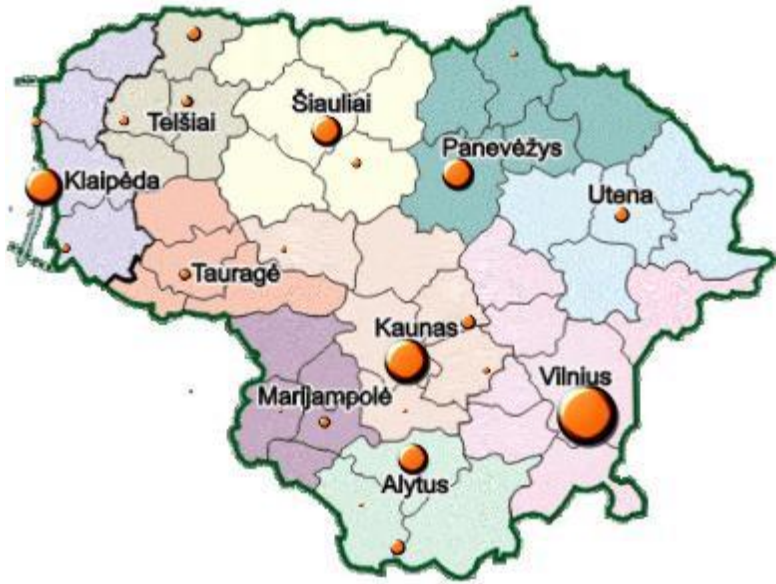
C. Following good practice in old EU memeber states

EU DIRECTIVES of high importance for district heating sector

- 1999/32/EC Relating to a reduction in the sulphur content of certain liquid fuels
- 2003/87/EC Establishing a scheme of greenhouse gas emission allowance trading within the Community
- 2011/83/EU on consumer rights; 93/13/EEC on unfair terms in consumer contracts; 2005/29/EC on unfair business-to-consumer commercial practices.
- 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants (LCPD)
- 2015/2193 on the limitation of emissions of certain pollutants into the air from medium combustion plants (MCPD)
- 2023/1791 on energy efficiency (EED)
- 2023/2413 promotion of energy from renewable sources (REDIII)
- 2024/1275 on the energy performance of buildings(EPBD)

Reorganizations of the DH sector

- State energy monopolistic enterprise „Lietuvos energija" was decentralised in 1997.
- Share holding enterprises for district heating service were established in the municipalities
- Ownership of DH assets was moved from the national to the municipal level
- Regional 6 share holding companies were set in the beginning but split to each municipality later
- Municipal assets of 17 DH companies were sold or leased to national or international investors: Fortum, Dalkia (Veolia) until 2004 y.
- Recently most consession agreements have been fulfilled and DH assets have been returned to the municipal management



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Examples of the direct influence of EU directives

- Forbiden usage of high sulphur heavy fuel oil – no more than 1 % of sulphur, without dešulphurization plant
- Maximal allowed concentration of emissions in flue gas of different fuels and boilers
- Safety, efficiency, environmental requirements for hardware according to EN, CE etc. for potentialy danger equipment.
- Allocation of GHG allowances for the DH enterprises above 20 MW. New regulation (since 2025) will set this limit to 7,5 MW
- State Consumer Rights Protection authority was established in 2001 - implement public policy in the field of consumer protection.

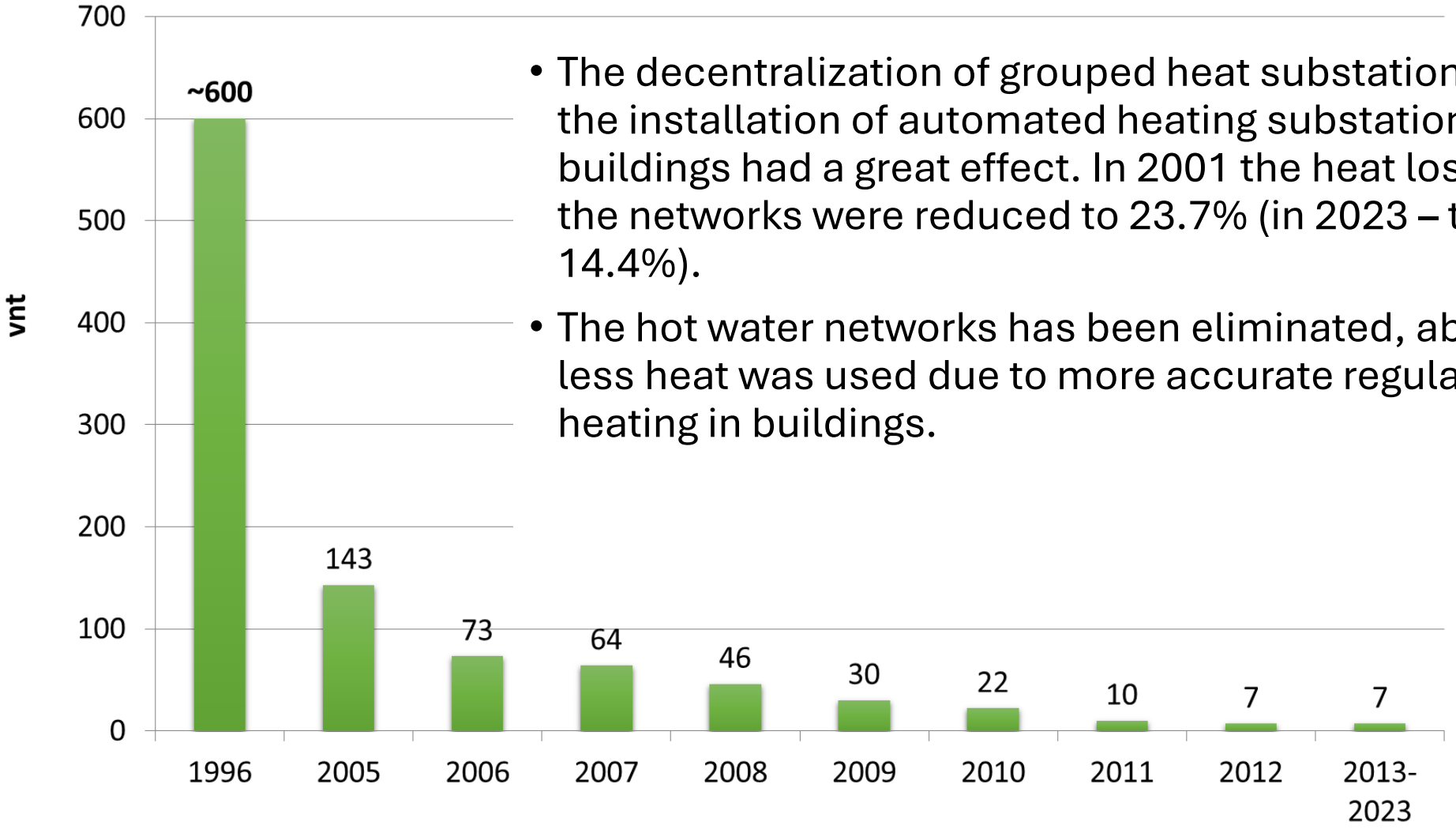
The Heat Law approved in 2003

- Heat operator tasks (supply heat, maintain system)
- Heat planning and zoning etc.
- Relation with heat consumers (responsibilities)
- New customer contract principles
- Regulation of consumers' disconnection options
- Transparency for consumers
- Access for external parties to supply heat
- Separation from municipal economic activities

Following good practice of EU countries

- Inlet heat meters installed in all buildings since 1997
- Billing based on the real heat consumption introduced
- Independance of the National Energy Regulator
- Cost based DH pricing applied by the National Energy regulator
- No cross-subsidization between heat consumers
- Individual approach to the social support of vulnerable consumers
- Replacement of grouped heat substations by individual heat substations in each building
- Absorption heat pumps introduced for deep recovery of thermal energy from flue gas
- Priority for CHP plants instead of heating only boilers
- Waste to energy CHP plants in 3 largest cities (Vilnius, Kaunas, Klaipeda)
- E.t.c...

Decentralization of grouped DH substations



- The decentralization of grouped heat substations and the installation of automated heating substations in buildings had a great effect. In 2001 the heat losses in the networks were reduced to 23.7% (in 2023 – to 14.4%).
- The hot water networks has been eliminated, about 15% less heat was used due to more accurate regulation of heating in buildings.

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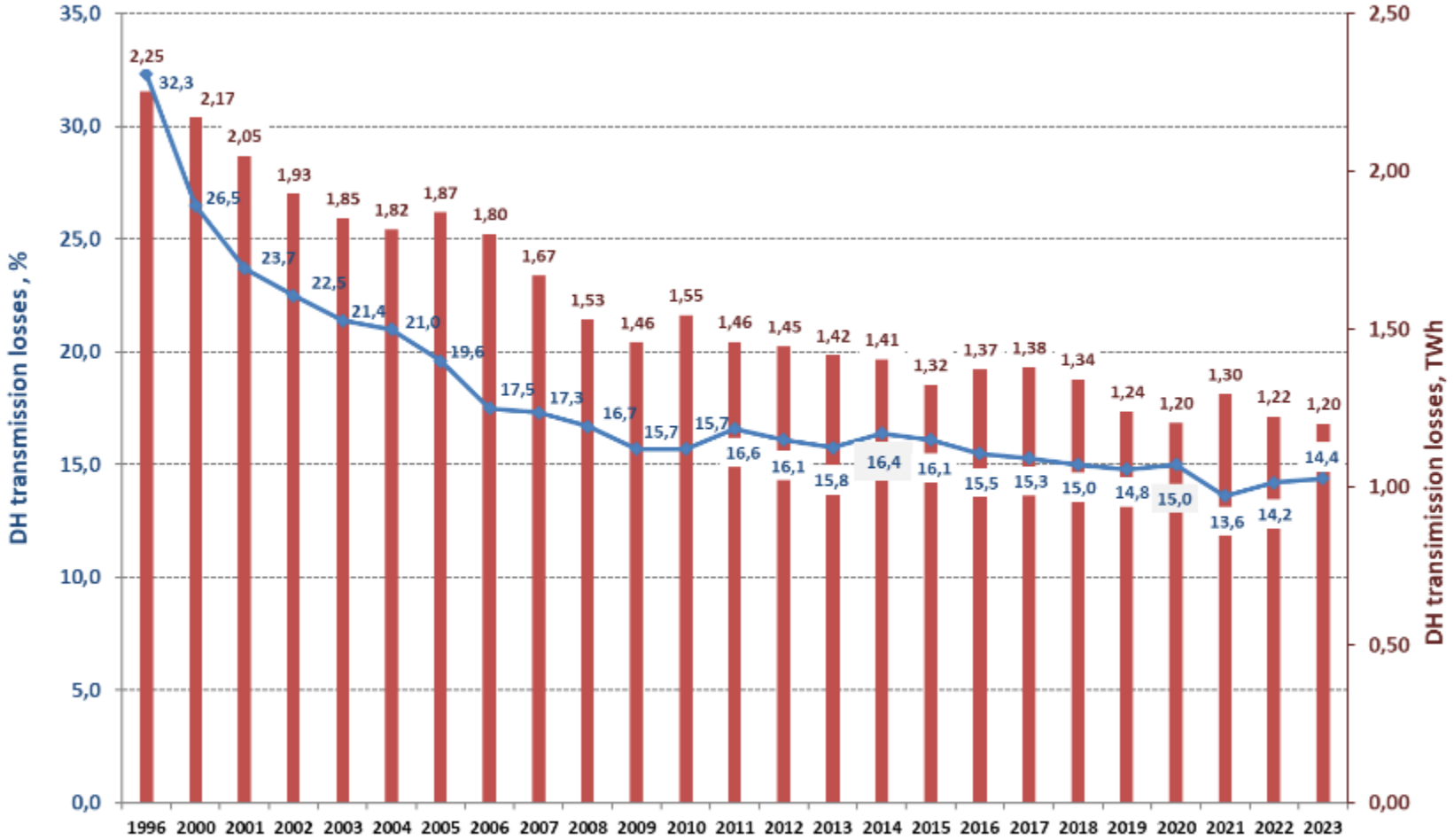
Modernization of DH networks

• Since 1996 after the heat transfer through networks decreased by 2-3 times, the actual amount of heat losses became clear only when heat meters were installed in boiler houses and at consumers building inlets.

• Part of the heat losses occurred due to accounting and heat distribution problems (commercial losses due to non-taxable “exceeding the norm" heat consumed in a specific building).



Directive 1999/32/EC relating to a reduction in the sulphur content of certain liquid fuels

- Member States shall take all necessary steps to ensure that as from 1 January 2003 within their territory heavy fuel oils are not used if their sulphur content exceeds 1 % by mass.

