Training on Low Temperature District Heating in the Baltic Sea Region

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Goal :

IMPLEMENTATION OF LTDH IN THE WHOLE CITY

Time **2017 - 2022**

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EUROPEAN REGIONAL DEVELOPMENT FUND
EUROPEAN UNION

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Lessons lerned – Supply temperature lowering in **Łomża district heating grid**

Application of the Verified Existing DHS Simulation Model and Method related to conversion the existing DHs into LTDHs, (ExToLTDHS$_{md}$)

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Łomża, Poland

Project background

- **Łomża** is situated in the North – East Region of Poland, **63 000** inhabitants, **32,7** km²

Goal

By 2022 : Convert the existing DH in to **LTDH**

From **121 °C** in 2017 to **96.3 °C** in 2022

Decreased heat production from coal

from **100 %** in 2017 to **11,6 %** in 2022

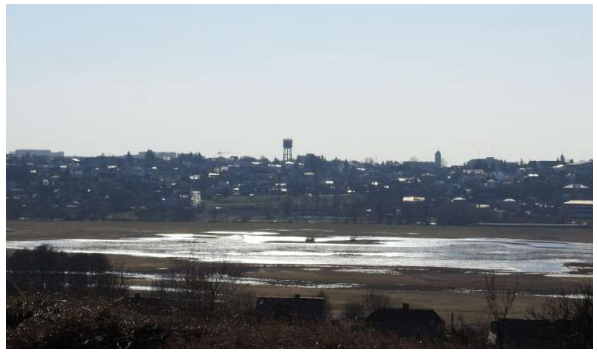
Nominal parameters: **121 / 65°C** i in the **2016**

109.8 / 61,8 °C in the **2018**

and **96.3 / 63,8 °C** in the **2022**

Reduction of the coal consumption:

from **100%** in the **2017** to **11.6%** in the **2022**



Fot. 1. Łomża City - View from the Narew River, source: M. Dzierzgowski, IMP PAN, WUT

Fot. 2. On the Narew River , source: M. Dzierzgowski, IMP PAN WUT

Łomża, Poland: Introduction

Pilot Project 2017/2018 : On the road from existing DH to LTDH

- Nominal supply and return temperatures: **Ts/Tr = 121°C / 65°C**
- Nominal heat demand of the existing coal-fired heat plant with **boilers 98,52 MWt.**
- Verified heat demand: **73,71 MWt**
- **860** substations,
- **160 km** length of the DH grid
- Actual **heat losses** of DH grid: **- 12,5 %**
- Primary energy source **– 100 % coal.**

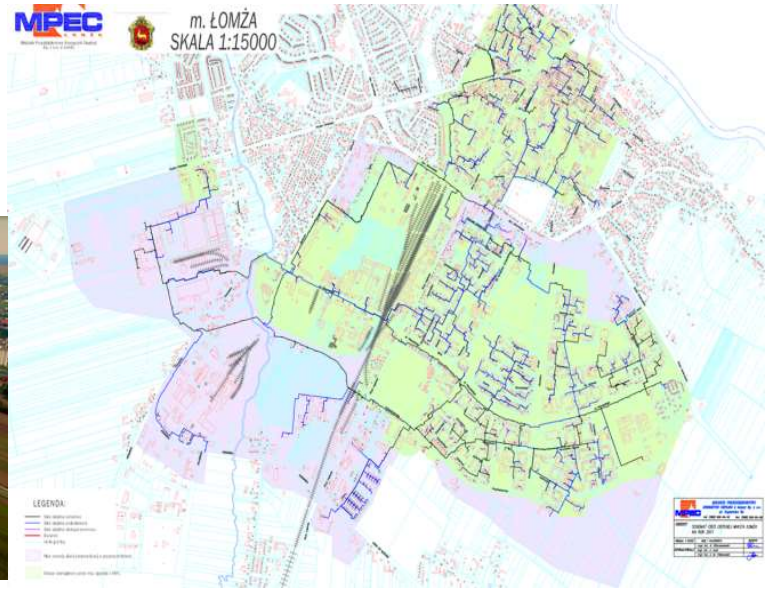
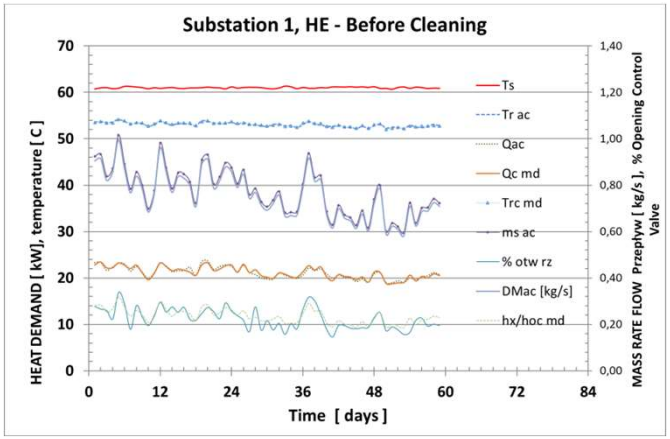


