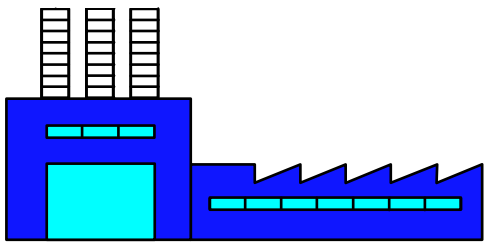
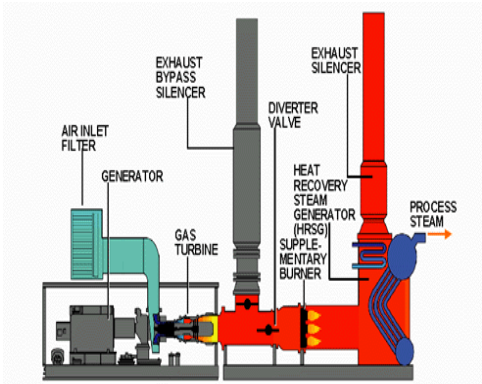
Development of CHP and District Heating in Central and Eastern Europe

Twinning project: Improvement of energy efficiency in Turkey





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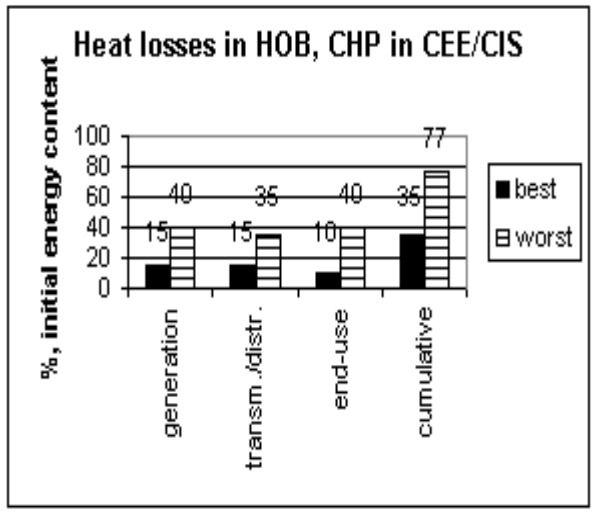
CHP and DH: important energy service

- **District heating: a long tradition in Central and Eastern European countries**
- **CHP and DH have a large share in the heating market**
  - *They provide 60% of the buildings with heat and warm water*
  - *They account for 39% of the primary energy*
    - 54% natural gas
    - 36% coal
    - 9% fuel oil and
    - 1% other forms
  - *Share of CHP in total heat supply varies*
    - 16% in Hungary, 37% in Russia, 70% in Hungary and 96% in Slovakia

Problems associated with CHP and DH

- **Inefficient**
  - *Cumulative heat losses in heat-only boilers and CHP during generation, transportation, distribution and end-use*
  - *Outdated equipment, overextended networks, overcapacities*
  - *Irregular peak service with subsequent shift of demand to electricity*



- **Unprofitable**
  - *Neither tariffs nor subsidies cover cost*
  - *Price distortions favor gas and electricity*
  - *Payment arrears are still a problem*
  - *Hence: lack of capital for repairs, meters*

Problems associated with CHP and DH

- **Governance problem**
  - *While a local service, the sector is determined by national policy (licensing, tariffs, fuel use)*
  - *At prevailing losses, CHP not rational in terms of energy use in comparison with direct use of gas or electricity*
  - *In CHP, the competitiveness of heat versus electricity output is biased (allocation of overheads, cross subsidies) in countries where electricity and heat markets are under different regulatory regimes*
  - *Gas/electricity industry restructuring models cannot be replicated; access to grids must be structured and regulated according to local circumstances (Third Party Access, Single Buyer, economic merit order…)*

Problems associated with CHP and DH

- **Economically not sustainable**
  - *Insufficient investments/incentives to enhance efficiency*
  - *No full cost accounting and allocation*
  - *No optimization of local energy systems (= multi-fuel competition on the basis of life cycle cost)*
  - *Rise of tariff and distortion of gas and electricity prices led households to disconnect from DH systems and use either gas or electricity heating*

Tools and measures for CHP/DH sector

- **Objectives**
  - *Develop and promote tools and measures to overcome barriers*
  - *Understanding of the problems related with upgrading and modernization of the existing systems*
  - *Provide key actors with possible solutions to these problems*
- **Restructuring policies following 5 lines of action**
  - *From centralized public systems to a range of decentralized ownership and management models*
  - *From vertical integration to unbundling and competition*
  - *From subsidized, lump-sum tariffs to full-cost, metered tariffs*
  - *From ad hoc decisions to internationally compatible legislation*
  - *From DH-specific policies to local energy systems*