- In 2002 Ministry of Environment adopted LAND 43-2001 „The determination of emission standards from large fuel combustion plants and emission standards from fuel-burning facilities“

Since 2004 January 1 in the territory of the Republic of Lithuania it was forbidden:

- to use fuel oil with a sulfur content of more than 1% by mass.
- the sulfur dioxide limit value of all installations burning liquid fuel cannot be higher than 1700 mg/nm3

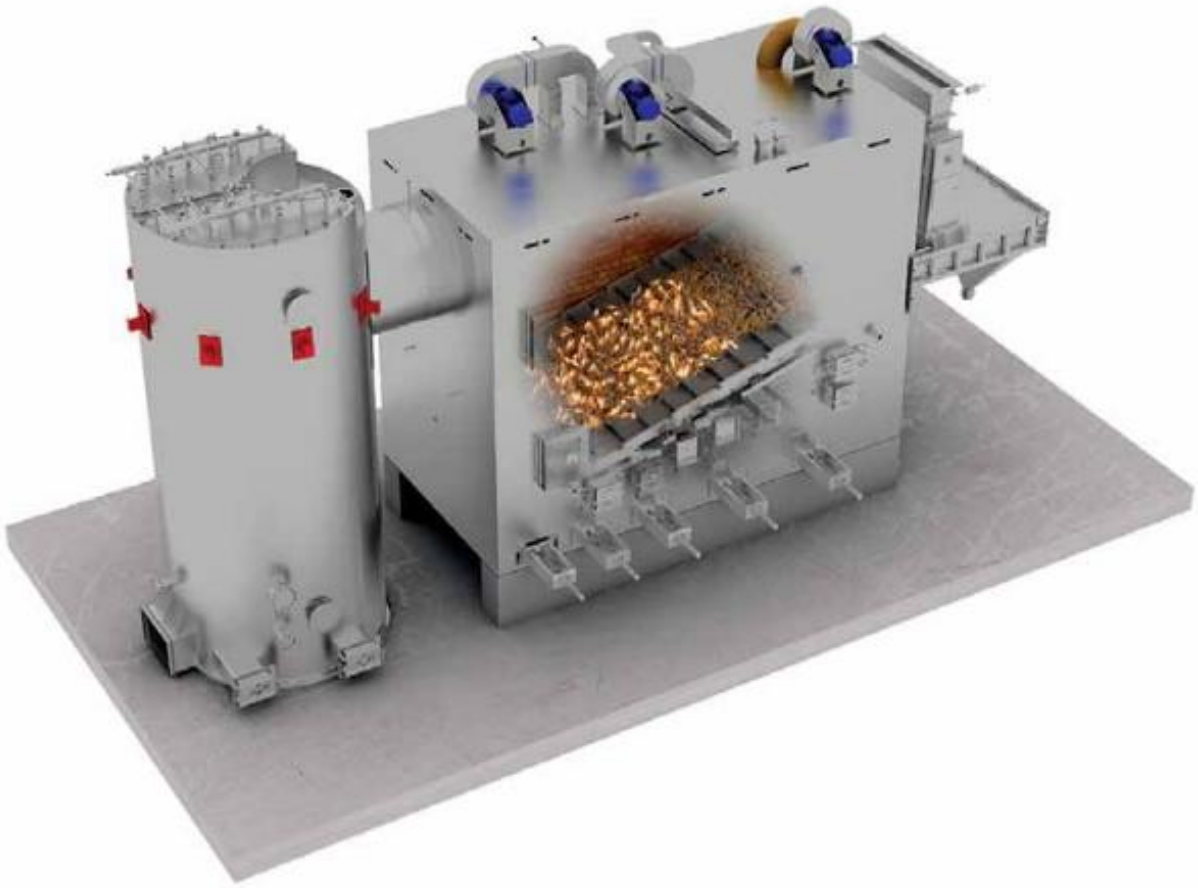
2003/87/EC Establishing a scheme of greenhouse gas emission allowance trading within the Community

- **Lithuania ratified Kyoto protocol in 2002**. The obligation to reduce CO2 emissions to 8 % of the 1990 year level by the 2008 – 2012.
- It was foreseen that the average annual CO2 emissions in 2005-2007 will be only 54.6 % of the Kyoto protocol requirements.

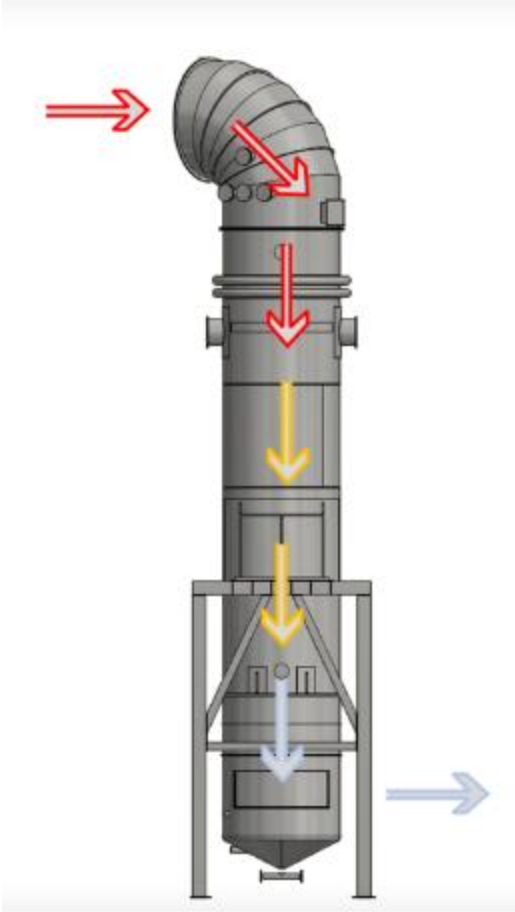
- **In 2004 Lithuanian National Emission Allowance Distribution Plan 2005-2007 was adopted**
- The international emission trading market had a positive impact to the pay-back time of investments in RES technologies, as well as the opportunity to reduce rather high heat or electricity prices for consumers.
- This incentive created good conditions for biomass (CO_2 neutral fuel) development in DH sector

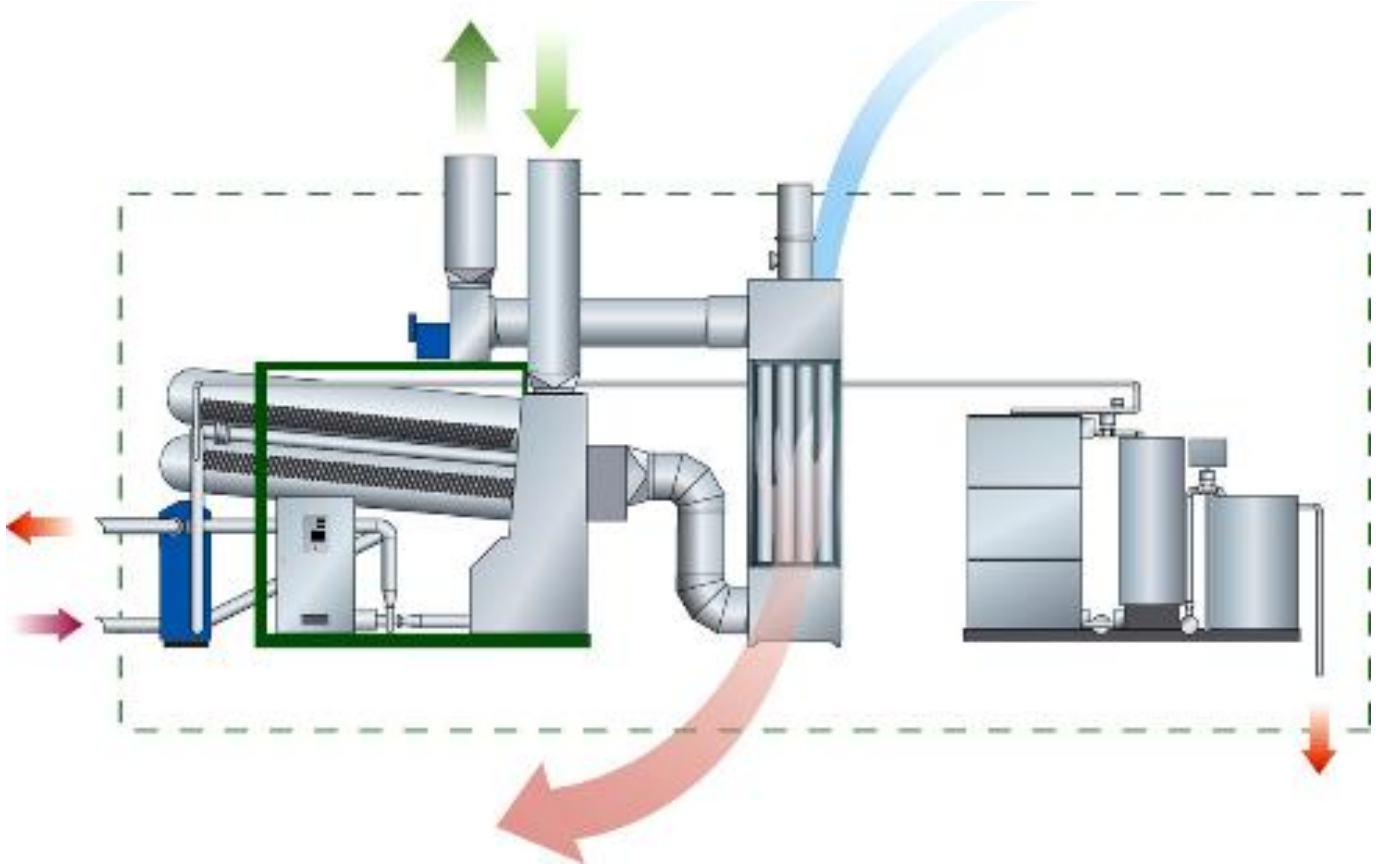
Replacement of watertube boilers by firetube boilers

Replacement of fosil fuels by biomass firing boilers



Typical condensing economizers in biomass firing boiler plants





Up to 25 % additional heat recovery

Combined cycle gas firing CHP plant in Panevėžys

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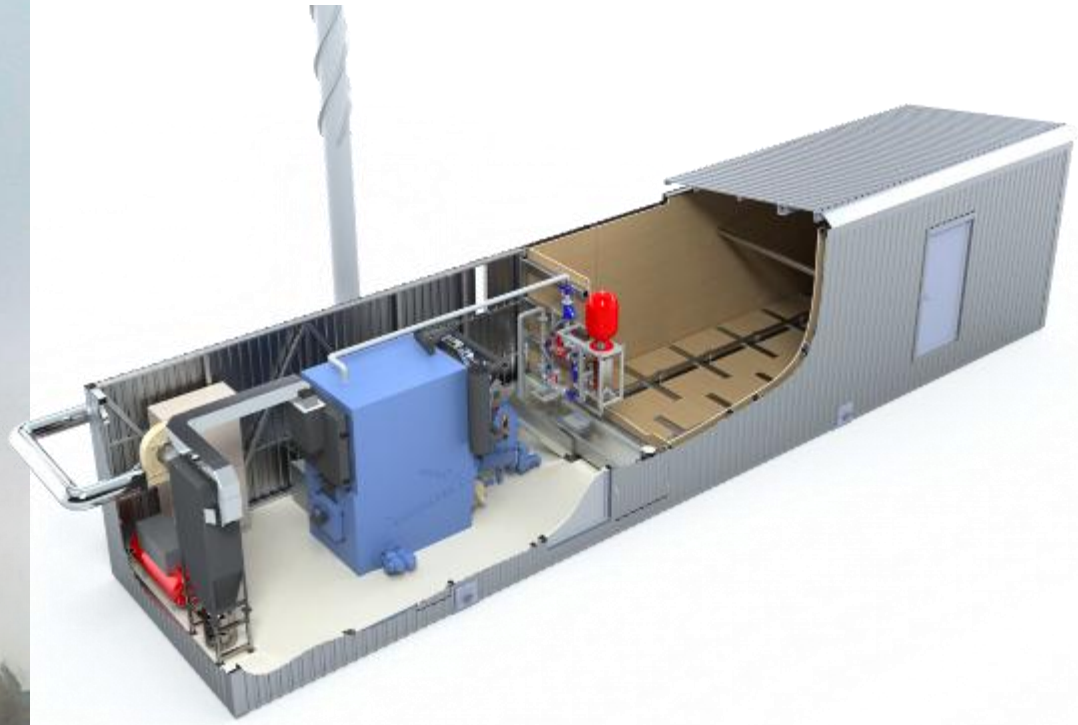
EU policy 20x20x20 until 2020

- Share of the renewable resources should reach 20 %
- Part of this obligation was allocated for DH sector
- State support and EU funds were available to reach these targets
- DH sector achieved this task
- New targets in climate protection have been set

Wide introduction of biomass firing boilers



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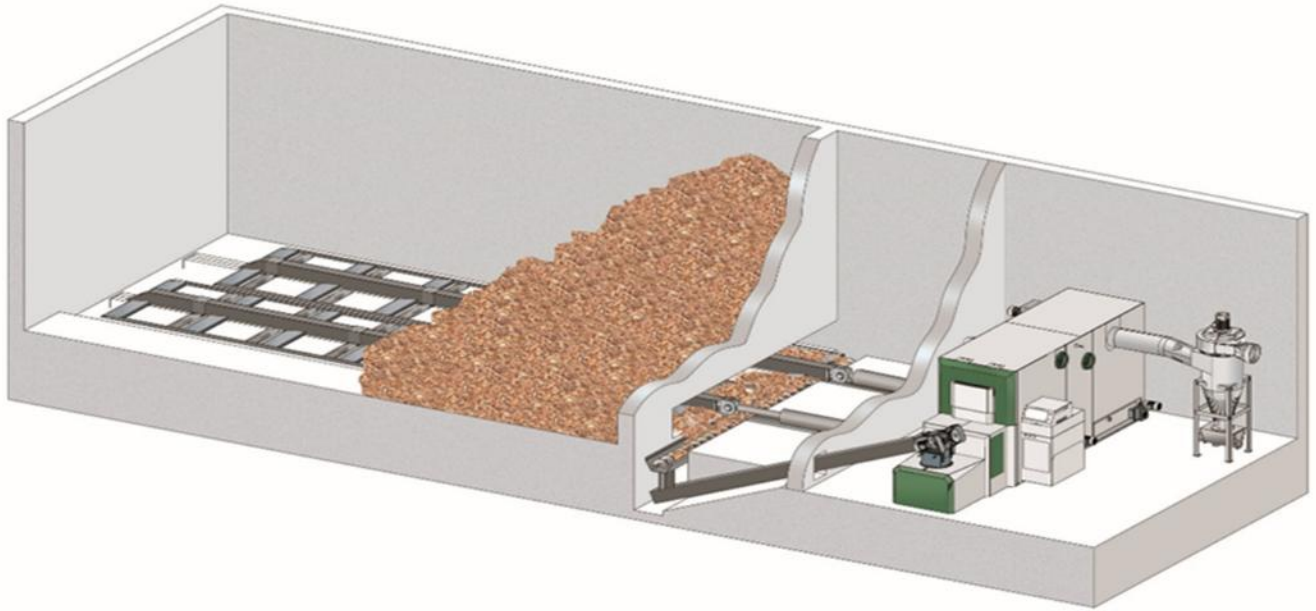
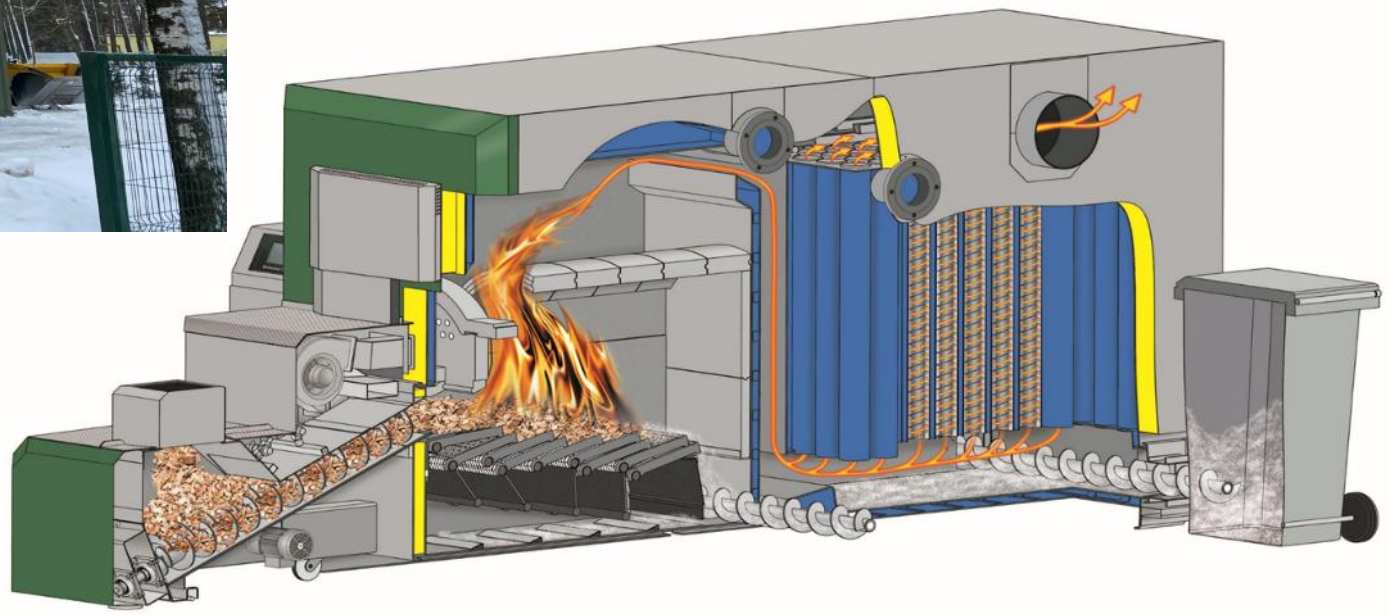
Examples of fully automatic biomass boiler plants