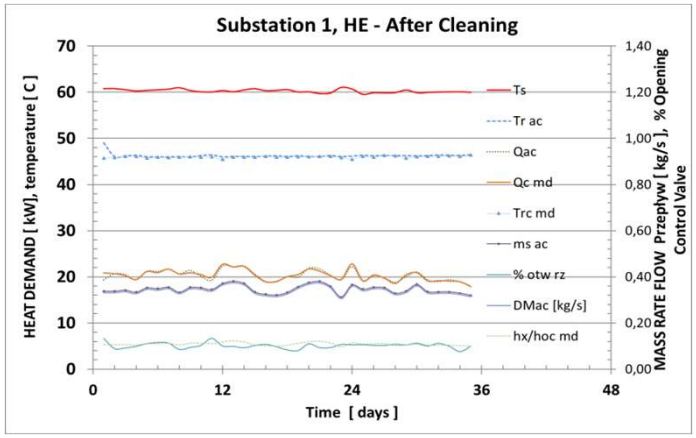
Fig.1. Layout of DHS in Łomża, source: [6.1] M. Dzierzgowski, IMP PAN, WUT

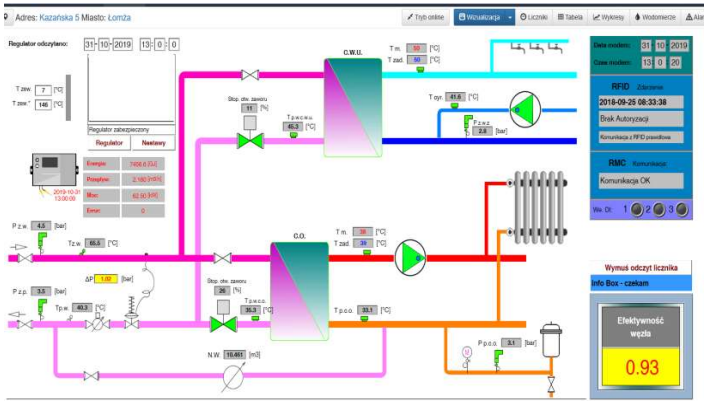
In the 2017/2018 : Seasonal Heat Production: 484 300 GJ, 100% from the coal

Source: [6.1] M. Dzierzgowski, *Strategy for implementation the LTDHS in Existing district heating systems of Łomża municipality, 2018 – Preprint of final Report 1*

Project Step 1 : 2017/2018, data collection, modeling of existing DH, verification of the DH model, analyses and elimination of failures and operation errors in the substations - actual results







Schematic Layout

Figure 2. Substation 1 -measured and calculated hourly changes of the **heat demand, mass flow, supply and return temperatures,** % opening of the control valve - before and after **HEs cleaning ,** Source: [6.1] M. Dzierzgowski, IMP PAN, WUT

- **Regulation of existing substations to comply with requirements of energy efficient LTDH**

Results: decreased (required) mass flow rate 2.3 times; increased temperature drop - 43,2%

Differences between Calculated an Actual Operational Parameters below 3,0 %,

Fot.1. Source: [6.1] M. Dzierzgowski, IMP PAN, WUT

Source: [6.1] M. Dzierzgowski, *Strategy for implementation the LTDHS in Existing district heating systems of Łomża municipality, 2018 – Preprint of final Report 2*

Project Step 2 : 2017/2018, computer simulations of the whole existing DH grid with the „New Individual Quantity/Quality Regulations" – actual results

