Perspectives of district heating systems in Eastern Europe

International Conference On District Energy 2013
24.-26.03.2013 - Portorož, Slovenia

Robert Mikulandrić, Goran Krajačić, Neven Duić, Zoran Pranjić, Gennadii Khavin, Henrik Lund, Brian Vad Mathiensen

Department of Energy, Power Engineering and Environment
Faculty of Mechanical Engineering and Naval Architecture
University of Zagreb, Croatia

Introduction

- DH - provide high efficient heat generation, environmental and economic benefits to communities and energy consumers
  - Large variety of fuels, utilisation of waste heat and lower emissions
- Economically feasible in densely populated urban areas with high-density building clusters and industrial complexes
- Widely used in Scandinavian countries (Denmark – 60% of space and water heating)
  - Potential: 57% of overall heat consumption
- Recognised as one of the measures for CO_2 reduction

Introduction

- Fuels in DH systems
  - Natural gas
    - Most common energy in DH systems
    - Low emissions and high availability
  - Dedicated nuclear plants (nuclear combined heat and power)
    - Limited generation capacity and safety issues
  - Heavy oil
    - High fuel prices and environmental issues
  - Renewable energy
    - Expected to increase their share in the future
- DH systems → potential for RES integration
  - Integration → direct (RES DH systems) or indirect (heat pumps and cofiring)
  - Reducing negative effects of RES intermitency on energy system stability
    - In combination with heat storage

Status of DH systems in Eastern Europe

- Old and inefficient technology
  - High production and distribution losses
  - Poor maintenance
- Low environmental standards
- High operating and maintenance costs
  - Exceeds revenue → no economic interest to invest in DH system modernisation
  - Inadequate management and lack of investments
- Decrease in heat demand
  - Lack of customer satisfaction
  - Economical, political and social changes
- Lack of national regulations and policies
- Social problems
  - Difficulty in paying the bills

Source: Iacobescu, F., Badescu, V., Metamorphoses of cogeneration-based district heating in Romania: A case study, (2011)

Status of DH systems in Eastern Europe

- DH present in all larger urban areas in EEC
  - Russia - 91% of all buildings in large cities and 60% in smaller towns
  - Heat provided by utility companies via huge networks supplied by large centralized heat sources