Varena DH utillity





One of the first automatic wood chips boiler plant in Lithuania

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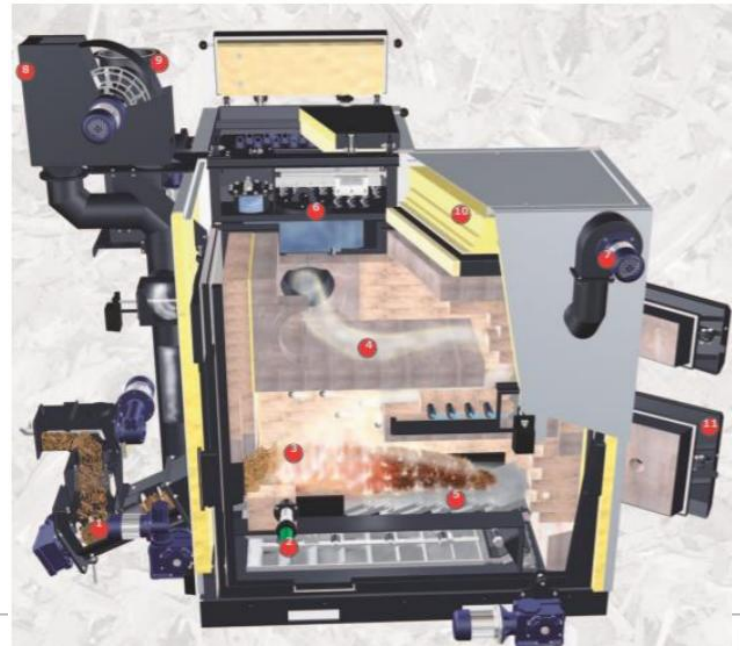
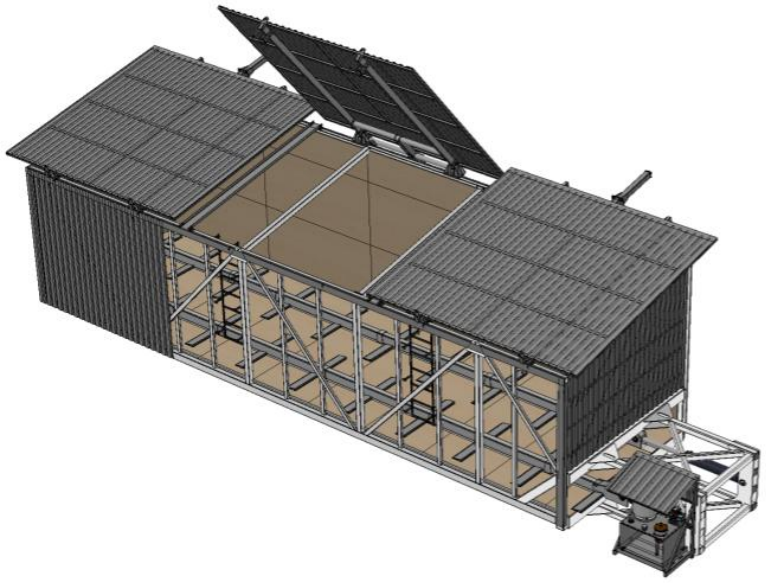
The number of automated wood chips-burning boilers is growing





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Challenges in small biomass firing boilerplants

- High quality and stabile composition of wood chips should be ensured – how?
- Facilities must be simple and reliable
- Storages for woodchips and ash should be large enough
- Automatical fuel storages - without tractor assistance?
- Wide turn down range required because single boiler applied for winter and summer regimes
- Spare parts and services must be available
- E.t.c...

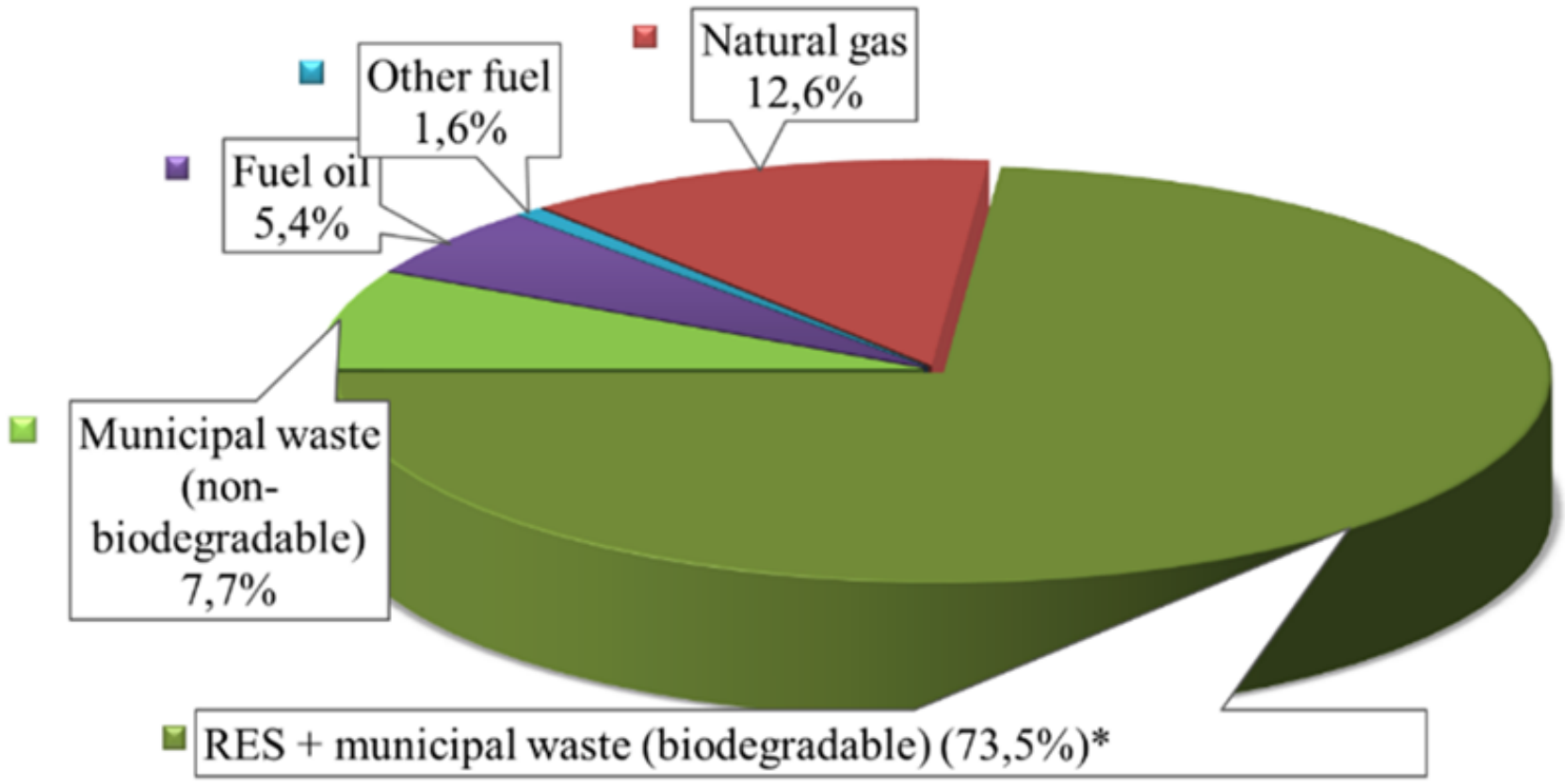
Vilnius CHP plant

1 unit – **city waste**:
53 MW_{th} + 18 MW_e

2,3 units – **biomass**:
174 MW_{th} + 70 MW_e

Investmant 343 mln. EUR

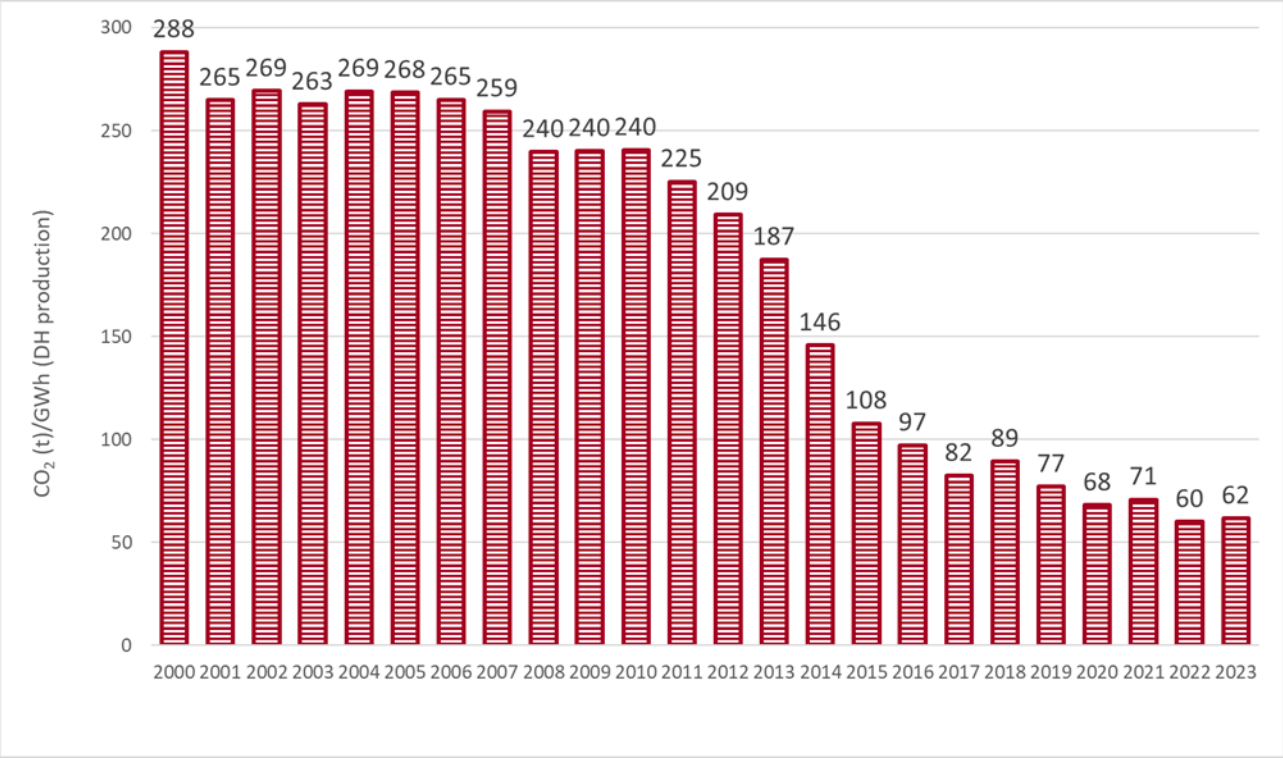
Fuel mix in the Lithuanian DH sector in 2023



* - Wood and its waste, biodegradable fraction in municipal waste 6436 GWh (72.7%), straw, lignin 31 GWh (0.4%), biogas, grain waste, sunflower pellets 27 GWh (0.4%)

EED- Efficient DHC definition: annual amount of GHG (average)