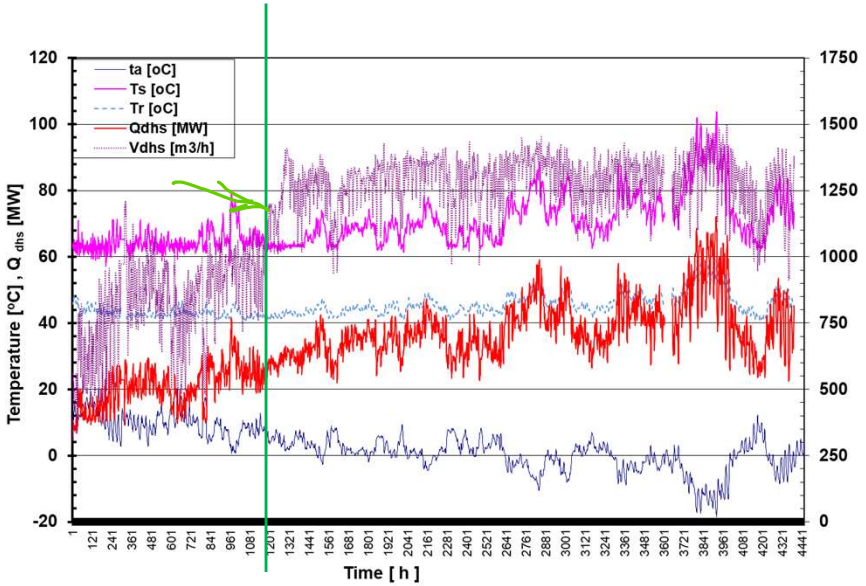


Figure 3.Time evolution of supply and return temperatures, flow rate and heat demand in 2017/2018 season, Source: [6.1] M. Dzierzgowski

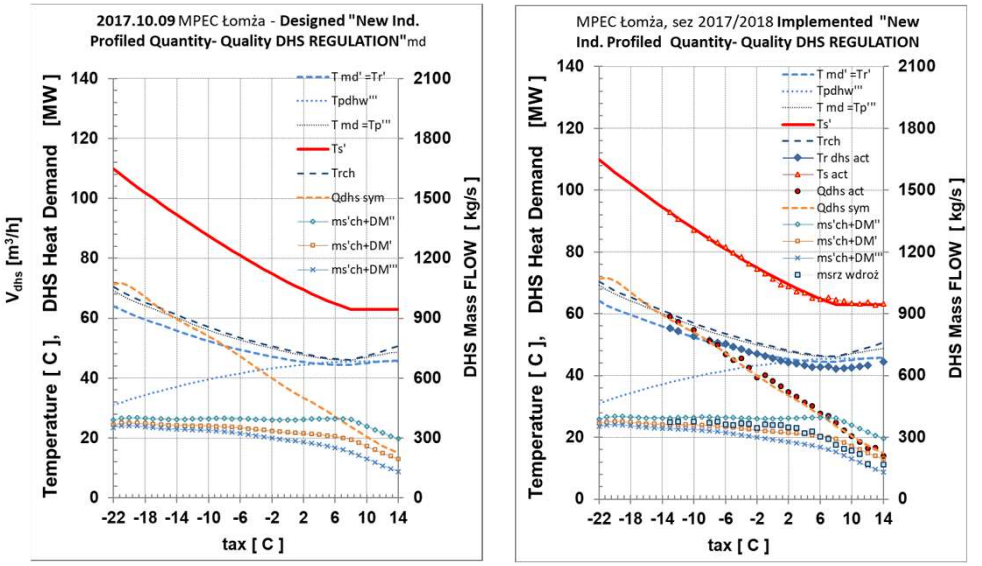


Figure 4. Measured and calculated supply and return temperatures, flow rate and heat demand of the whole DH grid - heating season 2017/2018, Source: [6.1] M. Dzierzgowski

Step 2. Decrease Nominal Supply Temperature from 121,5 to 109,8 °C

Result: decrease of seasonal DH heat losses from 12,6 to 10,6 %

Average seasonal DH return temperature: Tr = 45,1°C

Comparison between measured and calculated values of heat demand, mass flow and return temperature during heating season 2017/2018 – **differences < 3%**

Source: [6.1] M. Dzierzgowski, *Strategy for implementation the LTDHS in Existing district heating systems of Łomża municipality, 2018 – Preprint of final Report 2*

Project Step 3 : 2019/2021, IMPLEMENTATION of new biomass-fueled boiler and new gas-fired heat plant

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Pilot Project 2020 :

