MAYORS IN ACTION
FOR A SUSTAINABLE FUTURE

Mayors in Action Training Material

SUSTAINABLE USE OF HEATING THROUGH THE DISTRICT HEATING NETWORKS

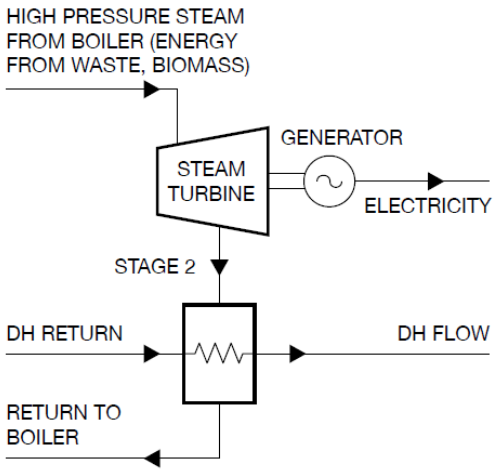
Co-funded by the Intelligent Energy Europe Programme of the European Union

Empowering Covenant of Mayors Coordinators and Supporters to assist municipalities in implementing and monitoring their Sustainable Energy Action Plan

District Heating

District Heating is a form of distributing heat through the circulation of water or steam.

Energy schemes incorporating District Heating (DH) networks offer an affordable way of achieving low carbon energy supply in densely populated areas, meeting domestic, commercial and some industrial space heating and hot water requirements.



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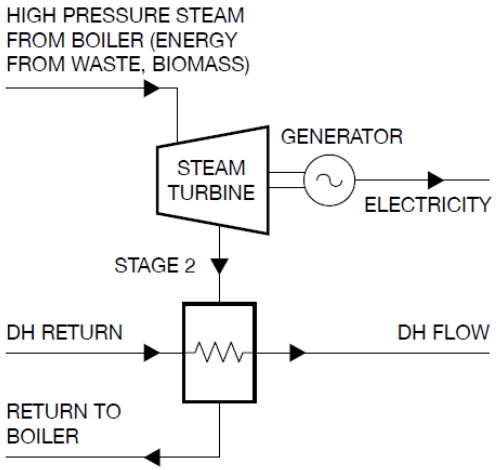
District Heating

The use of Combined Heat and Power (CHP) with DH results in …

… the highly efficient use of fuel, up to 80 - 90% efficiency.

… primary energy savings of 30 - 45%.

… approximately 30% less emissions to the environment.



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Potential Sources for Heating

→ DH can integrate combustible renewables that are difficult to manage in small boilers, e.g. wood waste, straw and olive residues, the biogenic fractions of municipal waste and sewage sludge.

→ Other renewables (bio fuels, biogas, geothermal, solar and wind energy) are more effectively when integrated into DH networks.