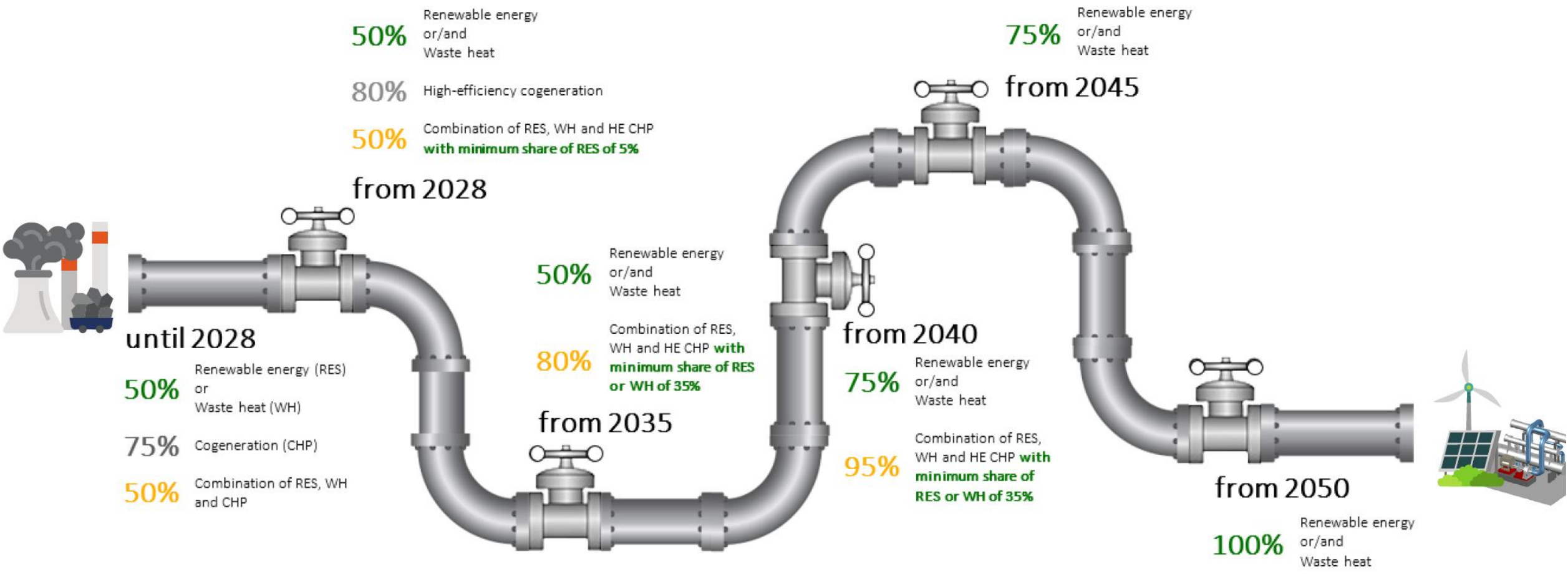
- until December 31, 2025 - 200 g/kWh
- from January 1, 2026 - 150 g/kWh
- from January 1, 2035 - 100 g/kWh
- from January 1, 2045 - 50 g/kWh
- **from January 1, 2050 - 0 g/kWh**



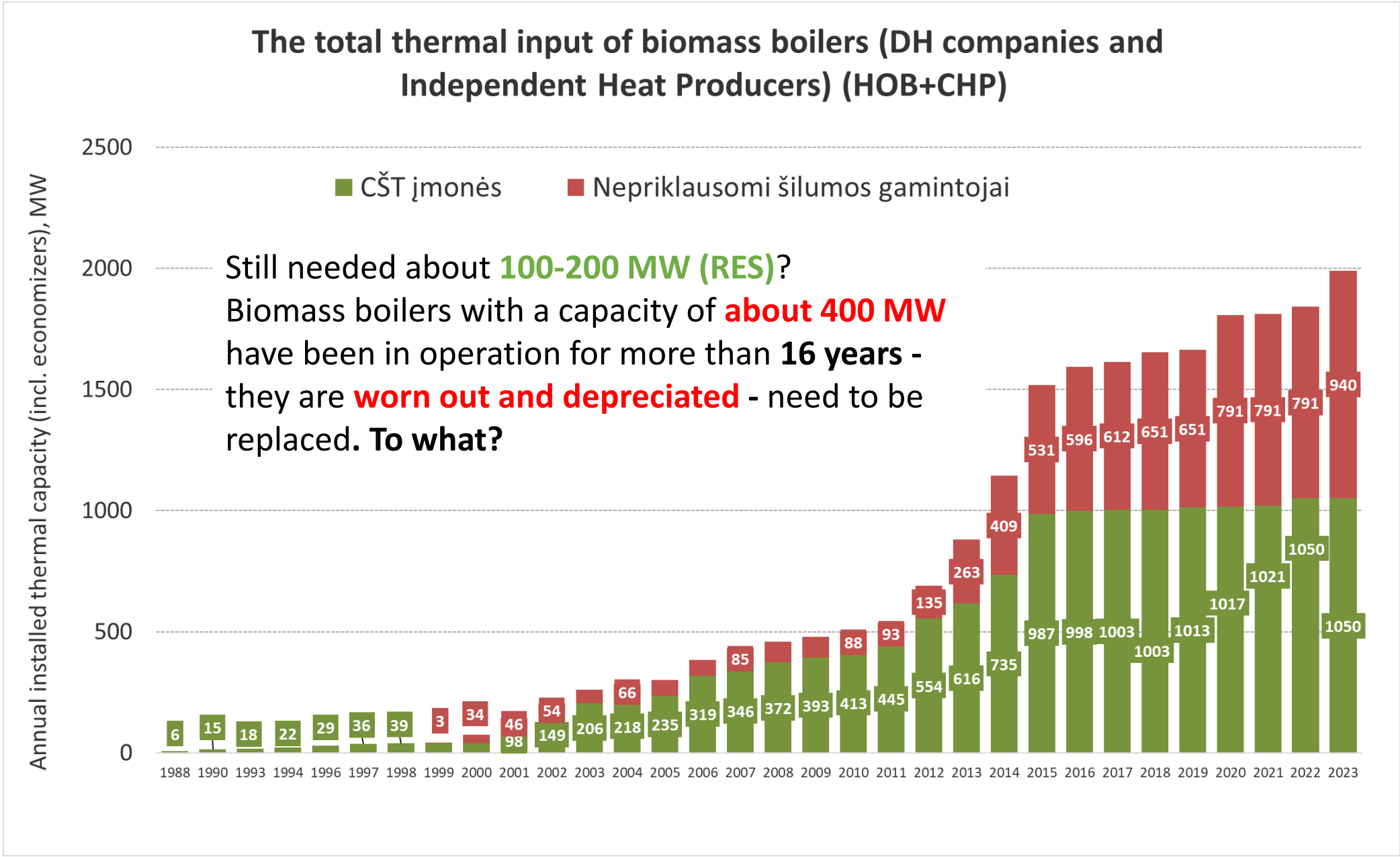
In Lithuania since 2000 due to the wider use of biomass, the amount of CO2 emissions in the DH sector decreased by 70%

Efficient DHC Definition (EED Art. 24.1)

EUROHEAT & POWER



Biomass development is completed?



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Requirements introduced by Energy Eficiency Directive

- Information provided to DH consumers about thermal energy saving solutions
- Annual reporting to Ministry of Energy about saved heat due to consumer's education and consultation activities
- Voluntary agreements between ministry and DH companies aimed to save energy in the heated buildings
- Municipal energy ėfficency investments plans for 10 years
- New targets for real energy savings in the buildings

Lithuanian targets in decarbonization of DH sector

2022

Heat demand per year **10,2 TWh**

RES **79 %**

Greenhouse gas emissions per year **599 ktCO2**

District heating

Buildings area - 71,4 millions m2

56 % of buildings area heated by **decentralized heating**
44 % of buildings area heated by **district heating**

2050

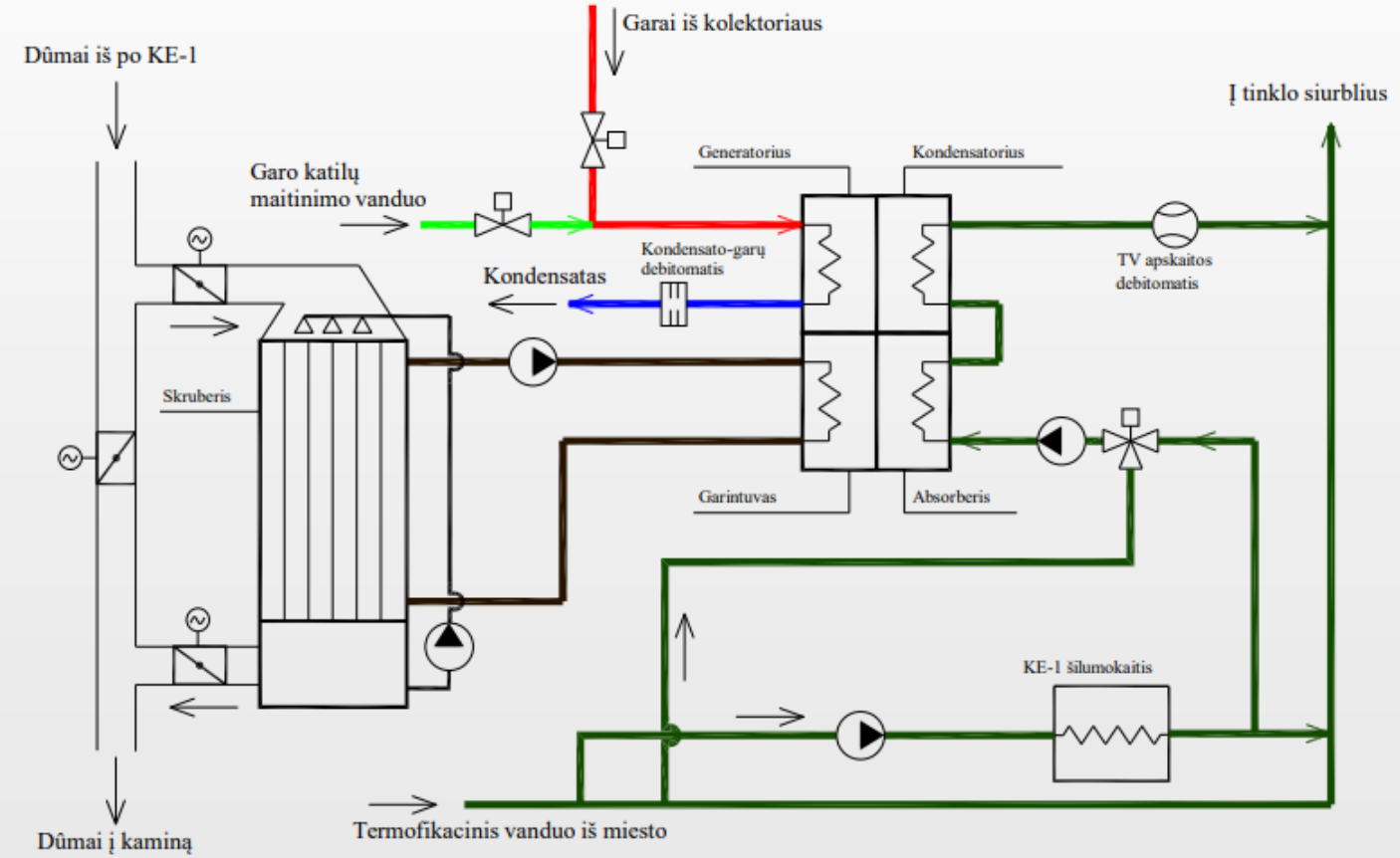
Heat demand per year **9 TWh**

RES **100 %**

Greenhouse gas emissions per year **±0 ktCO2**

New technologies introduced for increasement of efficiency

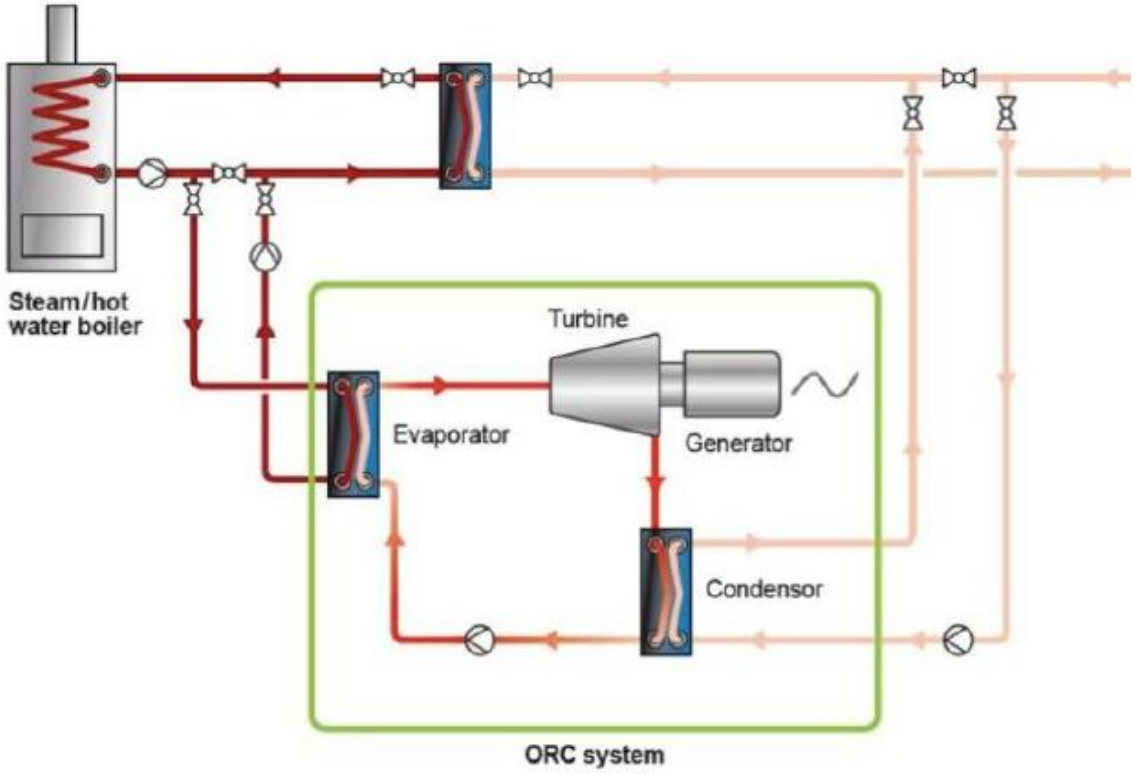
Absorption heat pump and secondary economizer