Activities undertaken

- **Understanding the organizational framework**
  - *In most CEEc, local government plays a key role in the DH and CHP sectors through ownership*
  - *Leasing, privatization and public-private partnerships to attract financial resources for system reform and refurbishment*
- **Price regulation and taxation**
  - *Independent regulatory bodies have been established to approve DH tariffs that reflect full cost recovery, including those for development and modernization*
- **Support and promotion mechanisms**
  - *DH rehabilitation and modernization financing mechanisms range from direct government support to third-party financing and capacity leasing*
  - *Private sector investment have an increasing importance, and in some cases, international financing bodies play a catalytic role*

Activities undertaken

- **Legislative and regulatory measures**
  - *Energy market reorganization and rule formulation for defining energy sector business activities*
  - *Energy sector restructuring*
  - *Reorganization and privatization*
  - *Increased energy efficiency through technological innovation*
- **Benchmarking**
  - *Comparison of technical and economic parameters amongst the different players and in different countries*
- **Financial options for CHP/DH development**
  - *Retrofitting of existing large DH companies with big capacity needs substantial investment*
  - *Price and tariff incentives and preferences for CHP have influenced the profitability of CHP projects*
  - *Different support schemes used as complimentary funding sources*

Lines of action

- **From centralized public systems to a range of decentralized ownership and management models**
  - *such as municipal agencies, limited liability companies, joint stock companies, public/private partnerships, ESCOs, industrial self-producers*
  - *privatization is heralded as a means to access the capital market and expertise,*
  - *but impeded by old debt, receivables and political interference in tarification and investments*
- **From vertical integration to unbundling and competition**
  - *towards separation of generators and distributors even though this may complicate system operation*
  - *third party access to heat distribution grids is not practiced*
  - *competition from gas*

Lines of action

- **From subsidized, lump-sum tariffs to full-cost, metered tariffs**
  - *despite substantial increases of heat prices, full cost coverage and elimination of producer subsidies has been attained only in the Baltic States*
  - *implications of tariff rises: social hardships, payment arrears, surge of self-production, surge of peak demand for electricity and disconnection from DH systems*
  - *cross-subsidization still prevails between industrial and residential, and small and big industrial customers*

Lines of action

- **From ad hoc decisions to internationally compatible legislation**
  - *laws have now been enacted on energy, environment and efficiency*
  - *Specific DH/CHP laws exist in Hungary, Latvia, Lithuania*
  - *regulatory authorities (national, provincial or municipal) to deal with DH/CHP*
    - *Licensing, tariffs, development planning and incentives for renewables, co-generation and efficiency improvement (audit, building codes)*
  - *policies aim at approximation to EU policies and standards*
  - *the provisions of the Energy Charter Treaty on non-discrimination of foreign investors (land ownership, concessions, licenses, dispute settlement) are applied except in Bulgaria*
  - *assistance through PHARE, USAID, IBRD, EBRD*
- **From DH-specific policies to local energy systems**
  - *Poland and Romania oblige municipalities to develop policies for local energy system*

Highlights of some national features

- **Highlights of selected countries**
  - *In Belarus, DH/CHP was operated centrally; households covered only 10% of costs*
  - *In Bulgaria, producer subsidies were withdrawn in 2005; dual tariffs (for capacity and use) were advocated to improve payment discipline*
  - *In the Czech Republic, heat supply was decentralized, but suffered from cross subsidies in favor of gas and electricity for small consumers; a cost-effectiveness audit was necessary for new or rehabilitated CHP projects*
  - *In Estonia, no subsidies for heat suppliers, but only for low-income customers*
  - *In Hungary, the District Heating Law stipulated that household customers can only cancel a heat supply contract if all flat users (owners) concur; full metering was expected by 2005, with estimated savings of 15 - 25%*

Highlights of some national features

- **Highlights of selected countries**
  - *In Latvia, most DH facilities were owned by municipalities; privatization was hampered by receivables, old debt and insolvency*
  - *In Lithuania, a first effort at privatizing Kaunas CHP on the basis of a lease agreement failed for lack of compliance of bidders with the terms of the tender; in 2001 another tender was launched by way of selling assets*
  - *In Macedonia, the privatization of the DH company serving Skopje was successfully launched on the basis of a workers-buy out, with shares now traded on the stock market*
  - *In Poland, about 3000 companies supplied heat to customers; the major issue was the setting of prices below cost thereby impeding competition and market entry of private investors*