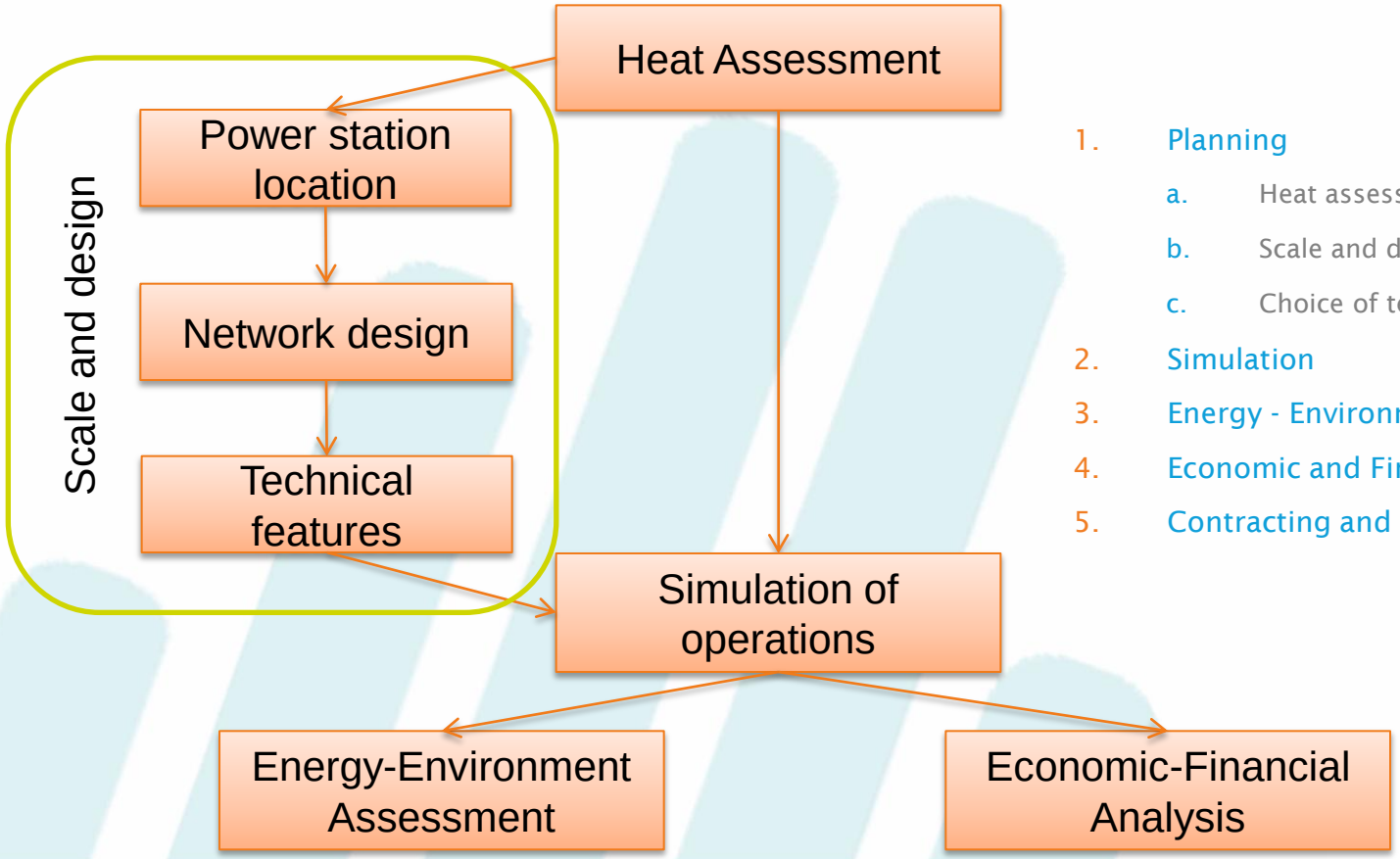
→ DH is often based on the utilisation of surplus heat which would otherwise be lost (surplus heat from industry)

→ Thereby avoids the use of fossil fuels

→ One of the cheapest heat sources.

→ Very stable heat source.

Steps for implementation



1. Planning
   a. Heat assessment
   b. Scale and design of the network
   c. Choice of technical features
2. Simulation
3. Energy - Environmental Assessment
4. Economic and Financial analysis
5. Contracting and works

