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Methodology of Development of Energy Strategies

Interreg Baltic Sea Region

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LowTEMP training package - OVERVIEW

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Introduction

- Intro Climate Protection Policy and Goals
- Intro Energy Supply Systems and LTDH
- Energy Supply Systems in Baltic Sea Region

Energy Strategies and Pilot Projects

- Methodology of Development of Energy Strategies
- Pilot Energy Strategies – Aims and Conditions
- Pilot Energy Strategy – Examples
- Pilot Testing Measures
- CO_2 emission calculation
- LCA calculation

Financial Aspects

- Life cycle costs of LTDH projects
- Economic efficiency and funding gaps
- Contracting and payment models
- Business models and innovative funding structures

Technical Aspects

- Pipe Systems
- Combined heat and power (CHP)
- Large Scale Solar Thermal
- Waste & Surplus Heat
- Large Scale Heat Pumps
- Power-2-Heat and Power-2-X
- Thermal, Solar Ice and PCM Storages
- Heat Pump Systems
- LT and Floor heating
- Tap water production
- Ventilation Systems

Best Practice

- Best Practice I
- Best Practice II

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EU Energy System Integration Strategy

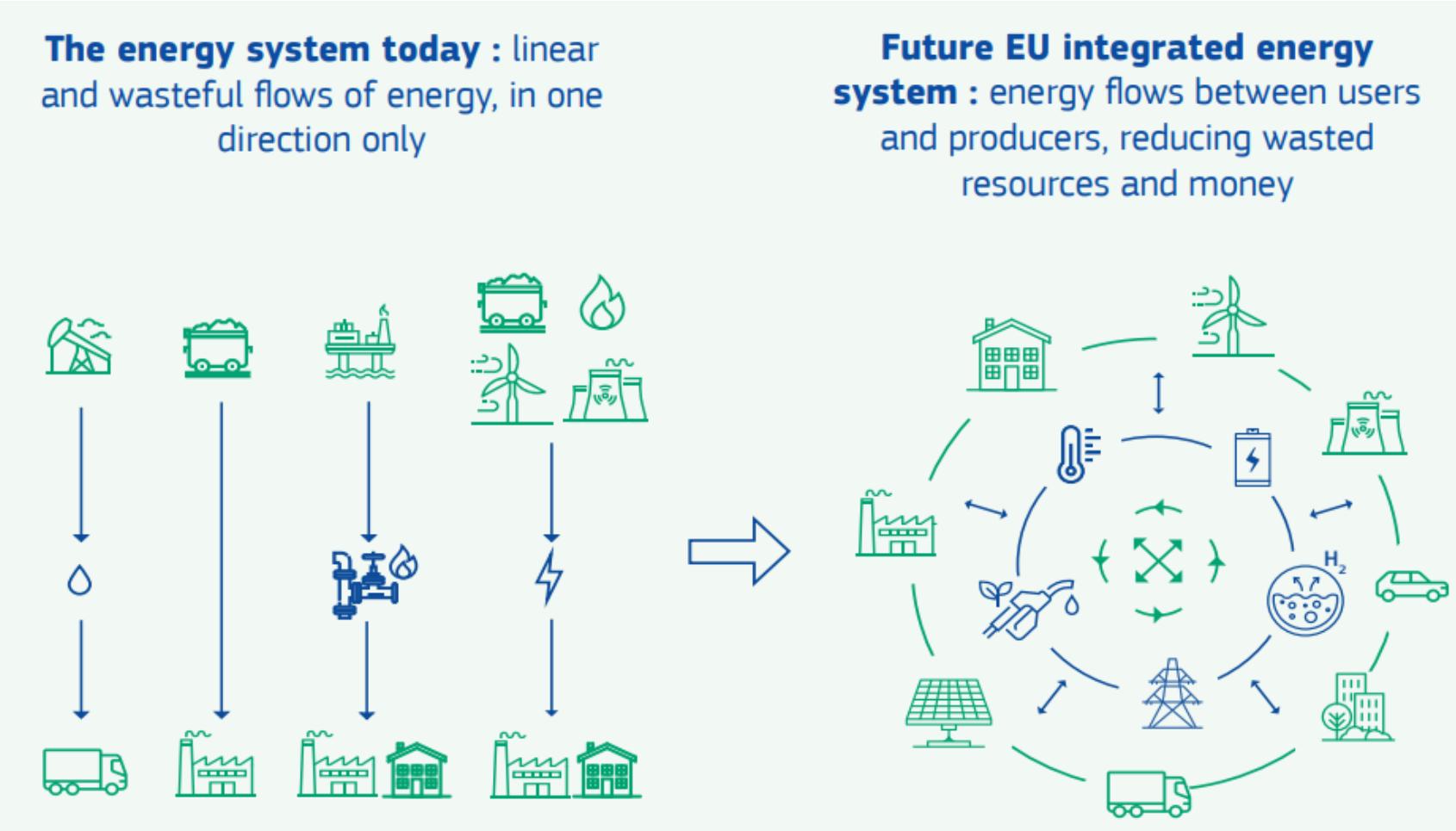


Figure 1: EU Energy System Integration Strategy.
Source: Factsheet: EU Energy System Integration Strategy 08 July 2020. Available online: https://ec.europa.eu/commission/presscorner/detail/en/fs_20_1295 [1]

Necessity

- Temperature lowering in heating network is **complex process involving heat production, distribution and heat consumer**
- **Long-term planning** is necessary to align all the system elements to lower heat carrier temperatures
- Puts the building modernization and infrastructure redevelopment into **a meaningful order**