Up to 7 % of additional heat from biomass

Panevėžys DH company

ORC type electricity generator at the biomass boiler plant



Panevėžys DH company
Rokiškis biomass boiler plant,
t=160/140°C q=105 kWe

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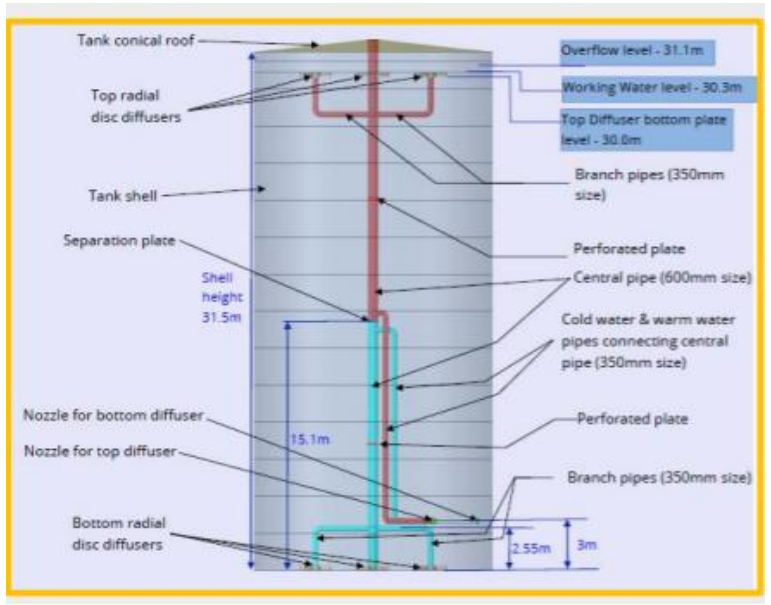
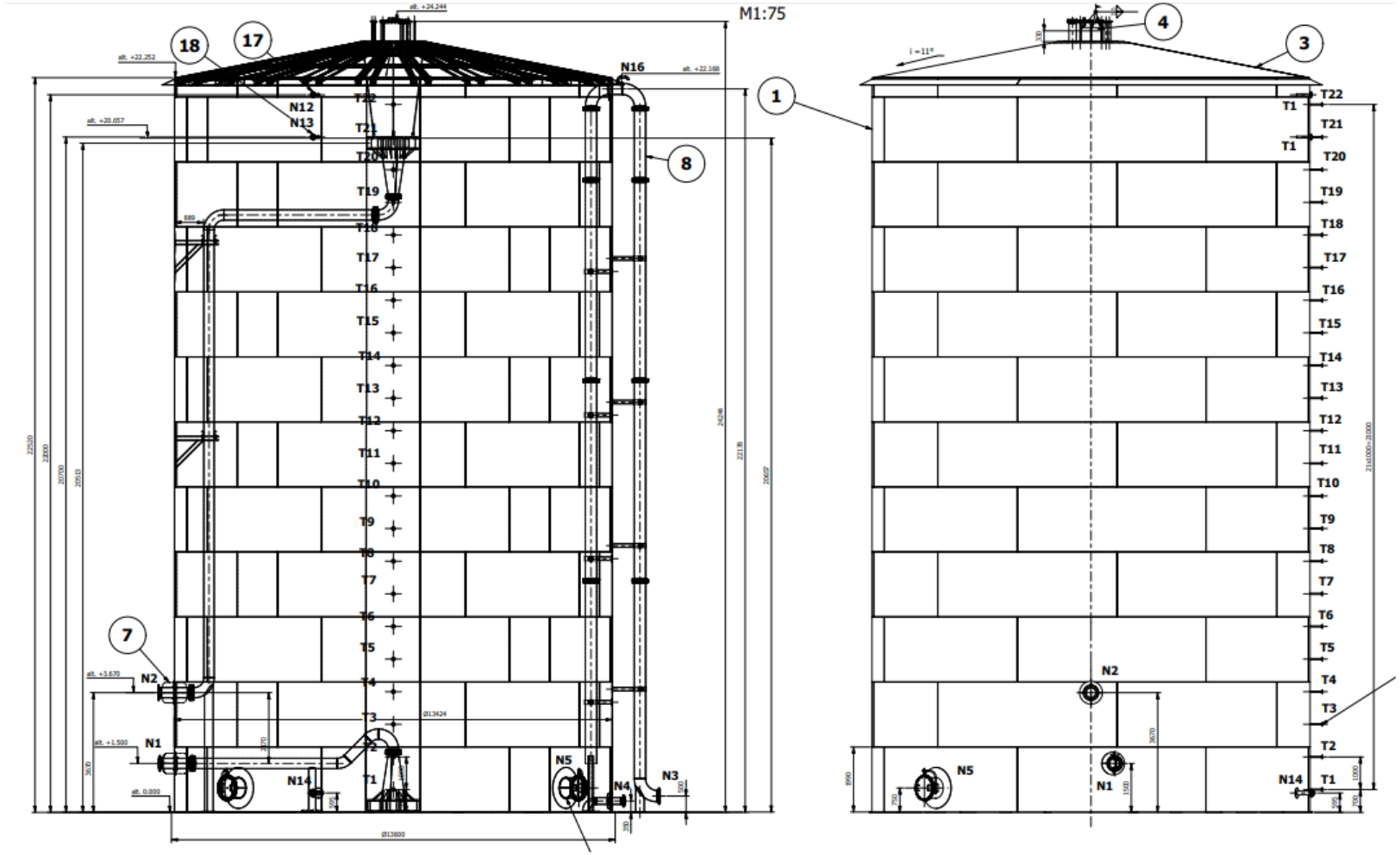
Heat acumulator in Klaipeda





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Challenges related to usage of biomass-based fuels

- Quality of biomass become worse and worse
- Effective combustion of forest residuals requirs new type boilers
- New standarts for emissions from biomass firing boilers are coming
- New national requirement to operate boilerhouse during 24 hours without electricity supply from the national grid
- Extra investment required...

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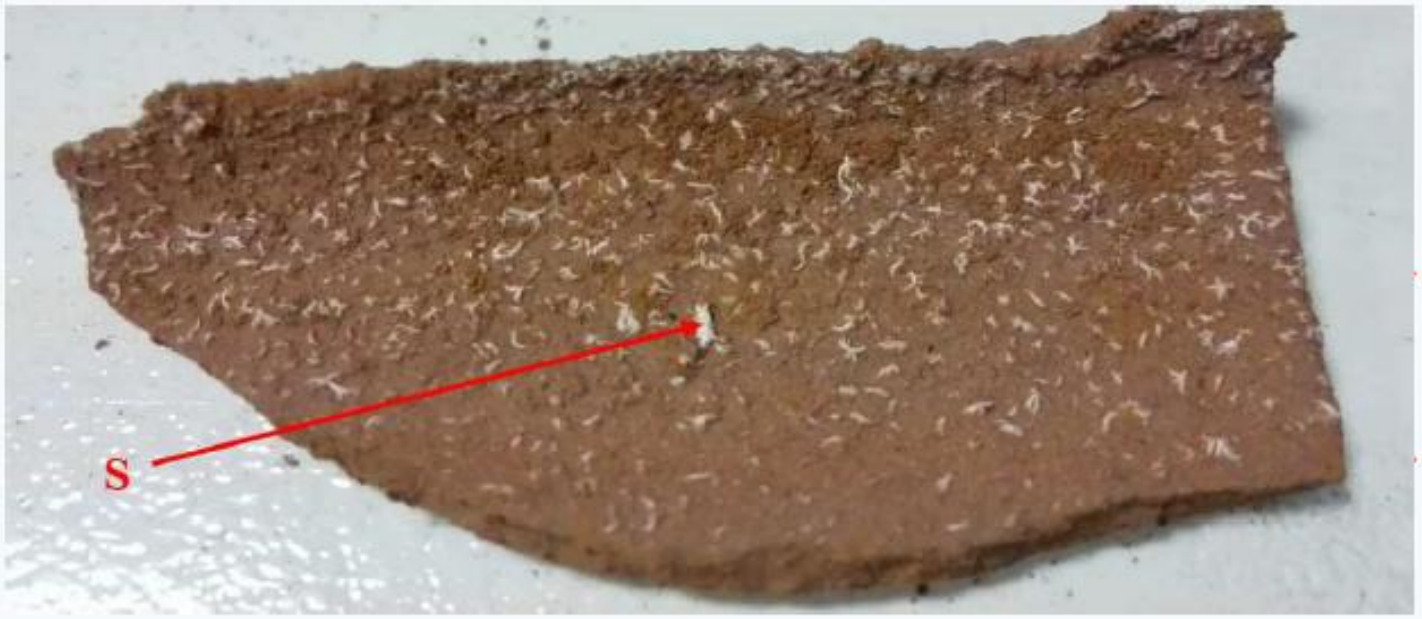
Specification of wood chips in Lithuania (Baltpool)

Biokuro rūšis	Kodas	Drėgnis % nuo naudojamosios masės		Peleningumas % nuo sausosios masės	Frakcijos dydis				Chloro kiekis (% nuo sausosios masės)[4]	Žaliava (1 lentelė)	Leidžiamos priemaišos
		Min.	Maks.	Maks.	Smulkelių frakcijos (<3,15 mm) leidžiamas kiekis, %	Pagrindinė frakcija , mm (min. kiekis %)[7]	Stambioji frakcija (maks. skerspjūvis 6 cm[2]), mm (maks. kiekis, %)[7]	Didžiausias leidžiamas ilgis, mm[7]			
Medienos skiedra	SM1	20	45	2	Iki 2 % masės	3,15 ≤ P ≤ 63 (min. 80 %)	> 100 (iki 10 % masės)	<150[5]	<0,02%	1;	-
Medienos skiedra	SM1W	35	55	2	Iki 5 % masės	3,15 ≤ P ≤ 63 (min. 80 %)	> 100 (iki 10 % masės)	<150[5]	<0,02%	1; 2;	-
Medienos skiedra	SM2	35	55	3	Iki 10 % masės	3,15 ≤ P ≤ 63 (min. 70 %)	> 100 (iki 10 % masės)	<150[5]	<0,02%	1; 2; 3.1; 3.2; 3.4; 3.5	Sausi lapai, sausi spygliai[4]
Medienos skiedra	SM3D	35	55	5	iki 20 % masės	3,15 ≤ P ≤ 63 (min. 60 %)	> 100 (iki 10 % masės)	<220[5]	<0,02%	1; 2; 3; 4.3; 4.4	Sausi lapai, sausi spygliai[4]
Medienos skiedra	SM3	35	60	5	iki 25 % masės	3,15 ≤ P ≤ 63 (min. 60 %)	> 100 (iki 10 % masės)	<220[5]	<0,03%	visos	Lapai, spygliai ir žievė
Medienos skiedra	SM4	35	60	7	iki 30 % masės	3,15 ≤ P ≤ 63 (min. 60 %)	> 100 (iki 10 % masės)	<220[5]	<0,03%	visos	Lapai, spygliai ir žievė

Corrosion and errosion of biomass firing boilers



Element	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error [%]
Oxygen	K-series	44.35	40.48	59.22	5.0
Carbon	K-series	2.15	1.96	3.83	1.0
Iron	K-series	14.82	13.53	5.67	0.5
Magnesium	K-series	2.79	2.55	2.45	0.2
Aluminium	K-series	7.06	6.44	5.59	0.4
Silicon	K-series	1.09	1.00	0.83	0.1
Phosphorus	K-series	1.32	1.20	0.91	0.1
Sulfur	K-series	13.22	12.07	8.81	0.5
Chlorine	K-series	0.44	0.40	0.27	0.0
Potassium	K-series	1.70	1.55	0.93	0.1
Calcium	K-series	16.84	15.37	8.97	0.5
Zinc	K-series	1.28	1.17	0.42	0.1
Sodium	K-series	2.10	1.91	1.95	0.3
Manganese	K-series	0.40	0.36	0.15	0.1
	Total:	109.55	100.00	100.00	

PROBLEM!!!

Multi-cyclone and bag filter ash are in red- an indicator of boiler severe rusting
As a result - boiler pipes are constantly replaced (every 2 years) - STOPPING - repair costs - burning of alternative (fossil) fuel

RESULT !

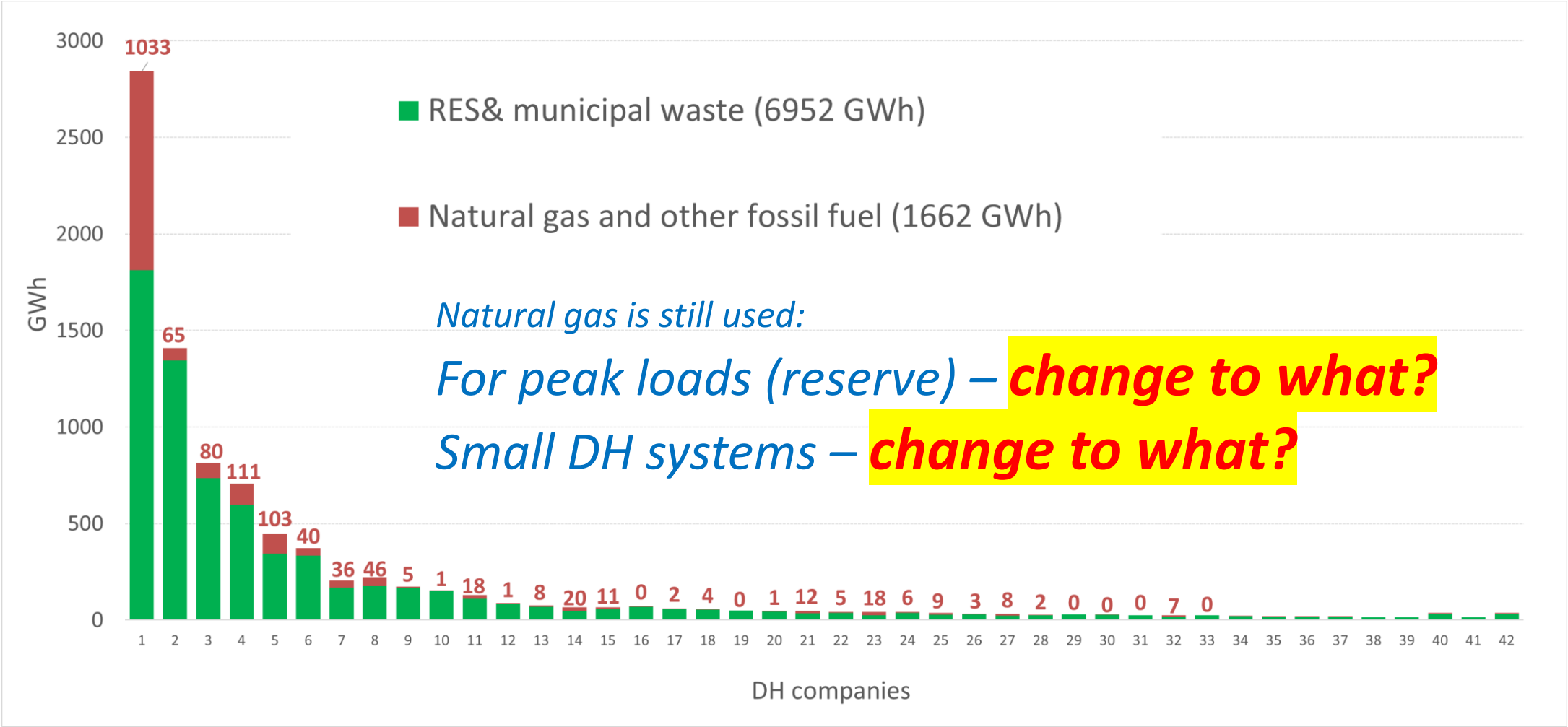
Significantly improved ash color

Electricity consumption decreased 2x (5-6 kW/MWh)