- **New biomass-fuelled boiler 15 MW** was installed in the beginning of 2020
- **New gas-fired heat plant** implemented 2020.
  (In the remote region of existing DH grid with mostly old, refurbished buildings, year of construction **from 60's to 80's**)
- **New BIOMAS COGENERATION UNIT 14 ,0 MWt of heat and 2,8 MWe of power** is planned to be installed **in 2022 .**
- **Strategy for implementation the LTDH in existing DH in ŁOMŻA, Report 4, 2020**

Fot.2. Source: [6.1] M. Dzierzgowski

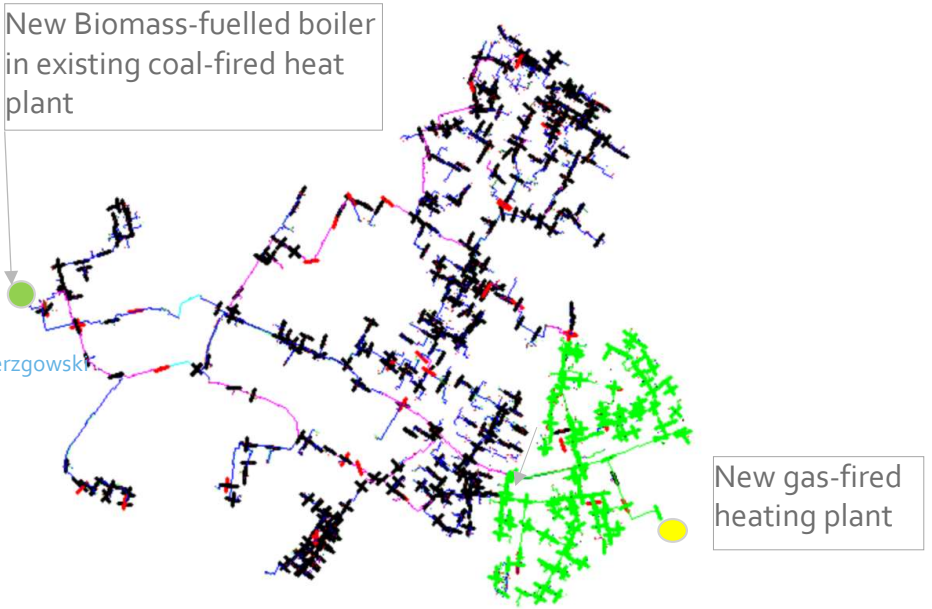


Fig.4. Layout of existing DH grid in Łomża - supplied from existing heating plant and new gas-fired heating plant (in yellow) , Source: [6.1] M. Dzierzgowski

Goal : in 2021/2022 Seasonal Heat Production: 52,0% Biomas, 36,4% Gas, 11,6 % Coal

Source: [6.1] M. Dzierzgowski, *Strategy for implementation the LTDHS in Existing district heating systems of Łomża municipality, 2020 – Preprint of final Report 4*

Project Step 3 : 2019/2021, computer simulations and optimization of seasonal regulation conditions of the new biomass boiler, new gas-fired heat plant and common open DH network

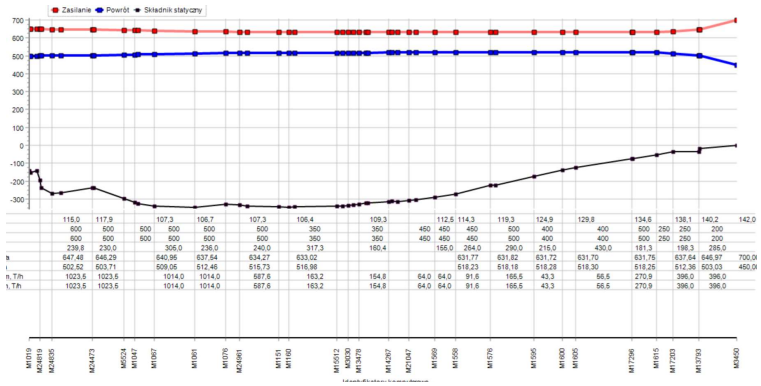
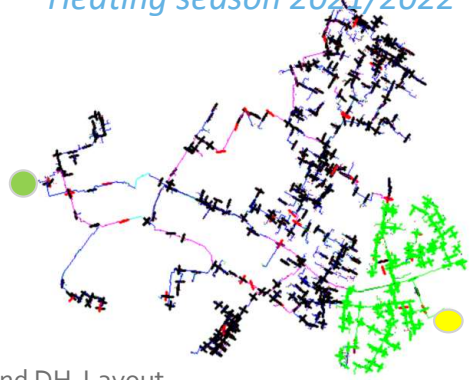