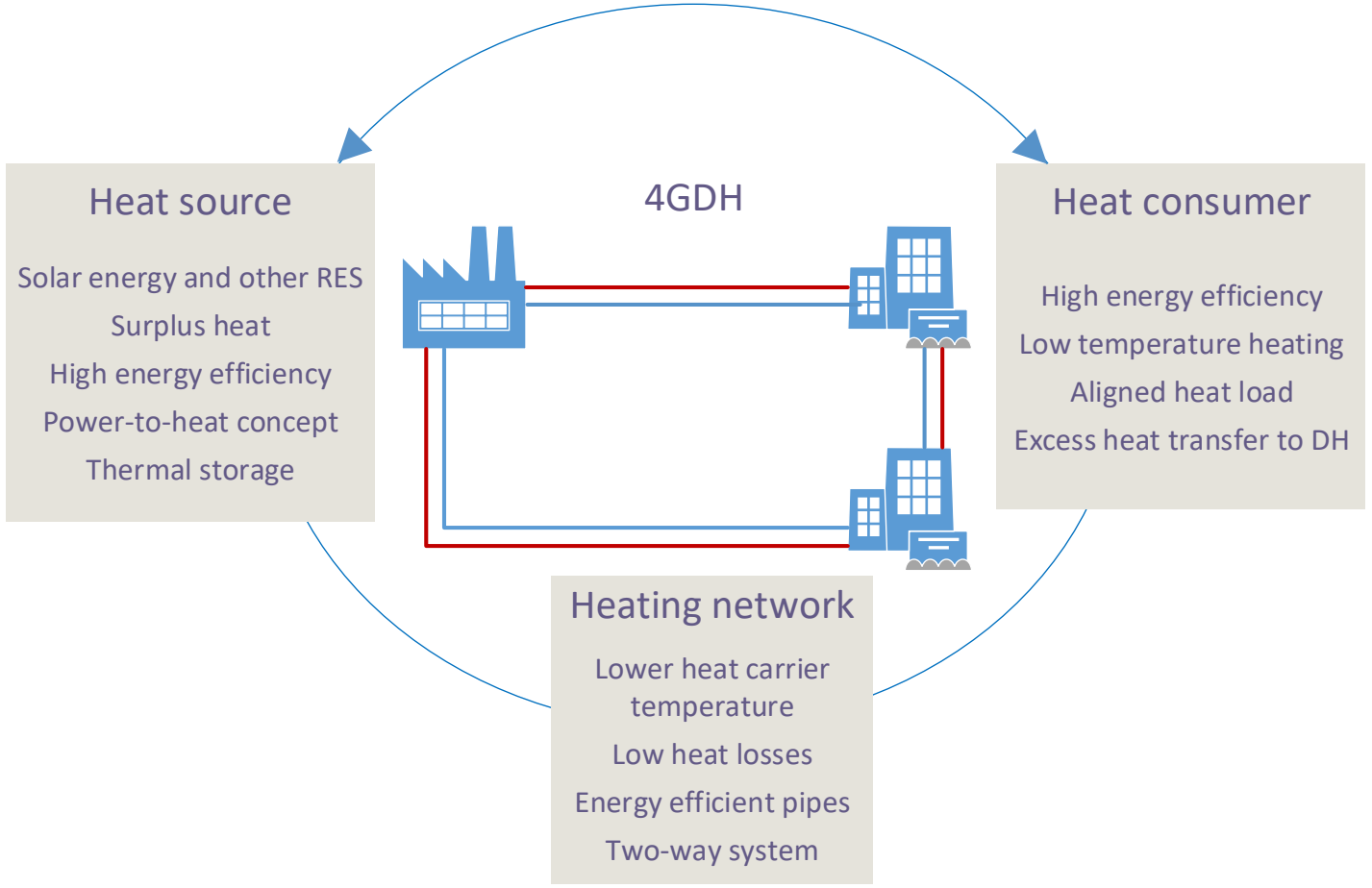


Figure 2: 4th generation district heating concept

Main target groups

- Municipality
- Close cooperation with other stakeholders:
  - DH Network operator
  - Heat suppliers
  - Energy agencies
  - Building owners
  - Others