Highlights of some national features

- **Highlights of selected countries**
  - *In Romania, losses exceed 50%; DH and CHP plants were decentralized for reducing the number of operators, attracting private capital and forming public-private partnerships; old debt was eliminated or postponed; three agencies regulated the grid-based energies*
  - *In Russia, CHP saved 15 million toe per year; small wood- or peat-based cogeneration units of 0.3 - 6 MW capacity were made available to serve small, remote cities*
  - *In Slovakia 1200 heat suppliers operated with a tendency towards mergers; heat supply subsidies for households were to cover the difference between costs and tariffs if they were regularly paid*
  - *In Slovenia, CHP was expected to contribute, by 2010, to the major part of a doubling of electricity production from plants with high efficiency or utilizing waste or renewable sources*

Russia's transition to EE district heating

- District heating statistics
  - *Huge market for DH as it supplies over 70% of Russian households with heat and hot water*
    - DH equivalent of 2.7 million GWh per year
    - 485 CHP plants
    - More than 190 000 large boilers
    - 600 000 individual heat generators and boilers
    - Network with a total length of 1.8 million km

  - *Main problems*
    - High production price of heat due to considerable losses
    - Major part of the network consists of uninsulated pipes
    - No use of decentralized thermostatic heating regulators in public buildings or residential homes

Russia's transition to EE district heating

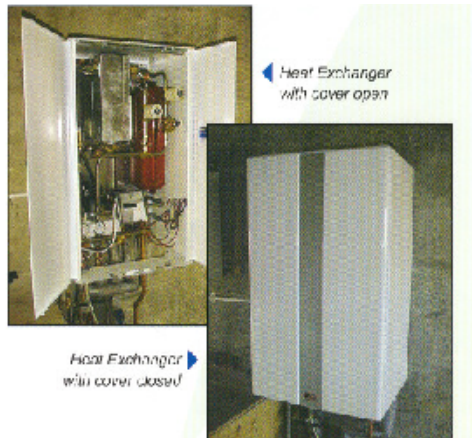
- Overall challenge
  - *How to speed up the modernization of the DH system?*
    - In the past, municipalities subsidized district heating to make the service affordable to the users
    - Consumers were not motivated to save or reduce energy
  - *Main challenge*
    - Creation of a transparent market where there is
      - *a clear distribution of responsibilities,*
      - *clear ownership of networks and installations, and*
      - *a clear incentives for seeking the most energy-efficient heating applications*
    - Things are moving in the right direction but there are still many **technical, legislative and cultural** obstacles

Russia's transition to EE district heating

- Technical challenge
  - *Present status*
    - Hot water circulated at high pressure and temperature (140-150ºC into distribution stations
    - Direct distribution of heated water into the buildings at 120ºC
    - Little or no control of pressure or flow in the network
    - In case of leaks, the damage can be considerable
  - *Western European practices*
    - Distribution temperature is a lot lower
    - Pressure and flow are under strict control
    - There is normally a primary network for heat distribution to the buildings and a secondary network for heat distribution within the building

Russia's transition to EE district heating

- Technical challenge
  - *Introduce dynamic solutions for pressure control*
    - In sub-stations which connect buildings to the district heating network
    - In the buildings and networks themselves
  - *Expected outcomes*
    - Stabilize the systems and drastically reduce the heat loss
    - Stable pressure and flow control will help in
      - *precise measurement of individual heat consumption*
      - *Improving awareness of energy efficiency among people*



Russia's transition to EE district heating

- Technical challenge
  - *Problems with the existing systems*
    - In case of leaks, the damage can be considerable
    - End-users often feel tempted to draw hot water for household purpose directly from the radiators instead of water taps because it is the cheapest and fastest access to boiling water
    - Lack of pressure and flow control system makes the heat supply unstable and inconvenient
  - *Use of water elevator to control temperature and flow of water circulated into a building's heating system*
    - Reduce the temperature of heated water entering the building by mixing the incoming hot water at 120ºC with water exiting the system, resulting in design temperatures of 95 to 105ºC

Russia's transition to EE district heating

- Case study: Renovation project in Moscow
  - *Situation prior to renovation*
    - No equipment for pressure control in the system connected to a 7-storied 83-apartment building
    - Users suffered from overheating and tried decreasing the indoor temperature by opening windows
  - *Renovation process*
    - Substation installed with heat exchangers, circulating pumps and electronic weather compensator to adjust hot water temperature according to the outside temperature
    - Adoption of balancing valves, control and measuring devices in each apartment for billing individual apartments
    - Thermostatic regulator installed on the supply pipe of every convector