Figure 5. Preasure changes along network from coal/biomas fuelled boiler and DH Layout to gas-fired heat plant, Source: [6.1] M. Dzierzgowski

Heating season 2021/2022



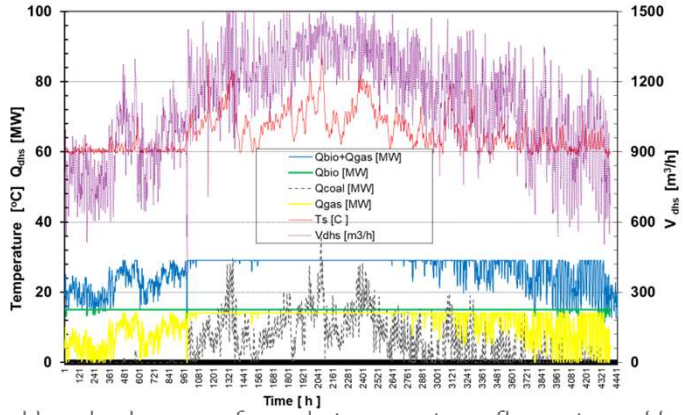


Figure 6. Calculated hourly changes of supply temperature, flow rate and heat load of gas, biomass and coal-fired boilers under 2019/2020 heating season conditions. source: [6.1] M. Dzierzgowski

Decreased nominal supply temperature in gas-fired heat plant and existing DH subsystem (**17,5 MW**) from **109,8 to 96,3ºC (LTDH)**

Change of **primary energy source** – reduction of coal from **100,0 % to 11,6 %**

Goal – by 2022: Heat and energy will be produced with 75% reduction of CO_2 emission, transformation of the whole existing DH into LTDH, Gas fired Heat Plant **DP: 39,5 kPa to 340,8 kPa** Ms : **14,0 T/h** do **504 T/h**

Decrease of DH heat losses from 12,6% to 9,5%

(use of biomass - local energy source in boilers and CHP unit)

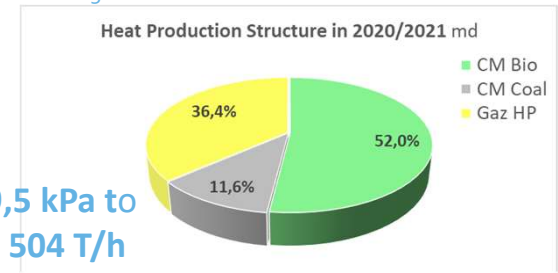


Figure 7. Primary energy sources during 2020/2021 season, source: [6.1] M. Dzierzgowski

Source: [6.1] M. Dzierzgowski, *Strategy for implementation the LTDHS in Existing district heating systems of Łomża municipality, 2020 – Preprint of final Report 4*

Coal fired Boilers ***WR*** **84 days Q** from **0,0 MW** to **36,9 MW.**
Mean Q = **3,3 MW**

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Conclusions

- The **Verified existing DH Network Model** based on the actual characteristics often substantially oversized heat exchangers and radiators enables implementation of the „New individually profiled quantity/ quality seasonal regulation" **as well as transformation of DH into effective LTDH grids also in all BSR countries before 2030.**
  - **Guidelines and demonstration** - how the WHOLE existing DH System should be prepared and transform to the LTDH **are available** but should be developed further.
- **LTDH networks are very sensitive** to characteristics and technical state-of-art of consumers space-heating installations (e.g. „Proper individually profiled heating curve", heat exchangers oversizing and technical state as well as quality and operational conditions of the control system)
- Transformation of the existing DH to LTDH grids is possible; leading to 15 - 25 % reduction of the heat losses and pollutions emissions. The aim can be achieved after good verified pilot-project.

Thanks for your attention !

Fot.3. Source:: M. Dzierzgowski: IMP PAN, PW

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Sources

Sources:

[6.1] M. Dzierzgowski: *Development and Impementation of Rational Quantitative-Qualitative Regulation as well as Indication of Activities Leading to an Increased Actual Energy Efficiency in District Heating Systems of Łomża Municipality, 2018-2020 – Preprint of final Raport 1, Raport 2, Raport 4*

[6.2] A. Cenian, M. Dzierzgowski, B. Pietrzykowski : *On the Road to Low Temperature District Heating, 2019*, Journal of Physics: Conference Series, Volume 1398, III Alternative Fuels Forum 20–22 November 2019, Zawiercie, Poland