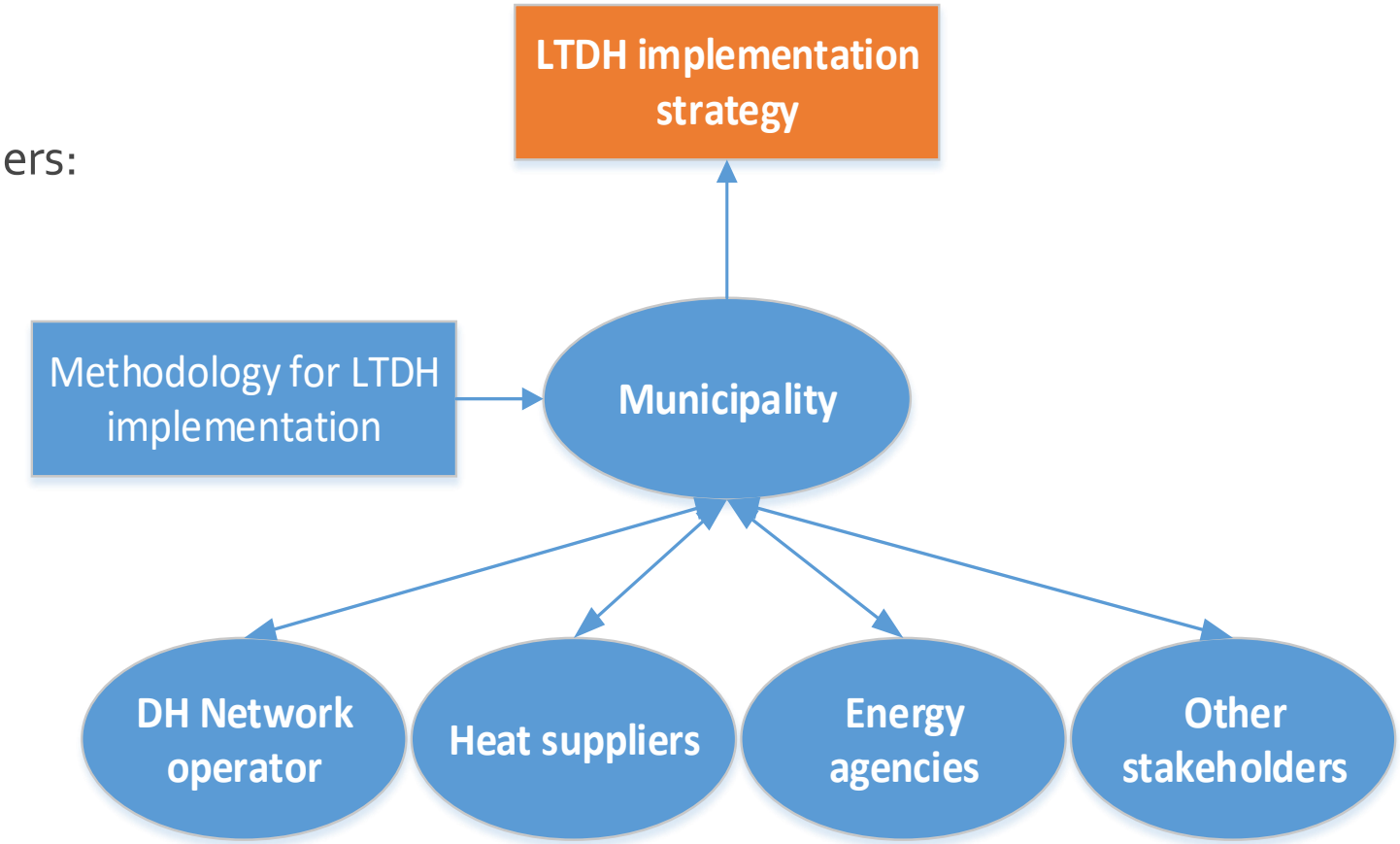


Figure 3: Main target groups for LTDH impelementation

Main steps for strategy development

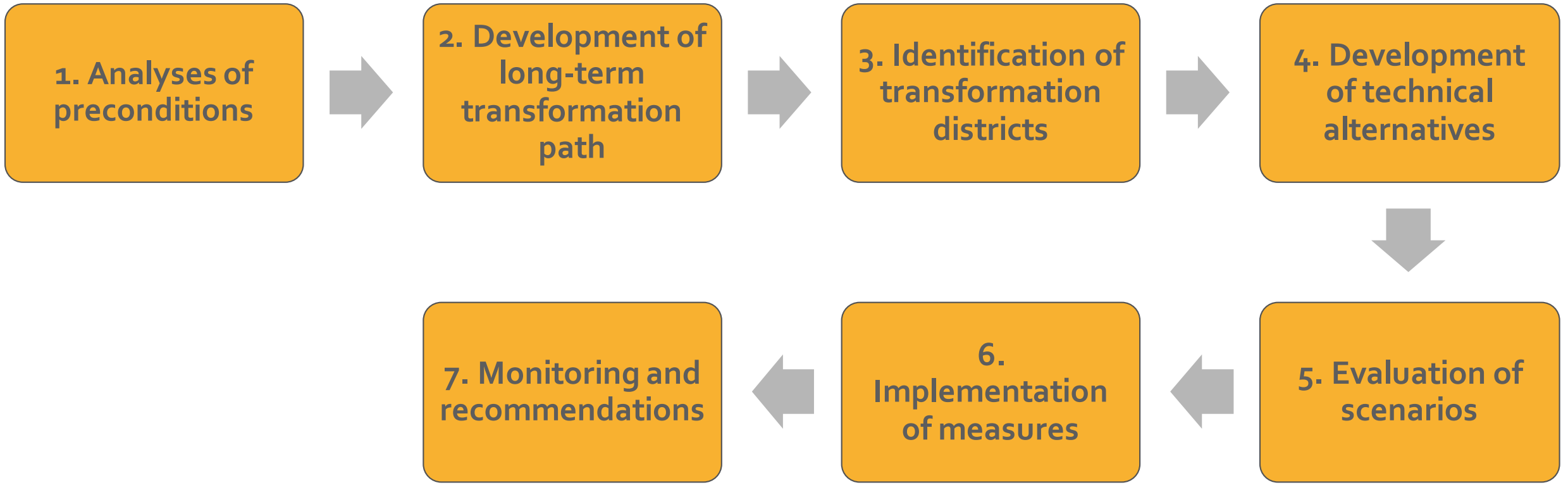


Figure 4: Main steps for strategy development

Analyses of preconditions

Existing planning documents	• Strategies • Action plans • Investment plans
Technical preconditions	• Locations and performance of energy generation plants • Heat distribution networks and district transfer stations • Related network analyses
Urban preconditions	• Regional settlement structure and heat demand densities • Location of potential construction and/or deconstruction residential areas