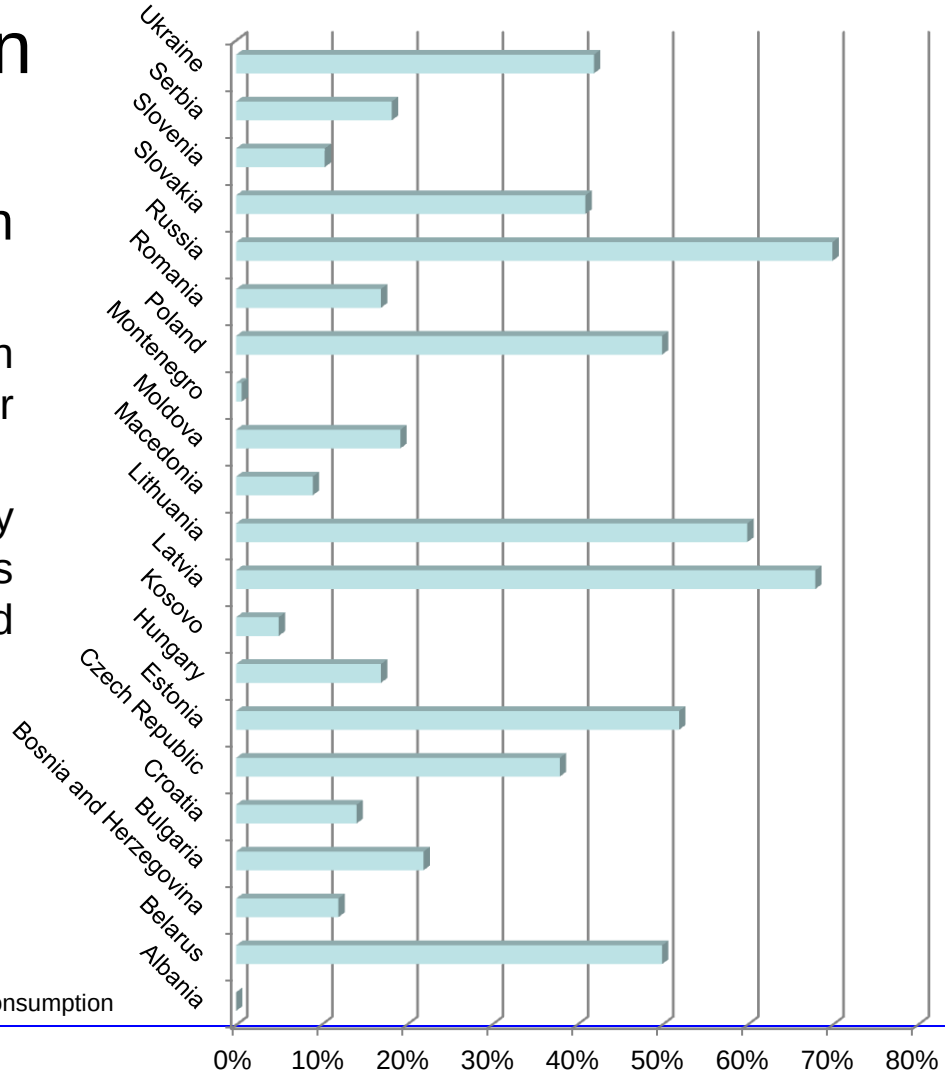


Figure: Share of district heating in final heat consumption

Status of DH systems in Eastern Europe

- Fuels
  - Most common: natural gas, heavy oil and coal
  - Nuclear – Russia, Ukraine, Hungary, Bulgaria, Czech Republic and Slovakia
  - RES → slowly increasing their share