We count the time until the pipes need to be replaced

Further replacement of fossil fuels by renewable sources

Fuel structure in the separate DH systems of Lithuania, 2023



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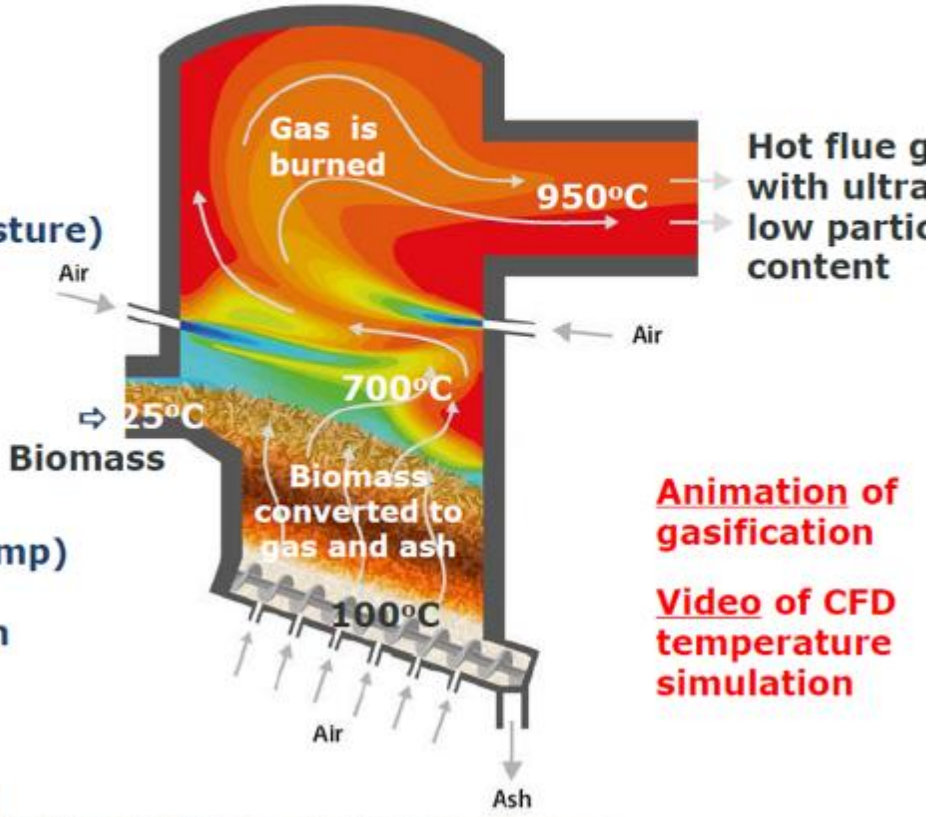
Boilers with Biomass Gasification Furnace?

Biomass Gasification Furnace

Multifuel – low emission – high efficient

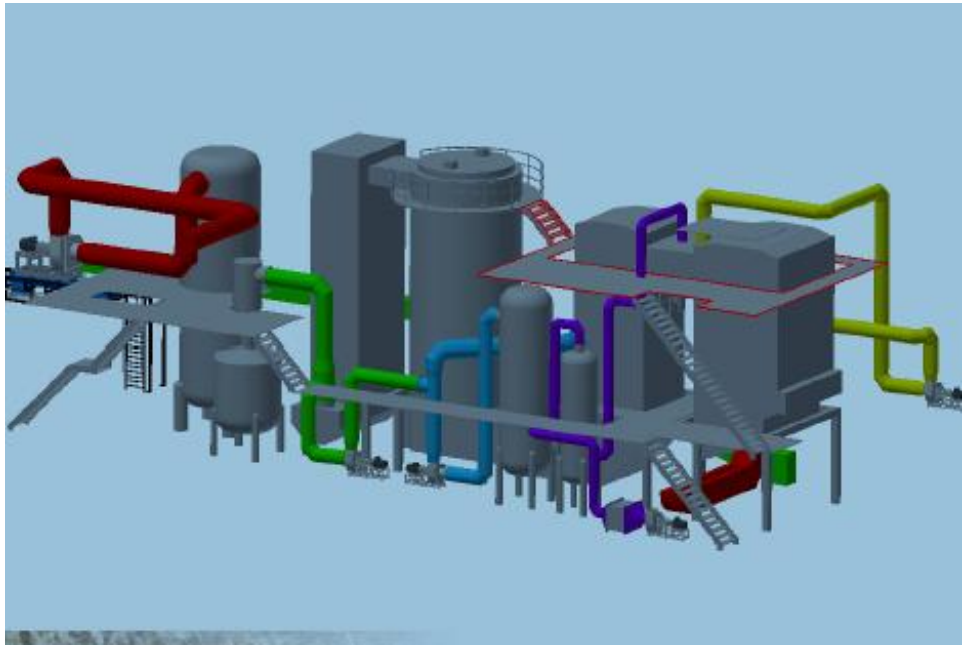
Costumer benefits :

- Low cost fuel (high ash & 20-60% moisture)
- 10-100% load
- 95% less dust (no filters)
- 25% higher efficiency (with absorption heat pump)
- Low power consumption
- Low NOx & CO
- Low maintenance costs



Animation of gasification

Video of CFD temperature simulation

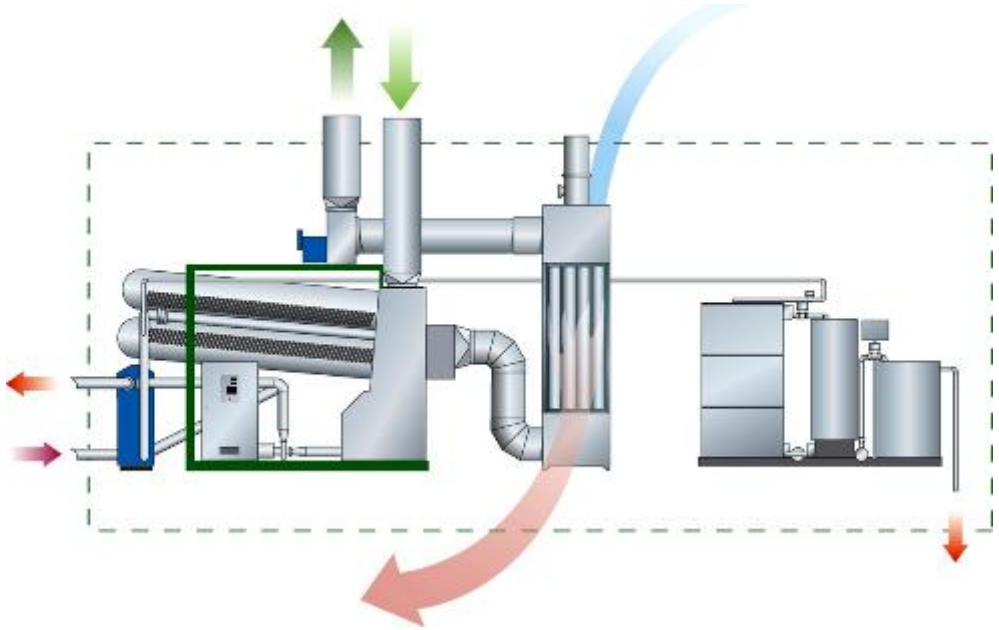


Wood gasifier + engine + electricity generator

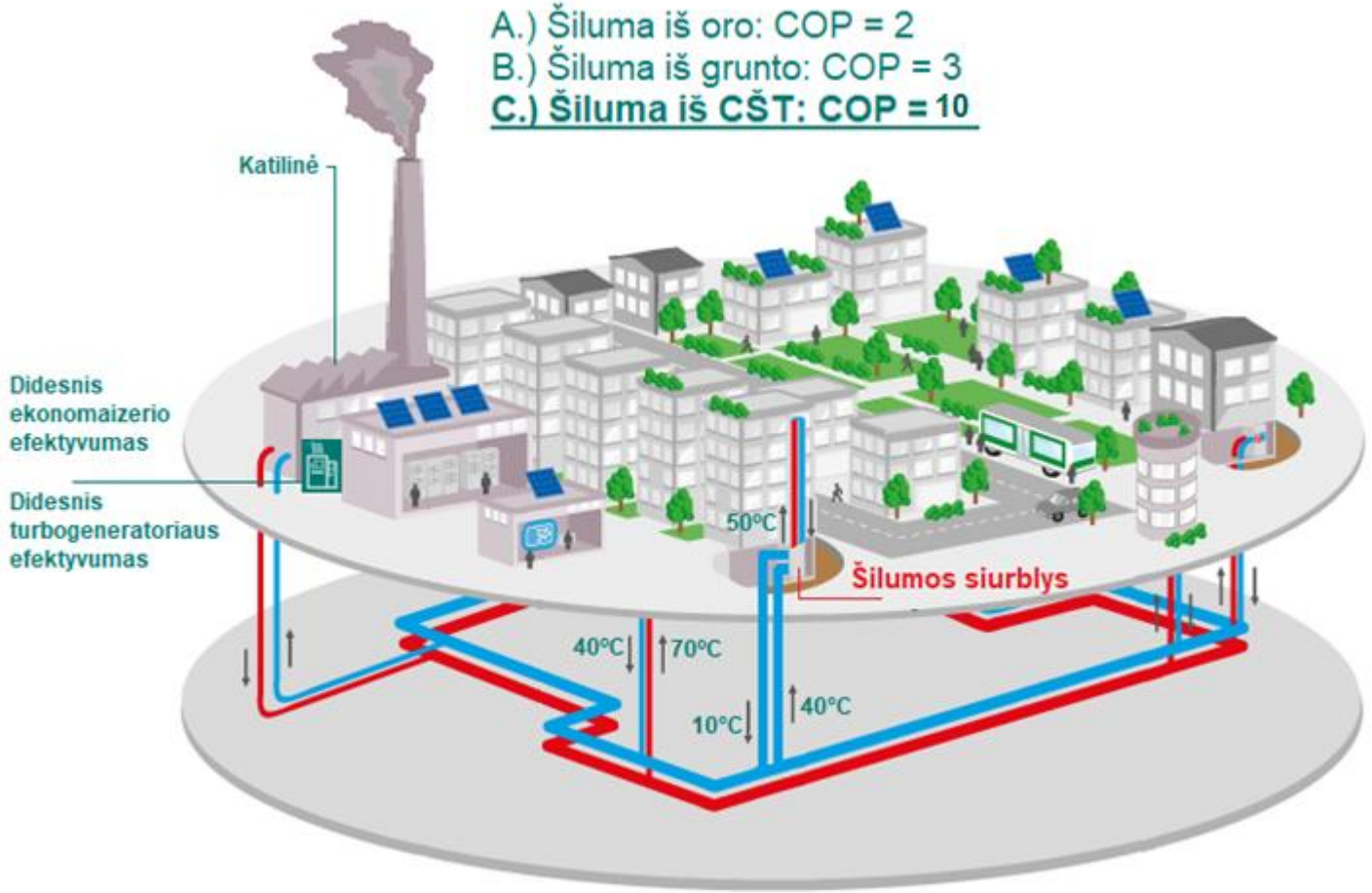
***New requirement**: to ensure non-freeze of DH supply process during 24 hours in case of power outage from the national electricity network.*

Heat Pumps in DH systems?