Technical preconditions

Heat generation plants and largest industrial plants

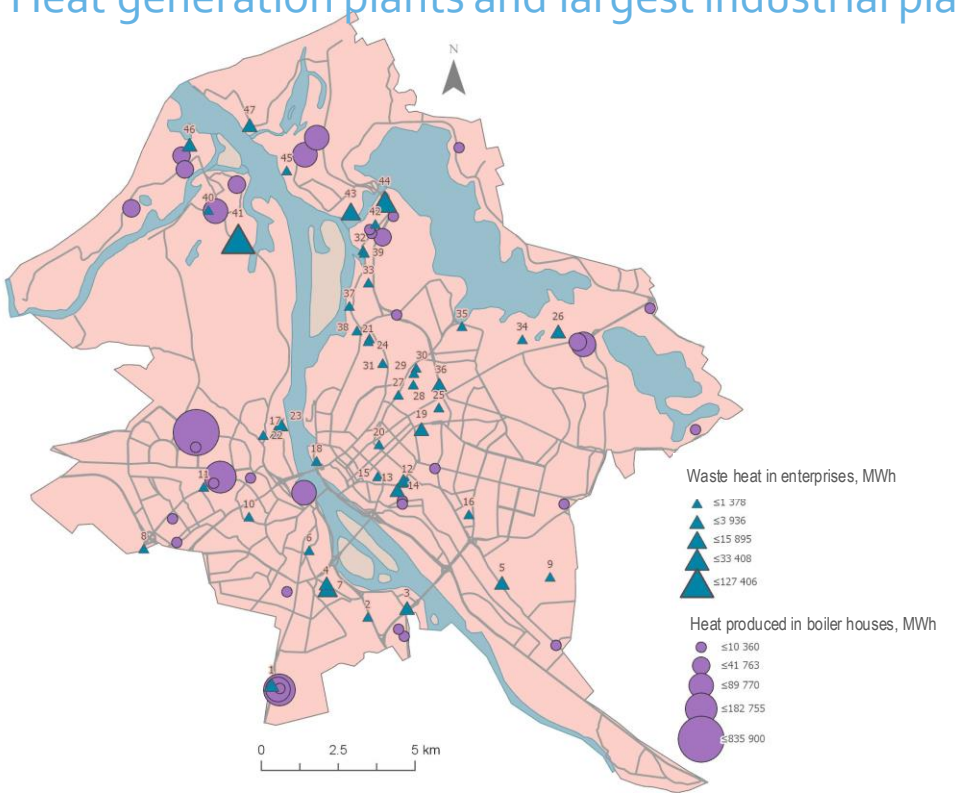


Figure 5: Waste heat mapping in Riga. Source: Report "Development of heat supply and cooling systems in Latvia" report. Available online: https://videszinatne.rtu.lv/wp-content/uploads/2021/02/DHCS_lv_1_nodevums_g_c.pdf [2]

Heating networks

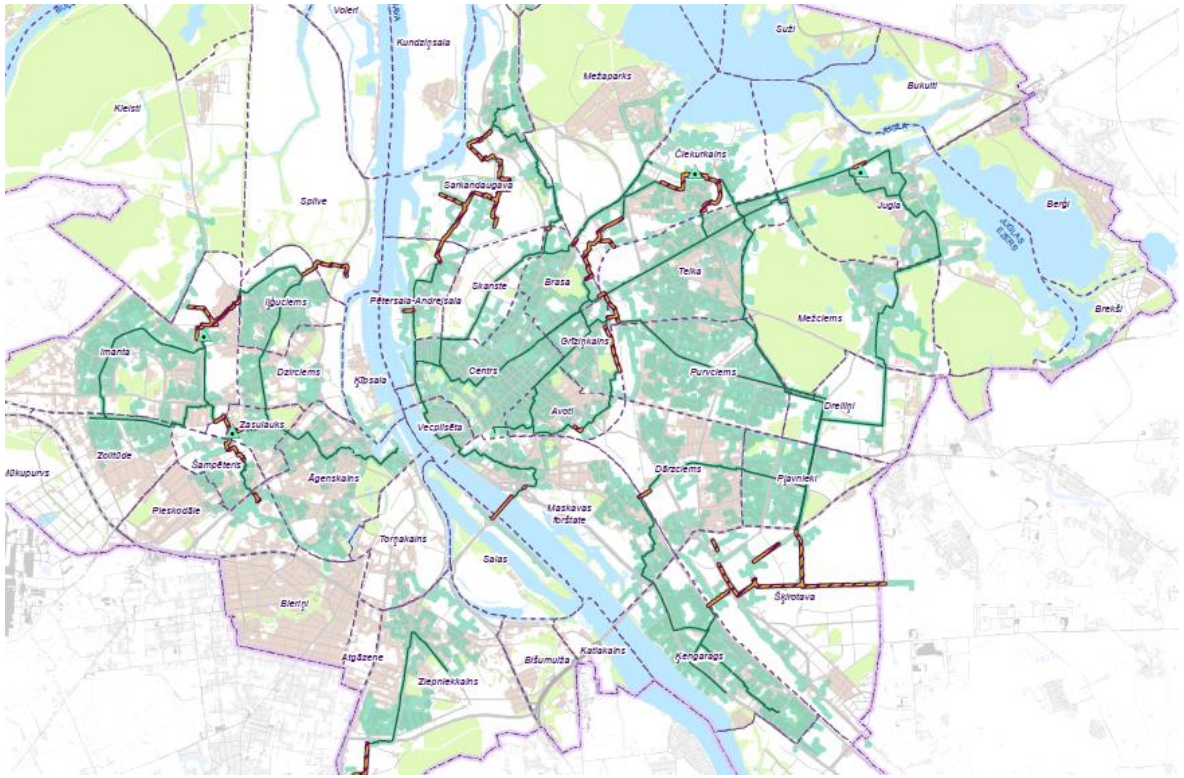


Figure 6: Location of DH network in Riga Source: Ltd. "Rigas siltums" https://www.rs.lv/sites/default/files/page_file/rs_gada_parskats_2016_0.pdf [3]