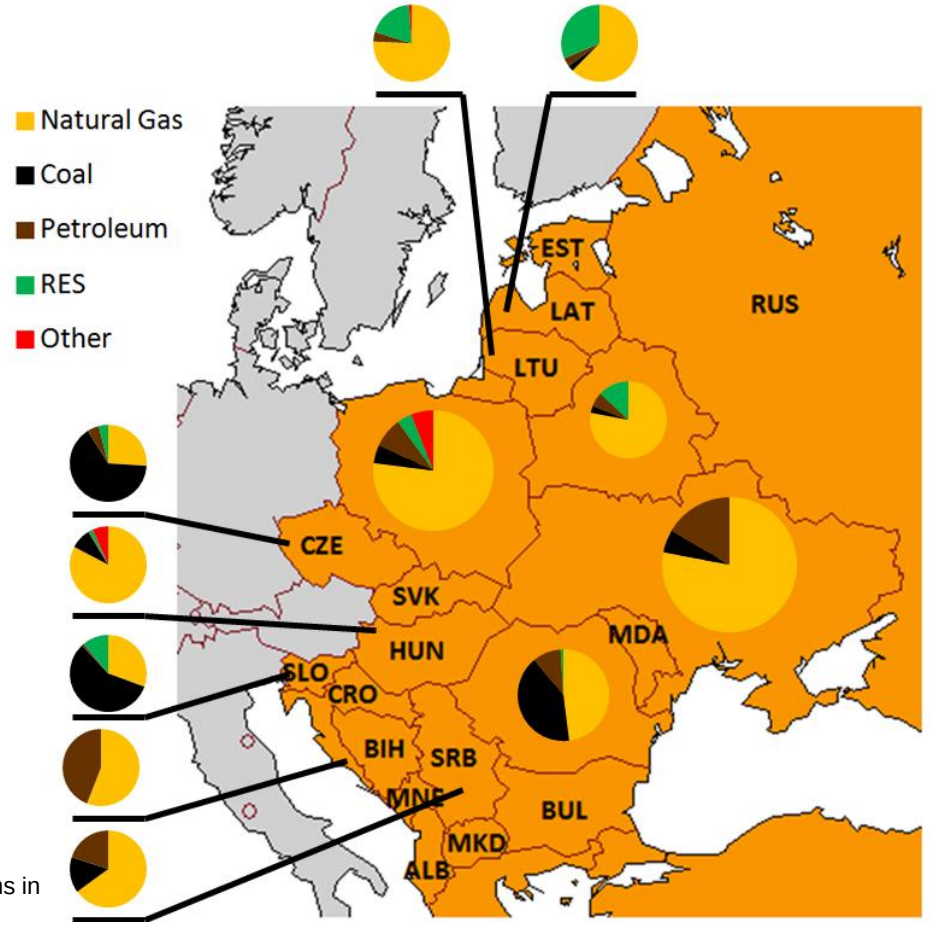


Figure: Share of different energy sources used in district heating systems in Eastern European countries

Status of RES in DH systems

- Biomass DH systems
  - In EU countries → very popular → substitute fossil fuels
  - Economically feasible heat production
  - Effective way to increase use of RES in high populated urban areas
  - In EEC → more than 20 biomass DH systems in operation (mostly EU members)
- Geothermal DH systems
  - High temperature geothermal energy → heat and/or power generation
  - Low and moderate temperature geothermal energy → geothermal heat pump
    - Increase efficiency and reduce the operational costs of existing heating and cooling system (could reduce building's energy consumption by 30-50 % compared to conventional electric heating)
  - Combined with solar energy → geosolar heating system
  - Attractive energy source for Low-Energy Buildings and Low-Temperature DH
  - In EEC → more extensively used only in Hungary and Poland

Status of RES in DH systems

- Solar DH systems
  - Used for heat production in order to reduce fossil fuels consumption and to reduce emissions
  - Economically feasibility depends on government subvention
  - Require heat storage systems
  - In EEC → solar potential is underused
- Municipal waste DH systems
  - Great energy potential + waste reduction
  - In EEC → potential of municipal waste systems is underused
    - Installed in Czech Republic, Slovakia, Poland and Hungary

Source: Kurti, Armond: Geothermal District Heating in a Part of Elbasan City, Albania