Russia's transition to EE district heating

- Case study: Renovation project in Moscow
  - *Main results after renovation*
    - Better thermal comfort due to automatic weather compensation and the use of thermostat to suit the needs of the end-users
    - Decrease in the household heat consumption by an average of 30-40%
    - Corresponding decrease in the amount paid by the end-users

Large Distributor Station | Commercial Substation | One-family House Substation

  - *Relevant solution for the future*
    - Move away from large, centralized substations
    - Use pre-fabricated modern substations in one block, with
      - *Heat exchangers, weather compensators, dynamic pressure controls and metering equipment*

District heating in Romania

- Heat supply in Romania
  - *Some statistics*
    - Approximately 31% of the country's building stock receives its heat and hot water from DH systems (it is 58% in urban areas)
    - DH accounts for 30% of the country's total heat and hot water demand
    - DH market in Romania is sub-divided into DH by CHP and heat-only plants
    - Biggest heat producer is the Romanian power supplier Termoelectrica (10 000 GWh, representing 32.2% of the total)
    - Termoelectrica does not operate in the DH market; DH operator RADET Bucharest (under the Ministry of Industry) holds a 33.4% share of the total DH market
    - 36 heat operator (of a total of 179) cover 90.4% of the market

District heating in Romania

- Heat supply in Romania
  - *Some statistics*
    - Total installed capacity: 29 GW (actually used: 17 GW)
    - 76% of heat generating plants are equipped with heat meters
    - DH network of 11400 km out of which 3450 km (29%) are primary networks
    - Fuel for district heating
      - *Coal (46%), natural gas (39%) and heavy fuel oil (7%)*
    - Peak demand for DH produced by heat-only boiler while base load is met by
      - *CHP installations*
      - *Back-pressure steam turbines delivering steam mainly to industrial consumers*
      - *Extraction-condensing steam turbines delivering hot water*

District heating in Romania

- Heat market and the role of DH
  - *Romania's DH network*
    - Constructed when energy price was low
    - Technology now is outdated and are incompatible with the objectives of minimizing losses
    - Insufficient provision of essential municipal infrastructure and services
    - Inadequate financial performance and significant inefficiency in service provision
    - Deteriorating facilities due to under-investment in maintenance and replacement

District heating in Romania

- Heat demand and consumption
  - *Continuous decrease of heat consumption by households*
    - In 2001, 2.94 million apartments representing 6.9 million inhabitants were connected to DH systems
    - By the end of 2003, the number had gone down to 1.92 million connected apartments representing 5.5 million inhabitants
    - High disconnection rate is due to the
      - *Poor customer experience with the supply of district heating in the past*
      - *strong competition with natural gas which is available at a low price for domestic cooking*
    - Gas-based single-unit heating systems are on the rise due to the aggressive commercial activities of the producers

District heating in Romania

- Some drawbacks of the present system
  - *Very large and inefficient electrical and thermal capacities, which are not flexible and cannot be customized to individual users*
  - *Poor match between heat demand and heat generated*
  - *Low technical efficiency and high energy losses*
  - *Inadequate consumption-based heat billing*
  - *Transport pipes with high heat losses*
  - *Poor quality of district heat water, corroding the pipes*
  - *Inefficient heat exchangers*
  - *No means for the consumers to control their consumption level*
  - *Lack of monitoring system for regulating system operation*
  - *Poorly designed buildings with high heat losses*

District heating in Romania

- Need of the hour
  - *To make DH cost-effective*
    - Investment needed to modernize heat generation facilities, renovate distribution networks, and install equipment such as regulators and meters at substations
    - To meet environment and public health standards, investment needed to convert boilers from running on coal to other fuels
  - *Developments with positive impacts*
    - Romania's accession into the European Union
    - Rapidly emerging municipal interest in bringing private involvement into municipal and environmental infrastructure
    - Reform of the financial system for the municipal infrastructure

District heating in Romania

- Institutional framework& private sector participation
  - *Municipal energy plan*
    - Local administration and government ministries showing interest in developing municipal energy plan with the aim of
      - *Identifying potential investment project*
      - *Strategic measures in the development of DH systems and their techno-economic optimization*
  - *Key market players*
    - State authorities and relevant regulating bodies
    - DH companies, associations (including COGEN Romania) and promoters
    - Housing associations
    - Housing associations