Stakeholder analysis

- The main stakeholders who have a significant influence on the direction and rapidity of the local transformation because of their decision-making powers:
  - Energy suppliers
  - Housing companies
  - Private owners, investors etc…
  - Public authorities and public service companies (sewage companies, waste companies)

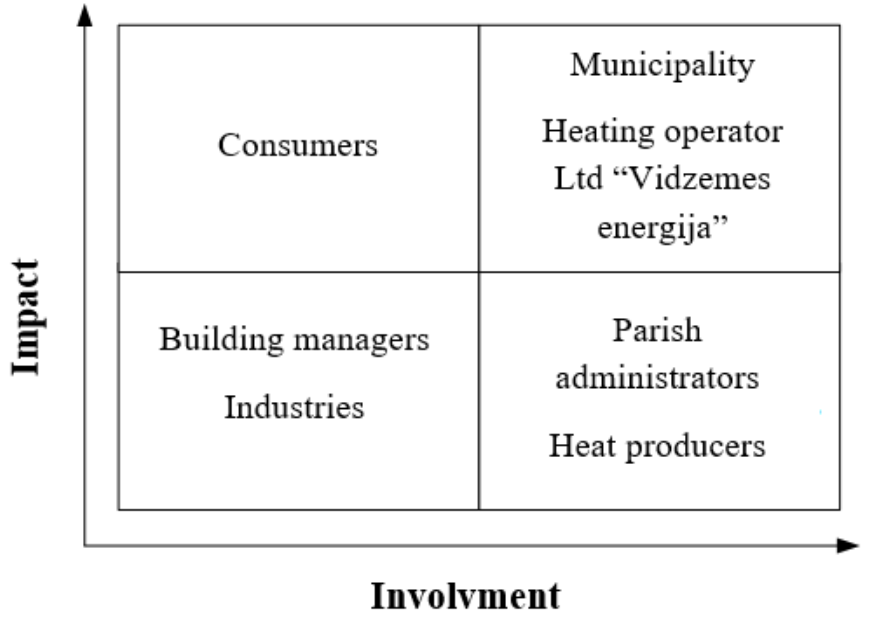


Figure 7. Example of particular stakeholder analysis

Institutional and organizational framework

- The institutional framework of DH Companies differs in each country:
  - Private stakeholders owned system
  - Municipalities owned system
  - Other government institutions owned DH system
  - Operator can be a non-profit organization
- Organization has different interests in DH system development in future.

Analyses of strategy pathway for transformation

- Two main directions for heat production:
  - **local heat supply** by individual heat solutions (called as "*Thousand flowers*" scenario)
  - **heat supplied by DH**
- The main aspect - **heat density of particular area**.