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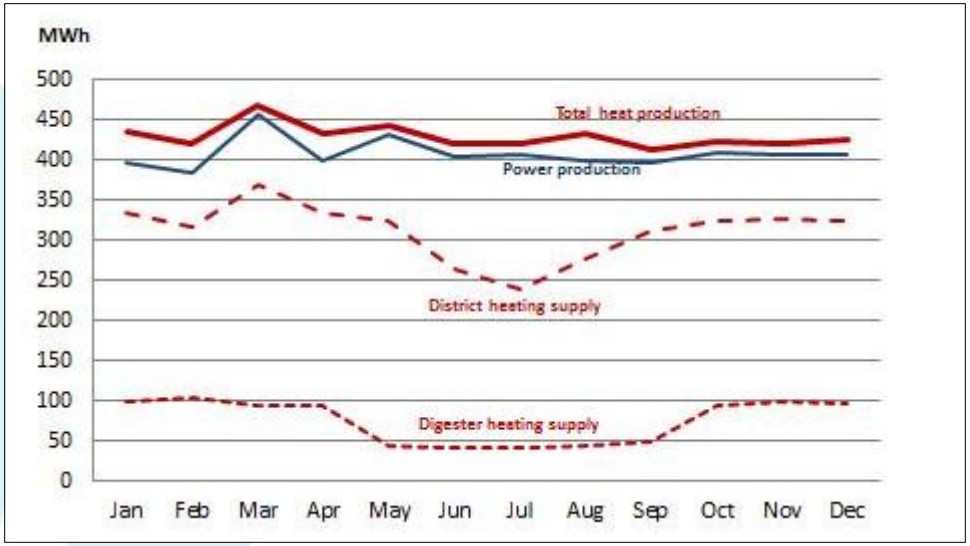
Planning: heat assessment

It is important to assess in detail:

1. The availability of waste heat.
2. The total and annual heat demand.
3. The seasonal variation of heat demand.
4. Peaks in heat demand.



Example: Heat and Power production compared to Heat demand from DH and for the digester in a biogas plant (Rutz, 2012, BiogasHeat)

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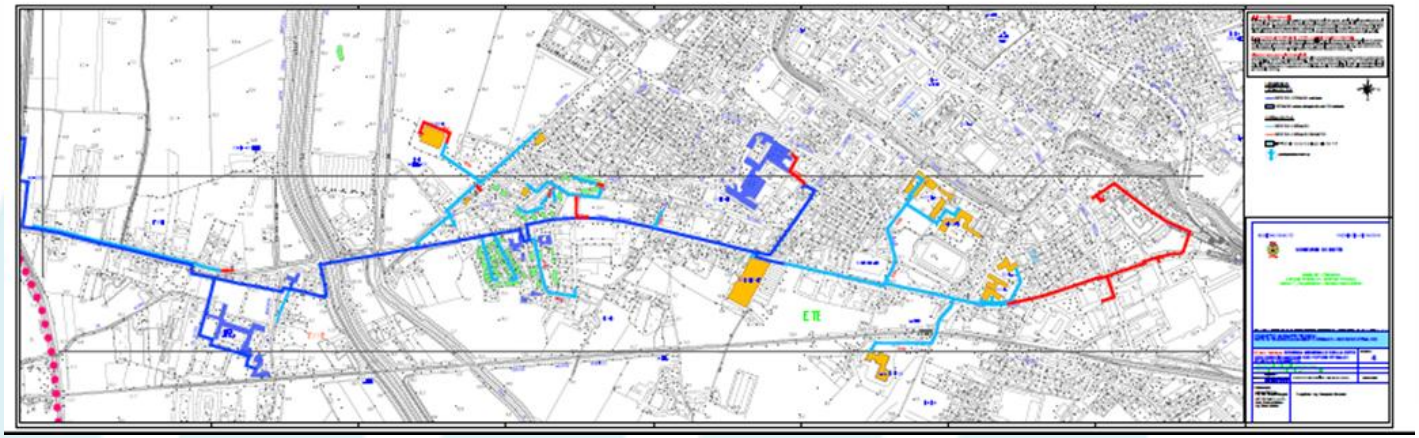
Scale and Design of a DH System

The scale of the district heating system:

- Very small-scale systems in which only a few households are connected (micro-heating grids).
- Large-scale systems in which entire cities are connected.
  - Connection of several heat generators (e.g. at a biogas plant).
  - Network of pipes, connected through heat exchangers.



The DH system in Este (Italy) fueled by the heat generated by combustion of biogas resulting from anaerobic digestion of urban waste. The DH line serves mainly public buildings.