Status of RES in DH systems

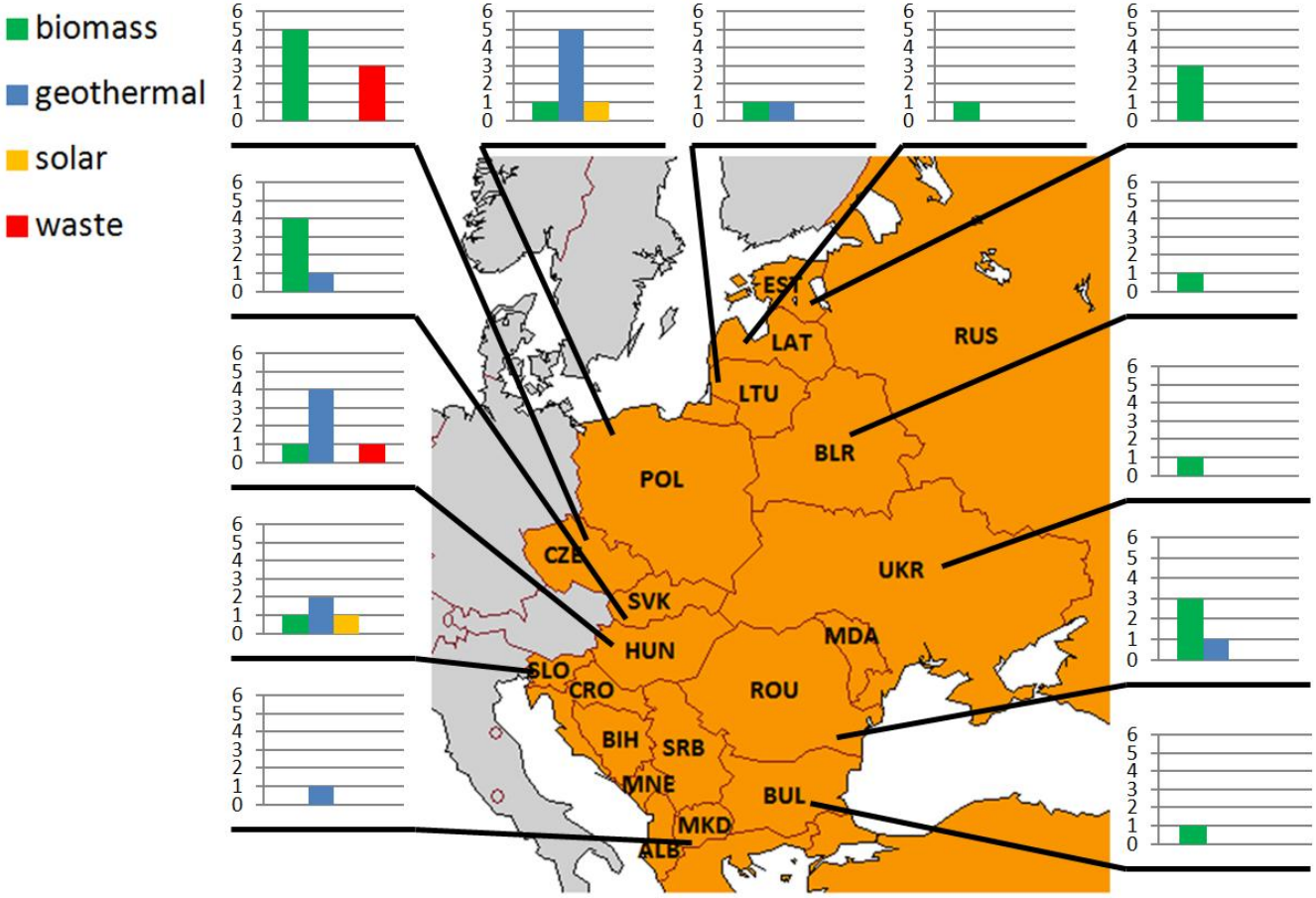


Figure: Number of operational RES based DH systems in EEC

Key challenges

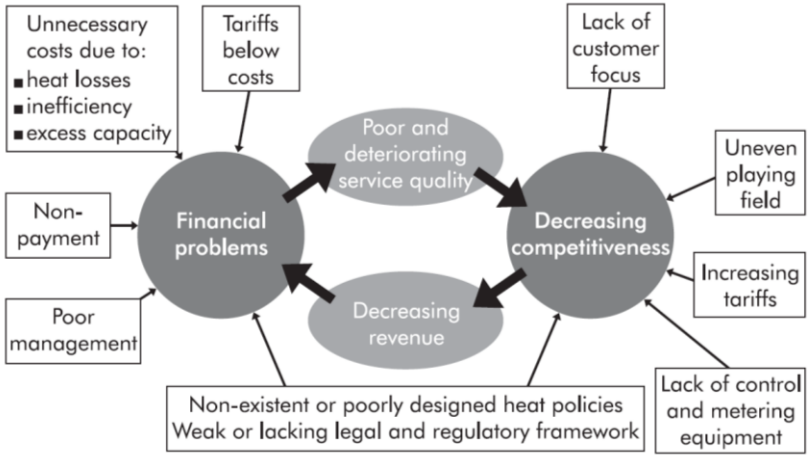
- Policy measures
  - Transition to more environmental friendly fuels in order to fulfil EU directives and goals set by Kyoto protocol is proposed in most national energy policies
    - Influences DH sector
  - Reduction in national energy demand
  - Energy reforms have not been focused on DH sector
    - Lack of interest in DH sector
  - Heat tariffs for consumers were generally under government subvention and utility plants were owned by government → low competitiveness of DH system
  - Problem in setting the DH tariffs (timeline mismatch between the approvals of heat and production prices)
  - Bureaucratic problems
  - Gas prices lower for public than for DH companies
  - Efforts to improve status of DH systems are being done without critical technical and economical research

Key challenges

- Future energy demands
  - Political, social and economic reform in EEC → heat load stagnation or decrease
  - New national energy policies → greater building energy efficiency → lower heat demands → risk for future competitiveness of DH systems → synergy between reductions in space heating and low temperature DH systems
- Competition and market saturation
  - In some EEC DH already has high share in fulfilling household needs for heat in large cities → market is becoming saturated
  - New buildings → high energy efficient → not attractive for DH system implementation
    - DH system will have to compete with other high efficient heating systems (heat pumps and high efficiency boilers)
  - Expansion to cities with lower population → economically questionable
  - Administration barriers → delay of DH market development