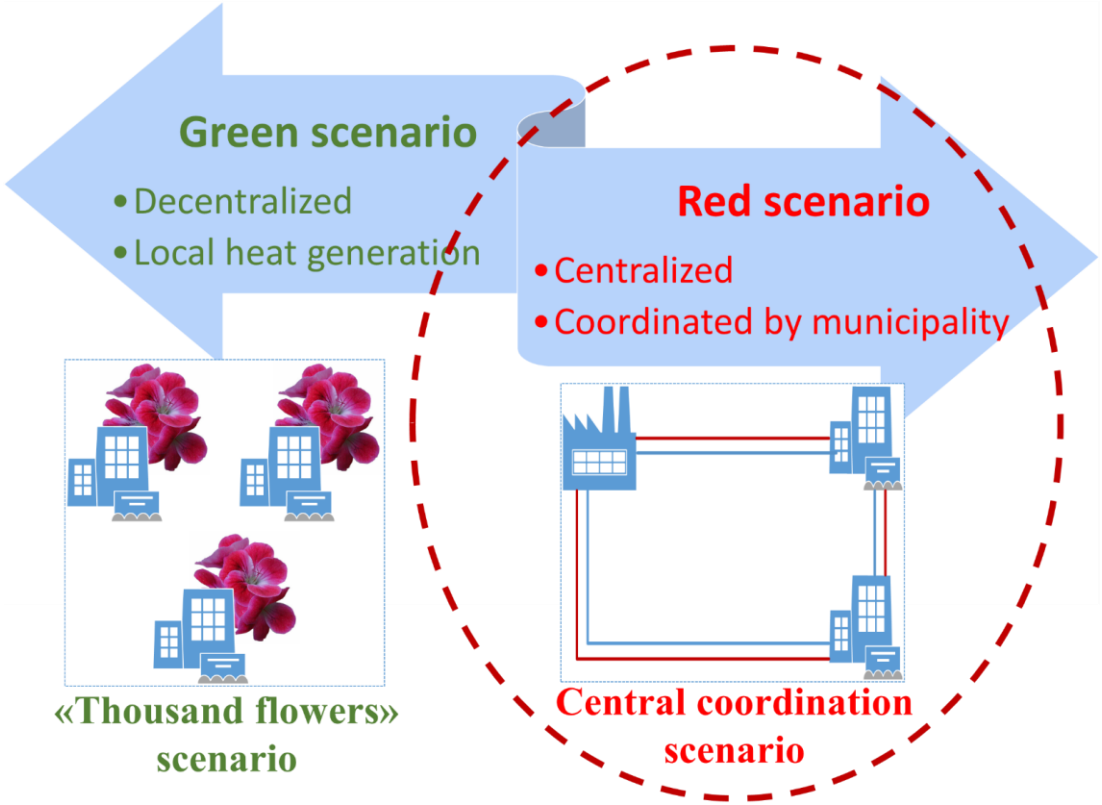
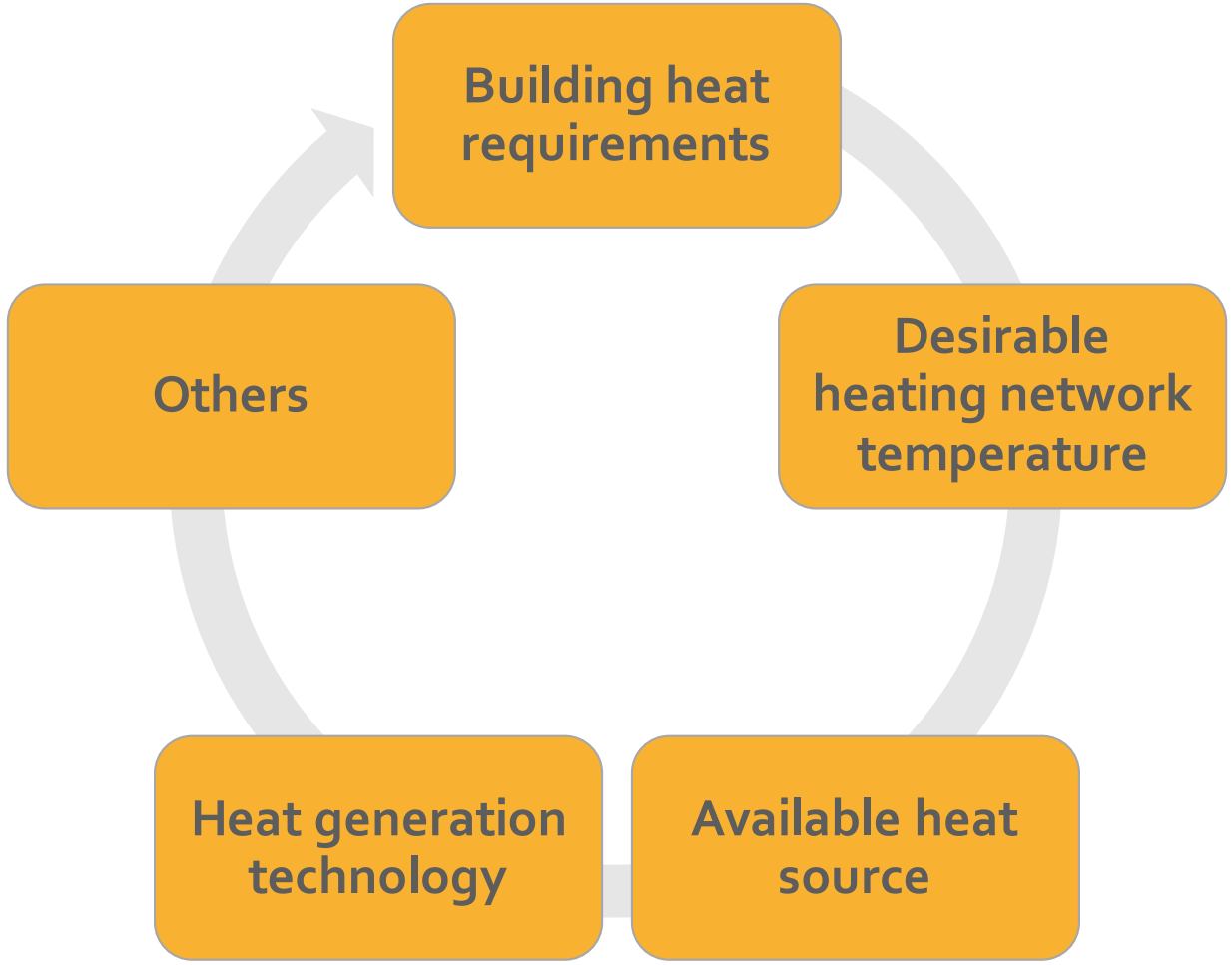


Figure 8: Strategical pathway for transformation

Analyses of strategy pathway for transformation



Building heat requirements

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Existing buildings

- Network temperature optimization programs
- Regulation and adjustment of substations
- Temperature can be lowered to the certain point

Mixed building areas

- Energy cascades
- Regulation and adjustment of substations
- Temperature can be lowered to the certain point

New and renovated buildings

- Low heat requirements
- Proper heating elements
- Lower supply temperature possible