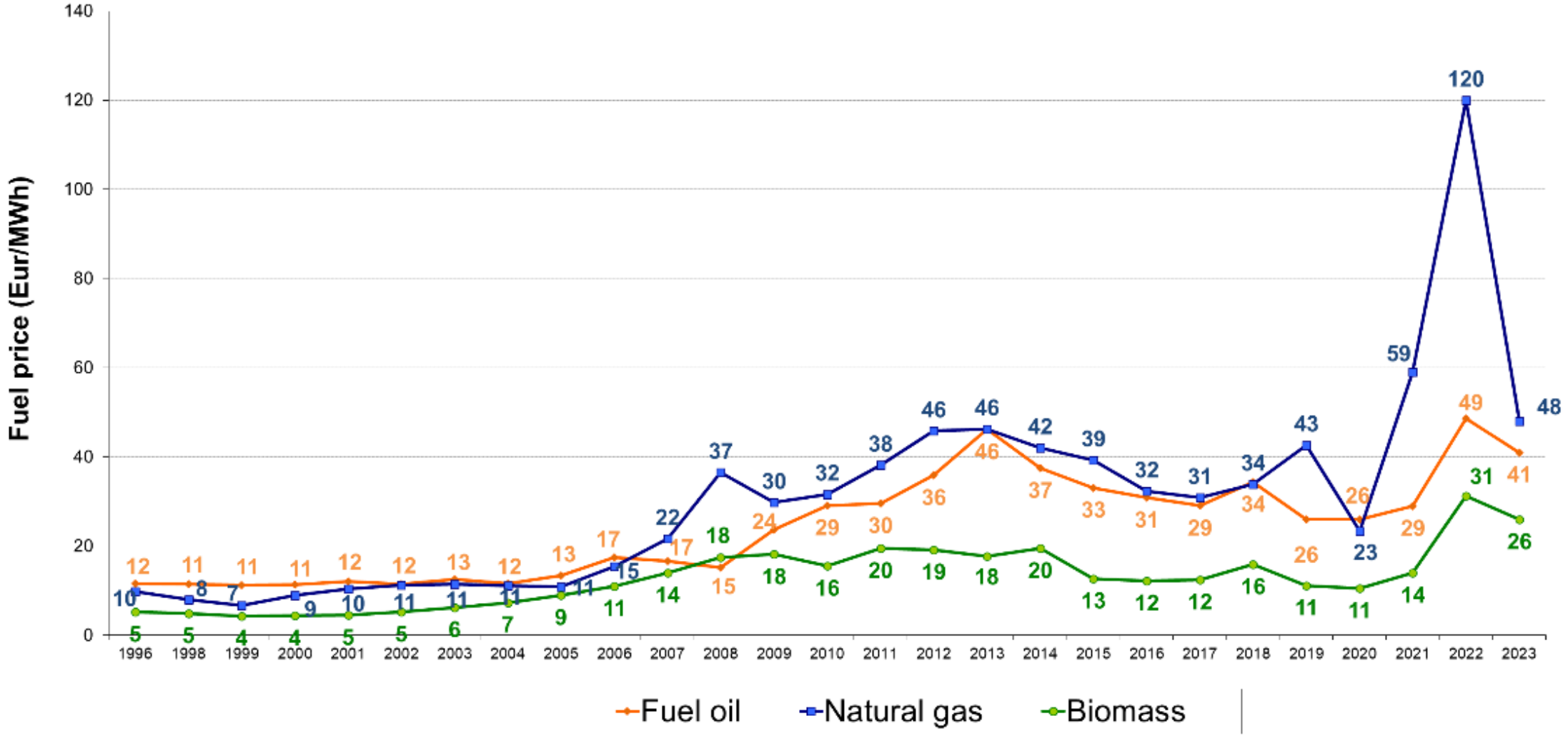
„ Take" heat from the return water pipeline much more efficiently than from the ground or air...



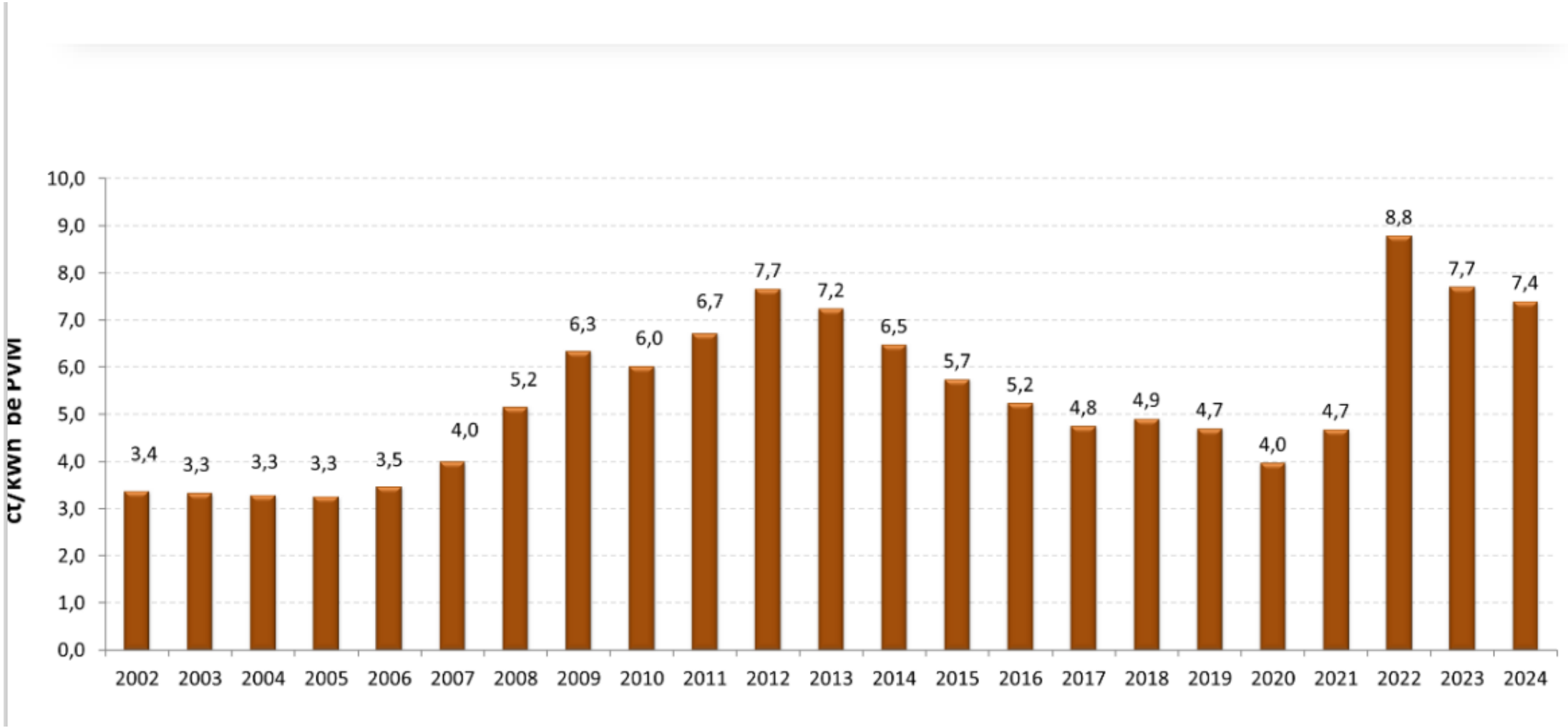
Efficiency of condensing economizer



Prices for DH energy resources

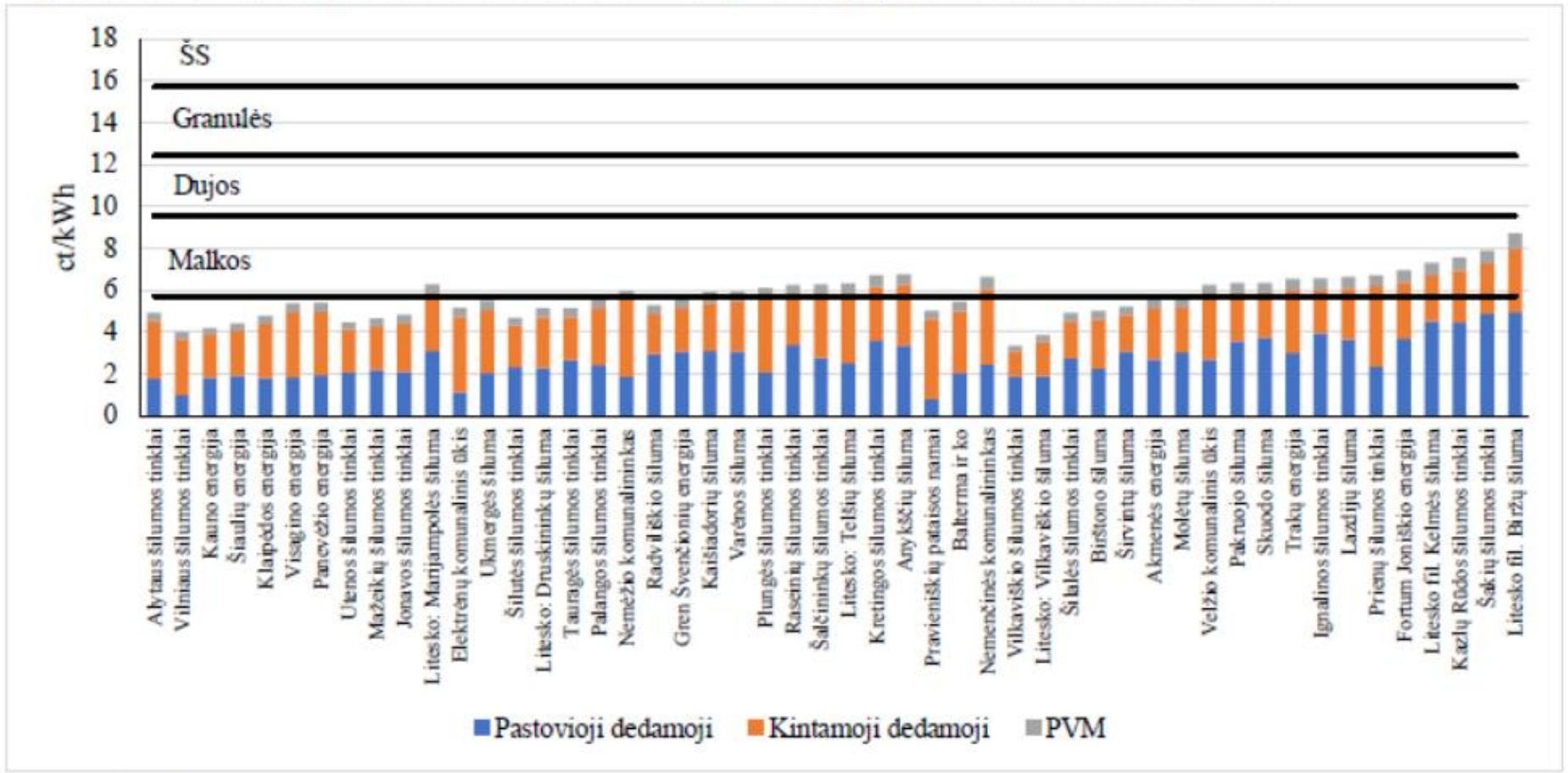


Average annual district heat prices (euro ct/kWh) must be competetive



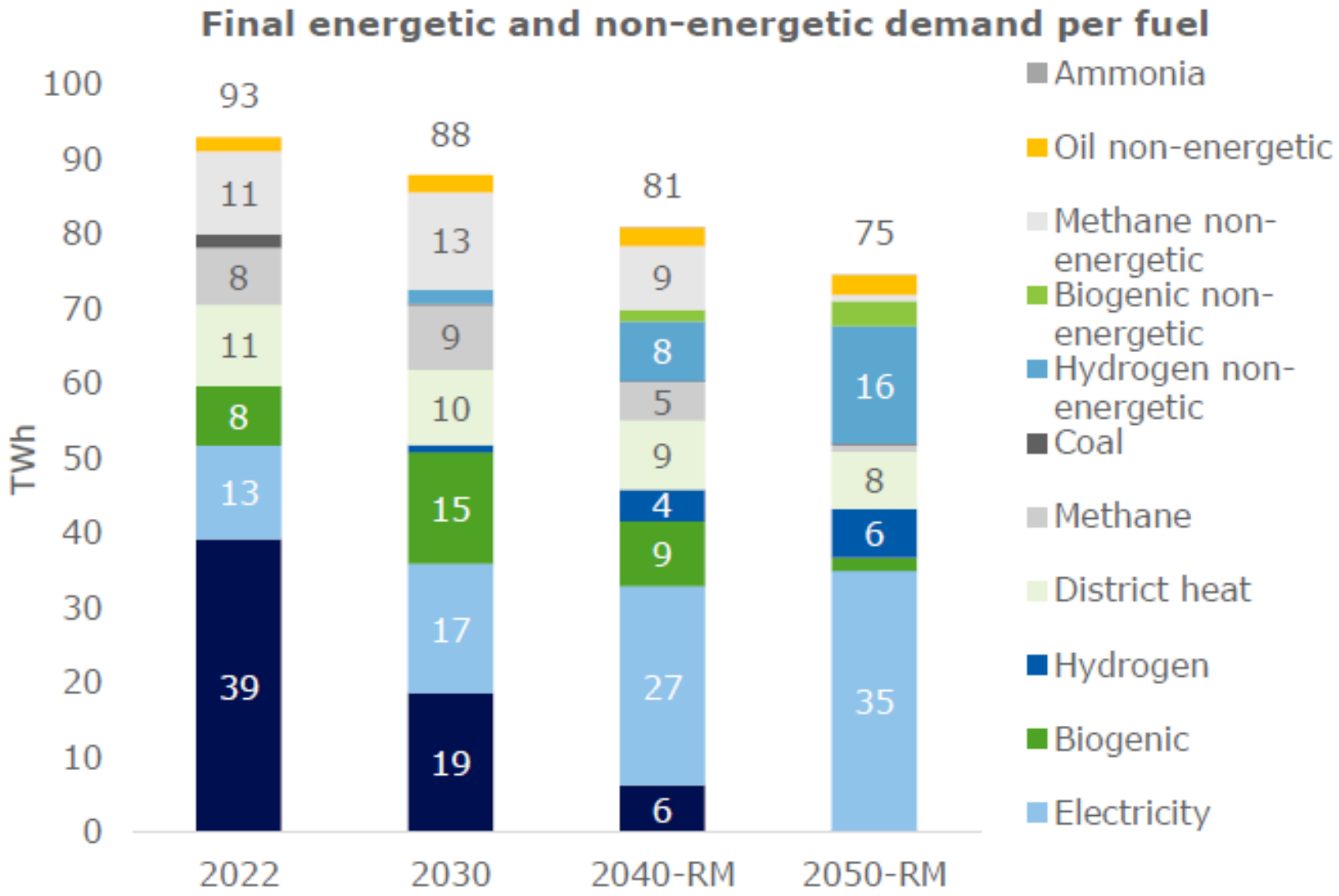
Prices of district heat and heating alternatives

31 paveikslas. CŠT sistemų patiektos šilumos ir individualių šaltinių pagamintos šilumos kainos 2020 m.



Šaltinis: Studijos autoriai

Future energy - electricity and hydrogen products?