Key challenges

- Technical quality of DH systems
  - Technical characteristics of DH systems in EEC
    - Low heat production efficiency
    - High heat production costs
    - High transmission losses
    - Oversized network coverage
    - Lack of heat production and utilisation control (technical rigidity)
    - Irregular peak service
    - Non-designed operation parameters due to low heat demand



Source: IEA/OECD, 'Coming in from the Cold – Improving District Heating Policy in Transition Economies', (2004).

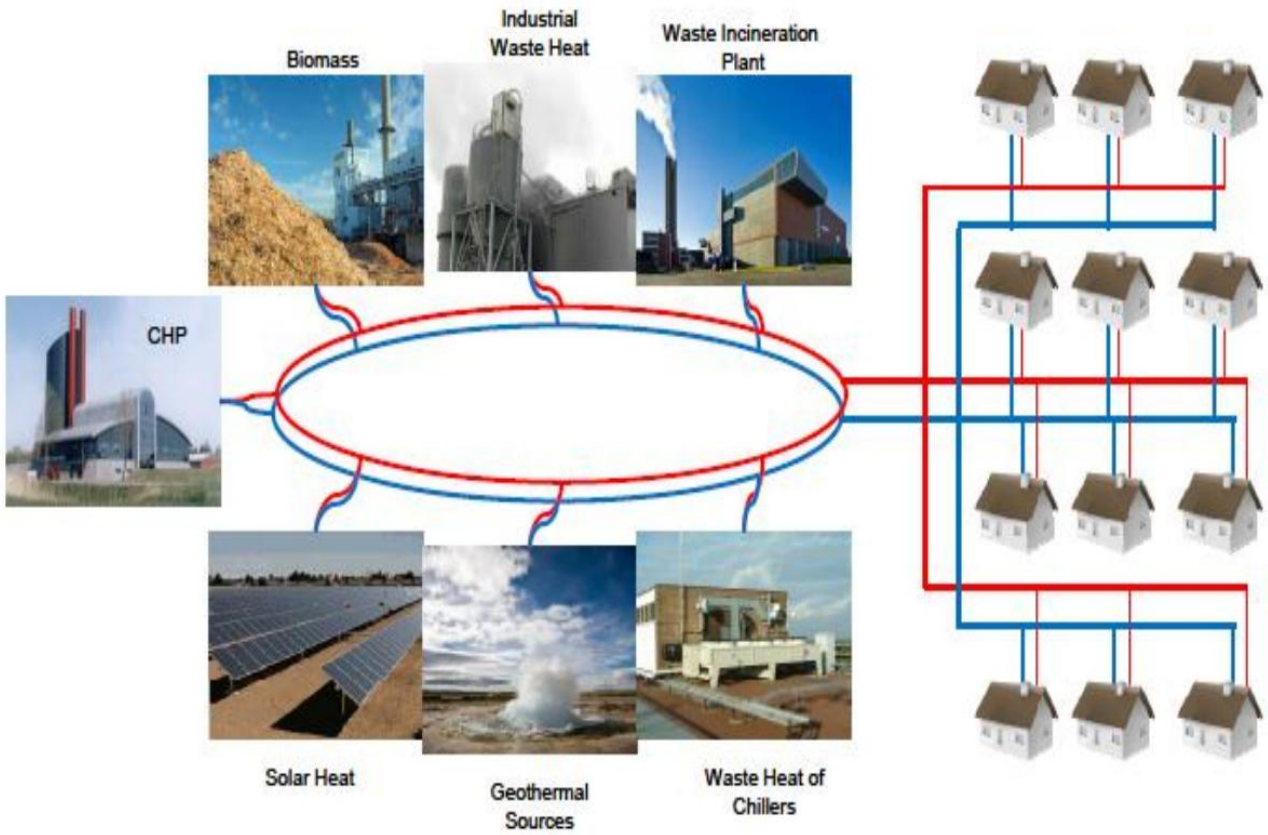
Perspectives of DH system in EEC

- Renewable energy systems
  - Reduction on fossil fuel dependence
  - Used in district heating systems either completely or as a supplement to traditional fossil fuels
  - Biomass DH systems
    - Economically feasible energy source
    - New jobs opportunities
    - Use of waste materials
    - Problems related to biomass transportation and storage as well as biomass rising price
  - Solar DH systems
    - Widely available renewable energy source
    - Reach their maximum capacity during hot and sunny periods when heating is usually not required → utilised in absorber cooling systems
    - Necessity for storage tanks → high investment
    - Problems related to high return temperature, heat surplus in summer, high capital costs which results in high production costs and low subsidies

Perspectives of DH system in EEC

- Geothermal DH systems
  - Space heating, food industry purposes, hot spring bathing or spas
  - Low temperature geothermal energy has great potential in terms of installed capacity
    - Utilised as heat pump
    - For low temperature district heating system
  - Do not require large space or mine shafts, tunnels, open pits, waste heaps, oil spills for operation, extensive forest harvesting or large fuel storage area
  - Resistant to weather conditions or changes in fuel distribution and it is available 24 hours a day
  - Dislocated from populated areas
  - Face problems regarding sulphate deposits, emissions and corrosion
- Municipal solid waste DH systems
  - Efficient way to reduce the waste volume
  - Could be located close to the populated areas (sources of waste and heat demand) → reducing the cost of waste transportation and heat distribution
  - Considered to be renewable energy
  - Problems related to air pollution control, heavy metals and slag production

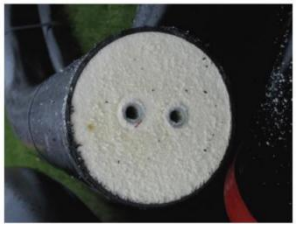
Perspectives of DH system in EEC



Source: Svendsen, S., The work on 4GDH in Denmark, (2012)

Perspectives of DH system in EEC

- Thermal storage systems
  - Store thermal energy in energy storage reservoirs for later use