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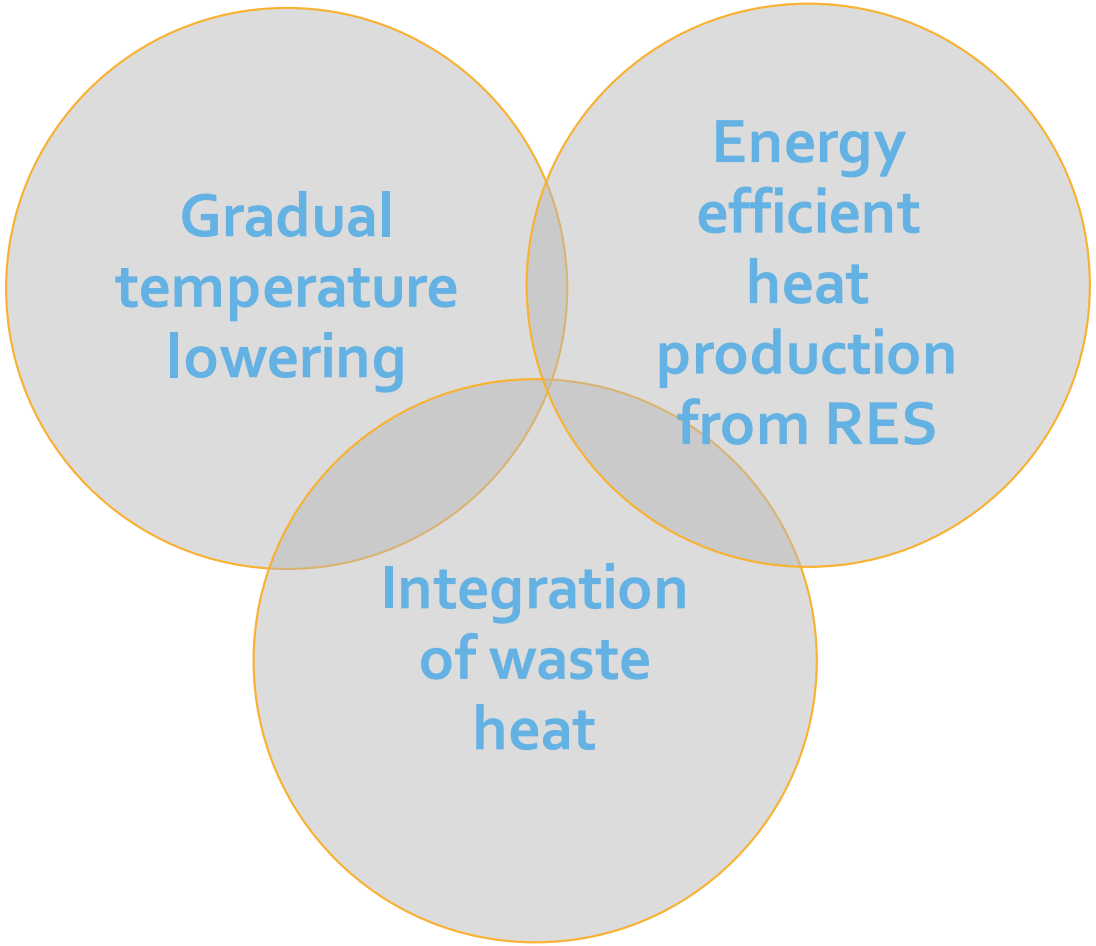
Example of transformation paths in Gulbene



Initial district identification

- Main criteria that can be used:
  - the energy efficiency potential
  - renewable energy integration potential
  - the building and heat consumption density
  - potential to increase the density by integrating new heat consumers or equip extra appliances within the DH
  - the identification of surplus heat from industries that can be integrated into the DH system
- In priority should be the buildings, heating networks or systems that **should have renovation or modernization**

Example of technical alternatives

Scenario	Technical solutions
1	• One woodchip boiler house provides the heat • 1.5 and 3.5 MW boilers installed • Actual operating temperature mode (90°C-70°C) • PV solar panels • Forecasted slight heat consumption increase due to new consumers
2	• One woodchip boiler house provides the heat • 1.5 and 3 MW boilers installed • Reduced operating temperatures (70°C-45°C) • PV solar panels • Forecasted slight heat consumption increase due to new consumers
3	• Base load from indutrial waste heat (1 MW) • Additional heat from woodchip boiler house (3.5 MW) • Reduced operating temperatures (70°C-45°C) • Forecasted slight heat consumption increase due to new consumers

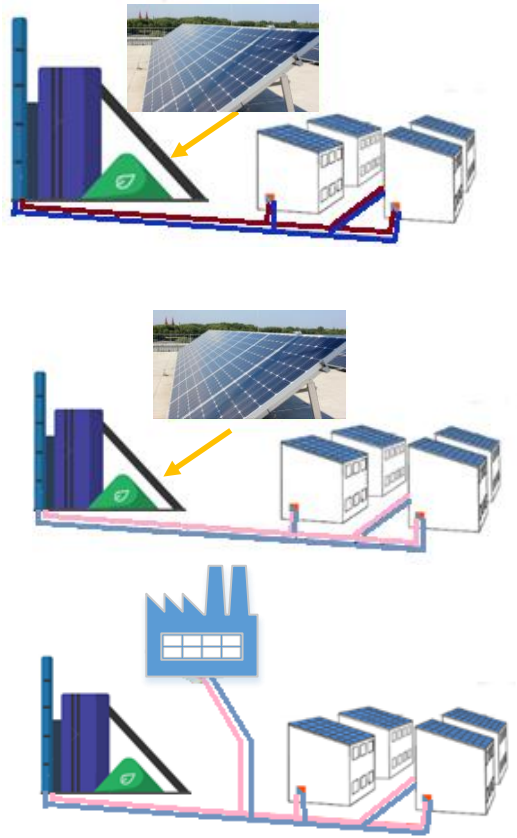


Figure 9: Schematic comparison of technical alternatives

Data collection

- Produced heat [MWh per year]
- Fuel consumption [natural units or MWh]
- Fuel's lowest calorific value [MWh/natural unit of fuel (tones, m^3 etc.)]
- Consumed heat energy for heating and hot water generation [MWh per year]
- Heat losses [MWh per year]
- Maximum temperature and return temperature [^oC]
- Length of the heat pipe [m]
- Average diameter of the heat pipe [mm]