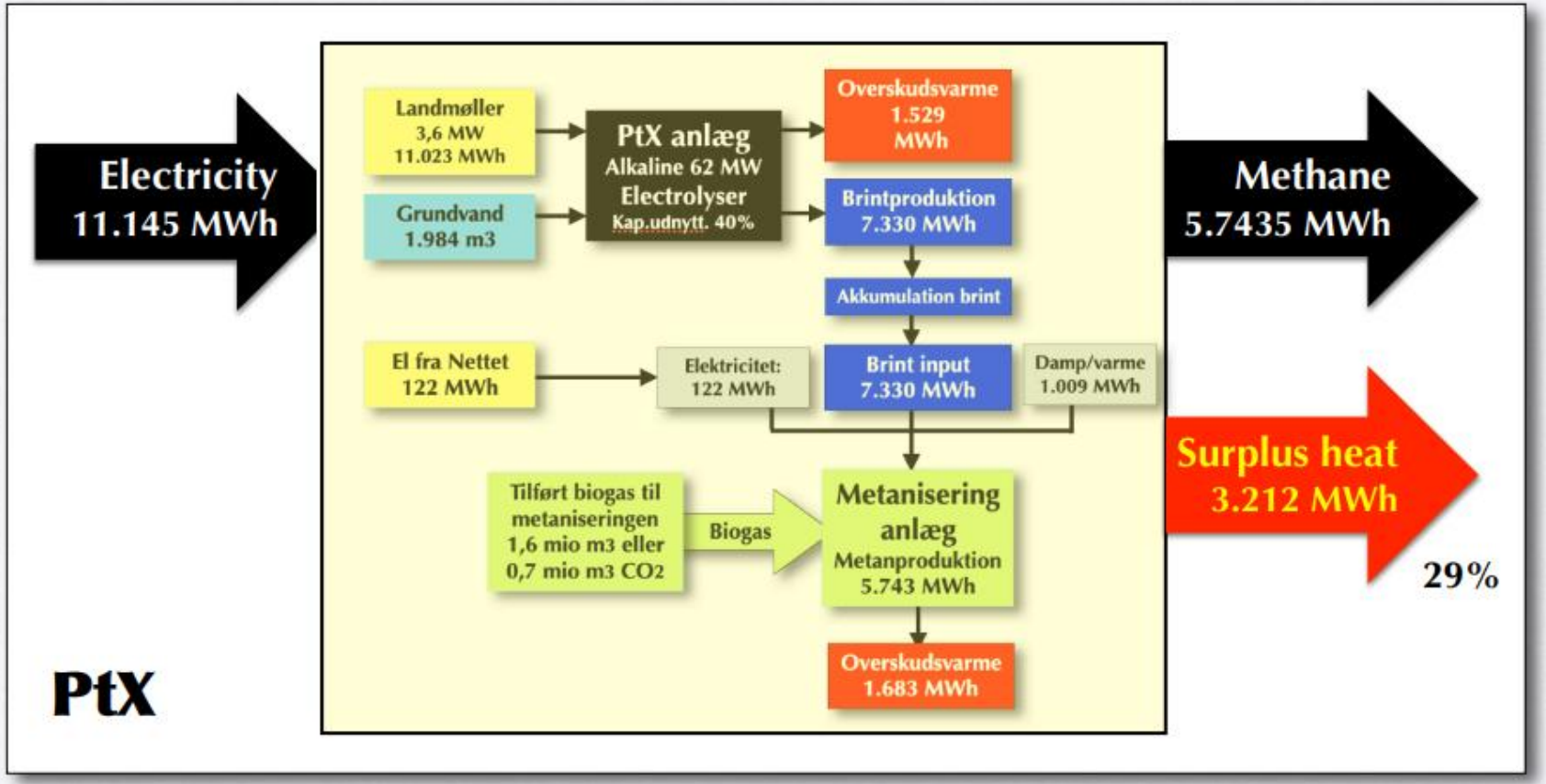


During production of methane, 29% of the consumed electricity is converted into waste heat - suitable for DH!

Kėdainiai has been using waste heat from LIFOSA for two decades

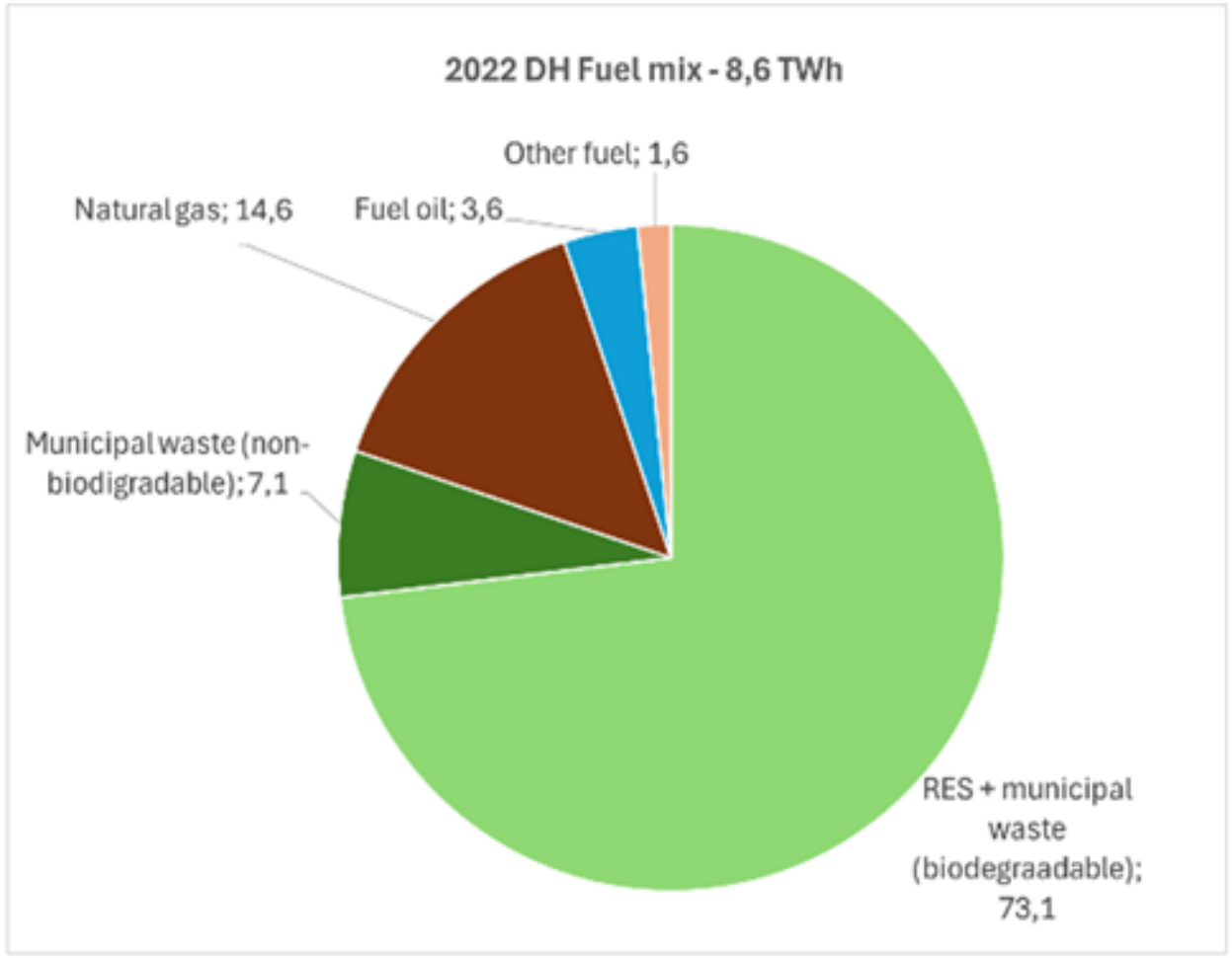
Sectorintegrated solution (2) - symbiosis

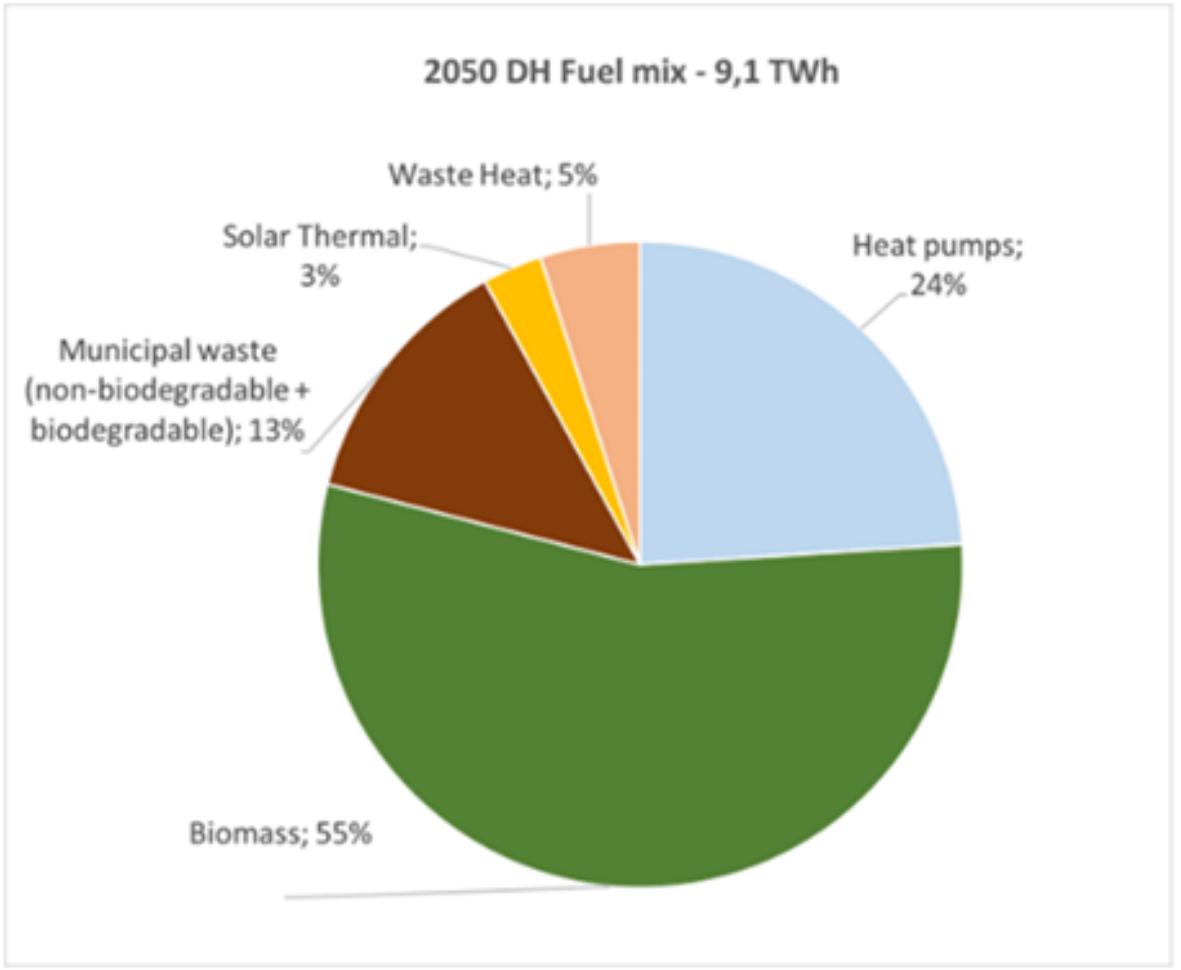
Using surplus heat from the new PtX-plants, illustrated with a methanization process
Requirements: Location of the facility near an adequate heating market



	2022 m.	2030 m.	2040 m.	2050 m.
Centralizuotas šilumos tiekimas	8,6 TWh	9,9 TWh	9,5 TWh	9,0 TWh
	73% iš AEI	90% iš AEI	97% iš AEI	100% iš AEI
Individualus šildymas	17,5 TWh	18,0 TWh	14,6 TWh	10,4 TWh
	50 % iš AEI	75 % iš AEI	85 % iš AEI	97 % iš AEI
Bendras galutinės energijos suvartojimas	26,1 TWh	27,9 TWh	24,1 TWh	19,4 TWh

DH Fuel mix in Lithuania in 2022 and 2050 (forecast)





VILNIAUS KOGENERACINĖ JĖGAINĖ (VKJ)

Šaltinis: atliekų ir biokuro deginimas
Viso: 527 tūkst. t CO_2 / metus
Bio-CO_2: 445 tūkst. t CO_2 / metus
Terminas - ne anksčiau 2032 m.

KAUNO KOGENERACINĖ JĖGAINĖ (KKJ)

Šaltinis: atliekų deginimas
Viso: 206 tūkst. t CO_2 / metus
Bio-CO_2: 87 tūkst. t CO_2 / metus
Terminas - ne anksčiau 2032 m.

AKMENĖS CEMENTAS

Šaltinis: cemento gamyba ir atliekų deginimas
Viso: 800 tūkst. t CO_2 / metus
Bio-CO_2: 120 tūkst. t CO_2 / metus
Terminas - ne anksčiau 2033 m.

GREN KLAIPĖDA

Šaltinis: atliekų deginimas
Viso: 270 tūkst. t CO_2 / metus
Bio-CO_2: 121 tūkst. t CO_2 / metus
Terminas - neapibrėžtas

BIOGENINĖS KILMĖS CO_2 SURINKIMAS IŠ HIBRIDINIŲ OBJEKTŲ, KURIOSE KARTU SU BIOGENINĖS KILMĖS CO_2 SURENKAMAS IR IŠKASTINIO KURO IŠMETAMAS CO_2

CO_2 SURINKIMAS IŠ HIBRIDINIŲ OBJEKTŲ,
mln. t CO_2 / metus

2030 m. -----> -
2040 m. -----> 1,8
2050 m. -----> 1,8

€ 1,2 Mlrd.

Analizės metu nustatytas preliminarus investicijų dydis

LIETUVOS ŠILUMOS TIEKĖJŲ ASOCIACIJA

Main trends of DH developments in Lithuania

1. More efficient and clean combustion of low quality wood chips
2. Deep heat recovery from flue gas
3. Electricity generation for self-operation during 24 hours
4. Diversification of heat production sources
5. Technologies for early detection of leakages in DH pipelines
6. Prolonged lifetime of DH tubes
7. Complete digitalization of DH networks...

LIETUVOS ŠILUMOS TIEKĖJŲ ASOCIACIJA

Thank you for attention...