  - Increase of heat capacity, greater reliability and greater flexibility of a plant operating regime
  - In DH systems → necessity for short-term thermal storages (CHP and solar systems)
    - to balance production in general and during peak load periods
  - Higher plant load (partial load due to smaller heat demand → lower efficiency)
- DH system modernisation and refurbishment
  - To increase efficiency, reduce fossil fuel consumption and to meet environmental and customers demands → to ensure continued operation and to remain competitive with other heat sources → customer service satisfaction
    - Introducing modern automation and control systems
    - Replacing burners
    - Cleaning boiler surfaces
  - Reduction of heat distribution losses
    - Piping refurbishment, implementation of more quality insulation and by changing operating regime to low-temperature DH operating regime



Source: Svendsen, S., The work on 4GDH in Denmark, (2012)

Perspectives of DH system in EEC

- Other perspectives
  - Low temperature district heating systems
    - Reduced network supply and return temperature → better match of the low quality building heating demand and the low quality heating supply from waste heat or renewable energy
  - Biomass gasification and bio-methane applications
    - Production of renewable energy based syngas that can be used in CHP plants
  - New household appliances (dishwasher and washing machines)
    - To reduce separate electric heaters
  - Absorption cooling systems
    - Annual load of DH system can be increased → higher revenues
    - Very perspective technology in high populated city areas

Source: Hope, G., Solar district coolin plant for Malasya, (2009)

Conclusion

- DH in EEC
  - Ageing of energy system infrastructure
  - Requires large investments in rehabilitation of existing district heating systems
  - Low technical quality → high customer dissatisfaction → reduced revenues and costumer heat demand
  - National policies are lacking strongly defined measures for development of national district heating systems
  - High investments needed in order to increase overall system efficiency, reduce emissions and improve service quality → national legislative regarding DH systems needed
  - High potential in locally available renewable energy sources (biomass, geothermal energy and municipal solid waste DH systems)
    - Decrease dependence on imported fossil fuels
    - Job creation in local communities
  - Potential of new technologies in DH systems
    - Thermal storage, low-temperature DH systems and gasification processes

Thank you for your attention!

Any questions?