Example of scenario analyses

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	Existing situation	Scen. 1	Scen. 2	Scen. 3
Installed boiler capacity [MW]	n/a	1.5+3.5	1.5+3	3.5
Volume of accumulation tank [m³]	n/a	10	10	10
Flue gas condenser capacity [MW]	n/a	1.5	2.4	2.2
Length of new heating networks [m]	n/a	681	681	681
Investments [k€ per year]	n/a	3516	3486	2675
Production costs [k€ per year]	750	613	584	631
Cost of fuel [k€ per year]	181	520	464	318
Cost of purchased heat [k€ per year]	526	n/a	n/a	211
Electricity costs [k€ per year]	43	81	97	81
Maintenance costs of flue gas condenser [k€ per year]	n/a	13	23	21
Personnel costs [k€ per year]	14 4	17 3	17 3	14 4
Other costs and profit share [k€ per year]	47 2	47 2	472	47 2
Total maintenance costs [k€ per year]	1366	1434	1403	1381
Specific cost of heat sold [€ / MWh]	55.71	56.18	54.96	54.09

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SWOT Analysis – Example

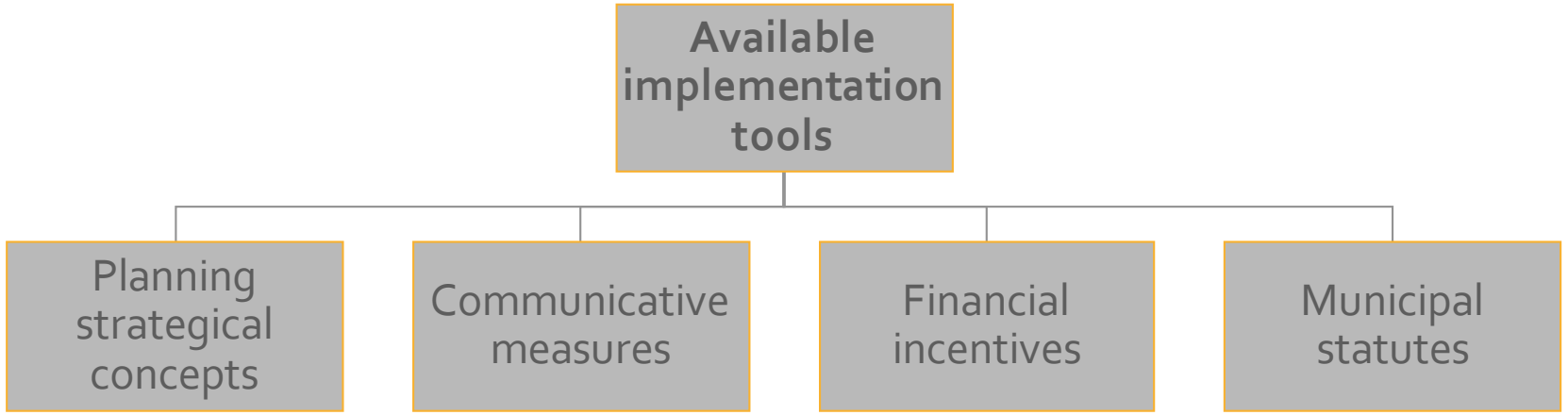
Alternative 1

Strength	Weaknesses
• Use of local and renewable heat source - biomass • Lower energy source costs • Lower heat losses • Increased efficiency in flue gas condenser	• Higher investment costs for biomass boiler • Heating unit adjustment
Opportunities	**Threats**
• EU and government support for alternative energy source • Biomass price stability	• Decrease of biomass quality • Consumer unwillingness to cooperate • Domestic hot water preparation

Alternative 2

Strength	Weaknesses
• Low investment costs • Low labor costs • High boiler efficiency	• Use of fossil fuel • High fuel costs • High environmental taxes • Higher heat losses
Opportunities	**Threats**
• Use of existing natural gas infrastructure	• Unstable fuel costs • Increased energy and environmental taxes

Evaluation of implementation conditions



- In accordance with other plans, programs and instruments by providing necessary synergy
- Clarify the responsibilities, priorities, guidelines and conflict management
- Should be flexible

Reflection and learning

- Indicators that can be monitored to obtain clear overview of the results:
  - Energy requirements for space heating and DHW [kWh]
  - Specific energy consumption parameters [kWh/ inhabitant; kWh/m² etc…]
  - Output of generation plants [kW/inhabitant]
  - Storage capacity [kW]
  - Efficiencies of technical installations
  - Number and scope of building modernization measures
  - Type and volume of energy used [kWh per year]
  - CO_2 emissions [ton per year]
  - Heat price developments [€/kWh]
  - Length of heat supply networks [km]
  - Heat supply flow temperature [°C]

Conclusions

- Development of long-term strategy is crucial for successful implementation of low temperature district heating
- Analyses of preconditions allows to identify most suitable future transformation pathway for particular DH system
- More detailed technical analyses is necessary for particular district to compare different technical alternatives regarding energy source, heat distribution and energy consumption
- SWOT analyses can be carried out to evaluate main strengths, weaknesses, opportunities and threats for each analyzed LTDH alternative solutions
- It is important to monitor the main indicators of implemented pilot cases (fuel and energy consumption, heat losses, heat production efficiency etc.) to drive conclusions for future projects

References

[1] Factsheet: EU Energy System Integration Strategy 08 July 2020. Available online: https://ec.europa.eu/commission/presscorner/detail/en/fs_20_1295

[2] Report "Development of heat supply and cooling systems in Latvia" report. Available online: https://videszinatne.rtu.lv/wp-content/uploads/2021/02/DHCS_lv_1_nodevums_g_c.pdf

[3] Ltd. "Rigas siltums" https://www.rs.lv/sites/default/files/page_file/rs_gada_parskats_2016_0.pdf

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