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Scale and Design of a DH System / 2

Choice of technical features

1. feed and return lines create a closed heating cycle.
   - Transport of hot water or steam to consumers and cold water back.
2. In some cases only hot water and no steam is used.
   - Due to lower temperatures of produced heat.
3. The pipes should be very well insulated and installed underground.
   - Over-ground pipes.
   - Diameter of the pipes.
4. Additional equipment may include.

Simulation of operation

A simulation of the operation of the system

→ specific software or predisposed models on spreadsheets.

The simulation of a typical year produces the following output:

1. Fuel consumption
2. Power produced
3. Power sold to the grid
4. Heat produced
5. Heat supplied to consumers
6. Emissions.

Energy - Environment balance

The energy and environmental balance:

- To quantify the energy savings.
- To measure the emissions avoided.
- Compared to a conventional decentralized production.

Steps of evaluation:

1. The study of the conventional systems to be replaced
   - both in terms of fuel consumption and in terms of emissions produced.
2. Compare with the simulation of the operation of the district heating system.

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Economic and Financial analysis

The economic analysis

- Economic benefits on top of the environmental ones.

Many aspects need to be taken into consideration into an economic analysis:

1. the useful life of the investment
2. positive cash flows over time that will determine the economic return of the investment
3. incentives or economic support measures, which often determine the feasibility or otherwise of the intervention;
4. type of heat used by the end user;
5. proximity of end user, which determines the investment costs less, a more efficient use of heat and that reduces the heat losses

Financial and economic analysis /1

The financial and economic analysis is a crucial verification step for the effective implementation of the project.

The main costs of a project for a district heating system are:

1. The distribution network and the thermal power station.
2. Cost for fuel
3. aling with organic or wood waste).
4. The maintenance and management of the plant.
5. the maintenance and management of the network of heat transmission.
6. The costs have a fixed component and a variable with the production, so depend also by plans to acquire users.
7. Revenues from the sale of heat and power.

Financial and economic analysis /1

The financial and economic analysis is a crucial verification step for the effective implementation of the project.

The main costs of a project for a district heating system are:

1. The distribution network;
2. The thermal power station;
3. Cost for fuel.
4. The maintenance and management of the plant and the network of heat transmission.
5. The costs have a fixed and variable component (depend from the amount of users).
6. Revenues from the sale of heat and power.

Financial and economic analysis /2

The financial and economic analysis is a crucial verification step for the effective implementation of the project.

The analysis is influenced by the developments on the international markets (electricity and gas)

The rates charged for district heating to end users are usually composed of a fixed annual fee, calculated according to the power used, and a variable portion, linked to consumption, which is updated quarterly on the basis of the prices of natural gas approved by national authorities. Rates are calculated so as to generate an economic advantage for the user compared to conventional systems.

Once costs and revenues are quantified, the yearly cash flow can be calculated. The profile of the cash flow over time determines the indexes of economic convenience of the investment.

Contracting and works

Which contract structure is most appropriate for a particular district energy project depends in part on the main contractual elements – works, services and property rights:

1. **Works elements: D**esign, Construction and connection of premises
2. **Financing**
3. **Services elements:** Energy purchase, Generation of heat and electricity, Operation and maintenance, Metering and billing, Connection of new customers, Supply of heat or heat and electricity to connected customers, Customer services
4. **Property agreements:** Sale or lease of operational land and buildings, Easements, rights of way and access, arrangements on private land and buildings, Street works licence

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Highlights

The District Heating System of Este

- Este (Padua, Italy)
- Local multiutility company S.E.S.A. SpA
  - waste collection, waste recovery activities, disposal, transport.
  - plant engineering design and development, construction and operation.
- S.E.S.A. manages two CHP biogas plants:
  - Plant 1 treats biogas from the local landfill.
  - Plant 2 treats leachate from organic urban waste.

→ The two CHP plants provide 85° C water to the Dhnetwork.

→ DH network is 6,5 km long: 4 km in Este municipality and 2,5 km in the Ospedaletto Euganeo municipality.

THANK YOU

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